Washington State Ferries

Seattle Multimodal Terminal at Colman Dock Project

NEPA Environmental Assessment
Volume II: Appendices

Washington State Department of Transportation
Federal Highway Administration
Federal Transit Administration

April 2014

Washington State Department of Transportation

Washington State Ferries

Appendix A – Final Scoping Report

Washington State Ferries

Washington State Department of Transportation

Seattle Multimodal Terminal at Colman Dock Project

Scoping Report for NEPA Environmental Assessment

October 2012

Introduction

WSDOT Ferries Division (WSF), the Federal Transit Administration (FTA), and the Federal Highway Administration (FHWA) are in the planning phase of a project to replace the aging and seismically vulnerable components of Colman Dock in Seattle in order to maintain the Seattle Terminal's role as a regional multimodal transportation hub into the future.

A formal scoping comment period for the Seattle Multimodal Terminal at Colman Dock Project was held from February 8 through March 15, 2012, as part of the project's National Environmental Policy Act (NEPA) Environmental Assessment (EA) process.

Environmental Elements Anticipated During Scoping Period

During the public and agency scoping meetings, FHWA and FTA identified thirteen elements of the environment for study in the Environmental Assessment. These elements were as follows:

- Transportation
- Land Use
- Social Elements and Environmental Justice
- Water Resources
- Ecosystems
- Hazardous Materials
- Geology and Soils
- Navigation
- Noise
- Air Quality
- Energy and Greenhouse Gas
- Historic and Cultural Resources
- Visual Quality

Review of Comments Received During Scoping Period

As summarized in the Scoping Comment Report (Spring 2012), approximately 200 people participated in the public scoping activities, and 196 comments were received from agencies and the public. FHWA and FTA have carefully reviewed the comments received during the scoping period, and have determined that several revisions will be made to the NEPA analysis as a result of this input. In addition, revisions to the project have been made in response to agency coordination and scoping comments received.

Revisions to Project Design

The most frequent comment received about the project during the scoping period was related to the proposed removal of the passenger-only ferry operation, currently located on the south side of the Seattle Terminal. Following this input, WSF coordinated throughout the summer with passenger-only ferry service providers, including King County, Kitsap County, the Port of Kingston, and the Port of Port Townsend, to identify and assess options for maintaining passenger-only ferry operations at or near Colman Dock. As a result, WSF has now revised the project to include a two-slip passenger-only ferry terminal on the south side of the Colman Dock facility.

WSF has also proposed to revise the project's Purpose and Need Statement to clarify that passenger-only ferry service will be preserved at Colman Dock. WSF has also proposed to revise the Project Description to include preservation of passenger-only operations.

WSF has also coordinated with the City of Seattle in response to the City's scoping comments. While design details have not yet been developed, WSF has agreed in principle to include street-level retail activities along Alaskan Way as a future project phase, should funding become available, and to analyze those activities in the EA.

The Port of Seattle also commented about the future retail/vendor spaces. The Port asked whether the on-site space dedicated to future commercial development would be better used for additional vehicle storage to reduce off-site traffic impacts. Because the anticipated retail space would be located above the parking level or adjacent to Alaskan Way, it would not displace vehicle storage in loading/unloading lanes, and would not increase off-site traffic impacts.

Several comments were received that suggested other revisions to the project description. These included suggestions to reduce project footprint by adding a second deck to the vehicle loading platform in order to develop a migratory corridor for salmon (US Fish and Wildlife Service) and to remove Pier 48 (King County Wastewater Treatment Division). FHWA and FTA have determined, in consultation with WSF, that incorporating a second deck for vehicle holding and removal of Pier 48 are not consistent with the project's Purpose and Need Statement and will not be incorporated into the Project Description.

Revisions to Scope of Review in the Environmental Assessment

FHWA and FTA have determined that the initial list of environmental elements remains generally appropriate for analysis in the Environmental Assessment. Because of the project revision to preserve passenger-only ferry operations, several changes to the analysis will be required. In particular, the Transportation section of the analysis will address pedestrian

movements, not only to and from the WSF service but also to and from passenger-only ferry operations. This analysis will be documented in the Transportation section of the EA.

In response to comments received from the Seattle Historic Preservation Office and the Pioneer Square Historic District, the Area of Potential Effects related to cultural and historic resources will be expanded slightly, to include consideration of the Washington Street Boat Landing (to the south of Colman Dock) and Seattle Fire Station No. 5 at Pier 53 (to the north).

Conclusion

FHWA and FTA, as NEPA co-leads for environmental review of the proposed Seattle Multimodal Terminal at Colman Dock project, have completed review of comments received during the formal scoping comment period for the project. In response to comments received, WSF, in consultation with FHWA and FTA, has revised the project description to retain a passenger-only ferry facility at the site. The scope of review for the Environmental Assessment is now modified to address the passenger-only ferry facility as an element of the project.

Appendix B – Biological Opinions

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E., Bldg. 1
Seattle, Washington 98115

Refer to NMFS Tracking No.:
NWR-2013-9585

March 20, 2014

R.F. Krochalis
Regional Administrator
Federal Transit Administration
US Department of Transportation
915 Second Ave., Suite 3142
Seattle, Washington 98174-1002

Daniel M Mathis
Federal Highway Administration
US Department of Transportation
Suite 501, Evergreen Plaza
711 South Capitol Way
Olympia, Washington 98501-1284

Re: Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Seattle Terminal Project, King County, Washington. (HUC 171100190203-Shell Creek-Frontal Puget Sound)

Dear Mr. Krochalis and Mr. Mathis:

The enclosed document contains a Biological Opinion (opinion) prepared by the National Marine Fisheries Service (NMFS) pursuant to section 7(a)(2) of the Endangered Species Act (ESA) on the effects of the project referenced above. In this opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon, PS steelhead, Georgia Basin/Puget Sound (GB/PS) bocaccio, GB/PS canary rockfish, GB/PS yelloweye rockfish, southern resident killer whales (SRKW), and humpback whale and is not likely to destroy or adversely modify PS Chinook salmon or SRKW critical habitat. We also concur with the action agency's determination that the proposed action is not likely to adversely affect the southern distinct population segment of green sturgeon.

NMFS is not including an incidental take authorization for marine mammals at this time because the incidental take of marine mammals has not been authorized under section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments. Following the issuance of such regulations or authorizations for marine mammals, NMFS may append this Opinion to include an incidental take statement for marine mammals.

The document also contains the results of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) Essential Fish Habitat (EFH) consultation. The US Department of Transportation (USDOT) determined that the project will adversely affect EFH. NMFS concurs with this determination and is therefore providing conservation recommendations pursuant to MSA (section 305(b)(4)(A)). The FTA must respond to these recommendations within 30 days (MSA section 305(b)(4)(B)).

If you have questions regarding this consultation, please contact Michael Grady of the Oregon/Washington Coastal Area Office at (206) 526-4645, or by email at Michael.Grady@noaa.gov.

Sincerely,

William W. Stelle, Jr.
Regional Administrator

bcc: F/NWR – PDF (Nickerson)
WSHO – PDF (Chron)
WSHO – PDF (Grady)
WSHO – PDF (Lisitza)
WSHO – File Copy

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion, Section 7(a)(2) "Not Likely to Adversely Affect" Determination, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation

Seattle Terminal Project
King County, Washington
(HUC 171100190203-Shell Creek-Frontal Puget Sound)

NMFS Consultation Number: NWR-2013-9585

Action Agency: U.S. Department of Transportation

Affected Species and Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Southern Resident killer whales (*Orcinus orca*).	Endangered	Yes	No	No
Humpback Whale (*Megaptera novaeangliae*)	Endangered	Yes	No	N/A
Puget Sound steelhead (*Oncorhynchus* mykiss)	Threatened	Yes	No	N/A
Puget Sound Chinook salmon (*O.* tshawytscha)	Threatened	Yes	No	No
Southern Green Sturgeon (Acipenser medirostris)	Threatened	No	N/A	N/A
yelloweye rockfish (*Sebastes ruberrimus*)	Threatened	Yes	No	N/A
canary rockfish (*S. pinniger*)	Threatened	Yes	No	N/A
bocaccio (*S. paucispinis*)	Endangered	Yes	No	N/A

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes
Pacific Coast Groundfish	Yes	Yes
Coastal Pelagic Species	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By:

for William W. Stelle, Jr.
Regional Administrator

Date: March 20, 2014

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1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531, et seq.), and implementing regulations at 50 CFR 402. NMFS also completed an Essential Fish Habitat (EFH) consultation in accordance with section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801, et seq.) and implementing regulations at 50 CFR 600. The Opinion and EFH conservation recommendations both comply with the Data Quality Act (44 U.S.C. 3504(d)(1) et seq.), and they underwent pre-dissemination review.

1.2 Consultation History

On January 9, 2013, the U.S. Department of Transportation (USDOT), represented by both the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA), submitted a biological assessment (BA) to NMFS for the Seattle Terminal Project and requested consultations under both the ESA and MSA according to their effects determinations presented in Table 1, below. The USDOT also made a determination that the proposed action will adversely affect Steller sea lions. However, NMFS delisted this species, effective December 4, 2013, so no consultation will be required.

The Washington State Ferries (WSF) Division of the Washington State Department of Transportation (WSDOT) will carry out the project. The USDOT is the lead Federal agency and will fund the project in part. Other future related Federal actions are the US Army Corps of Engineers' (USACE) issuance of a permit under section 404 of the Clean Water Act and NMFS' issuance of incidental harassment authorizations (IHA) under the Marine Mammal Protection Act (MMPA). NMFS received additional project information between January 9, 2013 and October 21, 2013. NMFS agreed with the determinations in Table 1 and consultation was initiated on October 21, 2013.

The justification for NMFS' concurrence with "not likely" determination for green sturgeon is presented in Section 2.11 of this document.

Table 1. USDOT ESA Determinations for the Seattle Terminal Project[1]

Species	Federal Status	Species Determination	Critical Habitat Determination	Listing/ Designation Date
Puget Sound steelhead (*Oncorhynchus mykiss*)	Threatened	LAA[3]	N/A	6/28/05 (70 FR 37160)
Puget Sound Chinook salmon (*O. tshawytscha*)	Threatened	LAA	LAA	6/28/05 (70 FR 37160)/ 9/2/05 (70 FR 52630)
Puget Sound/Georgia Basin yelloweye rockfish (*Sebastes ruberrimus*)	Threatened	LAA	N/A	4/28/10 (75 FR 22276)
Puget Sound/Georgia Basin canary rockfish (*S. pinniger*)	Threatened	LAA	N/A	4/28/10 (75 FR 22276)
Puget Sound/Georgia Basin bocaccio (*S. paucispinis*)	Endangered	LAA	N/A	4/28/10 (75 FR 22276)
Southern Pacific Eulachon (*Thaleichthys pacificus*)	Threatened	NLAA[2]	No Effect[4]	3/18/10 (75 FR 13012)/ 10/20/11 (50 FR 65324)
Southern Green Sturgeon (*Acipenser medirostris*)	Threatened	NLAA	No Effect[4]	6/6/06 (71 FR 177570)/ 10/9/2009 (50 FR 52300)
Southern Resident killer whales (*Orcinus orca*).	Endangered	LAA	LAA	11/18/05 (70 FR 69903)/ 11/29/06 (71 FR 69054)
Humpback Whales (*Megaptera novaeangliae*)	Endangered	LAA	N/A	12/2/70 (35 FR 18319)

[1] NMFS agreed with these determinations and initiated consultation accordingly
[2] NLAA = not likely to adversely affect
[3] LAA = likely to adversely affect
[4]The action area is not within designated critical habitat for these species.

1.3 Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies. Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. Interdependent actions are those that have no independent utility apart from the action under consideration.

The USDOT and the WSF propose to repair the Seattle Terminal at Colman Dock by replacing deteriorating and seismically- vulnerable structures and bringing the facility into compliance with the requirements of the Americans with Disability Act. The WSF will replace the timber portion of the trestle, the main terminal building, the vehicular transfer span, overhead loading ramps, and some marine components of Slips 2 and 3. They will also replace the passenger-only ferry (POF) dock at pier 50. The WSF will construct the project in four phases over seven years with 5 seasons of in-water work. The in-water work will be conducted from land, from the existing and new permanent overwater structures, and from barges, between August 1 and

February 15. The WSF will insure that the project, as a whole, will not permanently increase overwater cover. The construction of the new POF walkway will increase overwater cover by 5,200 square feet. In addition to incorporating light-penetrating surfaces such as glass blocks into the design of the walkway, the WSF will remove an equivalent area of existing overwater cover to compensate.

In Phase 1, the WSF will reconstruct the POF slip and Slip 3. Phase I will last approximately 12 months, with one season of in-water work. To reconstruct the POF, the WSF will conduct the following activities:

1. construct a temporary platform for the POF slip using eleven, impact-driven, 18-inch diameter concrete piles;

2. remove the existing POF pier and walkway, including supporting piles;

3. reinstall the POF float and gangway to temporary POF platform with five 36-inch and two 30-inch steel piles;

4. construct 38,590 square feet of new trestle south of the existing trestle using 253, impact-driven, 18-inch concrete piles;

5. construct the new POF slip using 132, 18-inch diameter concrete piles, five 36-inch steel piles, and two 30-inch steel piles; and

6. construct the new 5,300 square foot POF elevated walkway using a light-penetrating surface and four 72-inch drilled shafts.

To reconstruct Slip 3, the WSF will conduct the following activities:

1. construct the new Slip 3 transfer span and overhead loading structure (OLS) using four drilled shafts with steel casings (two 80-inch diameter drilled shafts for the transfer span and one 108-inch and one 84-inch diameter drilled shaft for the OLS);

2. construct a new bridge seat for Slip 3 using ten 30-inch steel piles;

3. remove two existing timber dolphins between Slips 2 and 3;

4. construct two new steel pile dolphins between Slips 2 and 3 using 12 30-inch steel piles and six 36-inch steel piles; and

5. construct a temporary dolphin at Slip 2 using seven 24-inch steel piles.

In Phase 2, the WSF will remove the Slip 1 walkway and a portion of the south trestle and construct the pile foundation for the new terminal and the southern third of the new terminal. Phase 2 will take approximately 28 months, with one season of in-water work. In this phase, the

WSF will remove 45, 18-inch diameter and 84, 16.5-inch diameter concrete piles and drive 69, 30-inch diameter concrete-reinforced steel piles using vibratory and impact drivers.

In Phase 3, the WSF will temporarily remove the Slip 2 transfer span and OLS, demolish a building under the Slip 2 OLS, and then reinstall the transfer span and OLS. The WSF will also demolish the existing terminal building and a 100-foot wide strip of the north (timber) trestle. They will replace the timber trestle with a new concrete trestle. In this phase, the WSF will remove 748, 12-inch diameter timber piles and 76, 12-inch diameter concrete-reinforced steel piles and drive 290, 30-inch diameter concrete-reinforced steel piles using vibratory and impact drivers.

In Phase 4, the WSF will demolish the remaining portion of the north trestle, remove a bulkhead, install the new stormwater vault, and finish the new terminal building. In this phase, the WSF will remove 1,187, 12-inch diameter timber piles and 80, 12-inch diameter steel piles and drive 237, 30-inch diameter concrete-reinforced steel piles using vibratory and impact drivers.

As part of the bulkhead removal, the WSF will also remove 7,674 cubic yards of fill behind the bulkhead. They will remove the fill while it is still isolated from Elliot Bay by the bulkhead. The WSF will dispose of the fill in an open water disposal site in the unlikely event that the fill meets the Dredged Material Management Plan (DMMP) conditions, or they will haul it to an offsite upland location. Once the fill has been removed and they will restore the area to match the bathymetry on either side, and will also remove the bulkhead.

The Seattle Ferry Terminal currently has approximately four acres of untreated pollutant-generating impervious surface (PGIS). As part of this project, the WSF will not add any new PGIS, but they will provide treatment for all PGIS at the terminal using wet vaults with oil-water separators underneath the trestle. The WSF will also sweep the terminal with a vacuum street sweeper quarterly.

1.4 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Seattle Ferry Terminal is on the shoreline of Elliot Bay in the City of Seattle. The action area includes the areas of Elliot Bay within three miles of the Seattle Ferry Terminal, framed by the extent of underwater noise from pile -driving. All of the species in Table 1 are reasonably certain to be present within the action area during in-water work. The action area also contains critical habitat for Puget Sound Chinook salmon and southern resident killer whale (SRKW).

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat on which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the United States Fish and Wildlife Service, NMFS, or both, to

ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, the Service provides an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, Section 7(b)(4) requires the provision of an incidental take statement (ITS) specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

2.1 Analytical Approach of the Biological Opinion

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts to the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR 402.02). This biological opinion does not rely on the regulatory definition of 'destruction or adverse modification' of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[1]

We will use the following approach to determine whether the proposed action described in Section 1.3 is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the range-wide status of the species and critical habitat likely to be adversely affected by the proposed action;
- Describe the environmental baseline in the action area;
- Analyze the effects of the proposed action on both species and their habitat;
- Describe any cumulative effects in the action area;
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat; and
- Reach conclusions regarding jeopardy and adverse modification.

2.2 Range-wide Status of the Species and Critical Habitat

Climate change affects listed marine mammals and listed fish species and their habitat throughout Washington. Several studies have revealed that climate change is affecting and will continue to affect salmonid habitat in nearly all tributaries throughout the state (Battin et al. 2007; ISAB 2007). While the intensity of effects will vary by region (ISAB 2007), climate change will generally alter aquatic habitat (water yield, peak flows, and stream temperature). As

[1] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

climate change alters the structure and distribution of rainfall, snowpack, and glaciers. These changes will alter riverine hydrographs. Climate and hydrology models project significant reductions in both total snow pack and low-elevation snow pack in the Pacific Northwest over the next 50 years (Mote and Salathe 2009). These changes will shrink the extent of the snowmelt-dominated habitat available to salmon. Such changes may restrict our ability to conserve diverse salmon life histories, especially spring-run Chinook salmon.

In Washington State, most models project warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation. Average temperatures in Washington State are likely to increase 0.1-0.6°C per decade (Mote and Salathe 2009). Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snow pack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing stream flow timing and increasing peak river flows, which may limit salmon survival (Mantua et al. 2009). The largest driver of climate-induced decline in salmon populations is projected to be the impact of increased winter peak flows, which scour the streambed and destroy salmon eggs (Battin et al. 2007).

Higher water temperatures and lower spawning flows, together with increased magnitude of winter peak flows are all likely to increase salmon mortality. Higher ambient air temperatures will likely cause water temperatures to rise (ISAB 2007). Salmon and steelhead require cold water for spawning and incubation. As climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations. Thermal refugia are important for providing salmon and steelhead with patches of suitable habitat while allowing them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid waters above summer maximum temperatures, juvenile rearing may be increasingly found only in the confluence of colder tributaries or other areas of cold water refugia (Mantua et al. 2009).

Climate change will make recovery targets for these salmon populations more difficult to achieve. Habitat action can address the adverse impacts of climate change on salmon. Examples include restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters, protecting and restoring riparian vegetation to ameliorate stream temperature increases, and purchasing or applying easements to lands that provide important cold water or refuge habitat (Battin et al. 2007; ISAB 2007).

Climate change will also affect listed marine mammals. Effects from climate change include increased ocean temperature, increased stratification of the water column, and changes in intensity and timing of coastal upwelling. These continuing changes will alter primary and secondary productivity, the structure of marine communities, and in turn, the growth, productivity, survival, and migrations of salmonids. A mismatch between earlier smolt migrations (due to earlier peak spring freshwater flows and decreased incubation period) and altered upwelling may reduce marine survival rates. Increased concentration of carbon dioxide reduces the availability of carbonate for shell-forming invertebrates, including some that are prey items for juvenile salmonids. In all of these cases, the specific effects on salmon and steelhead abundance, productivity, spatial distribution and diversity are poorly understood, but as a primary prey source for SRKW, the effect on salmonids from climate change has the potential to

affect prey abundance as a PCE of SRKW critical habitat. Climate change could also indirectly affect humpback whales via trophic dynamics and reductions in prey.

2.2.1 Status of the Species

Puget Sound Chinook Salmon

Generally, PS Chinook salmon adults spawn in freshwater rivers and large streams at elevations above the floodplain. The eggs are deposited in gravel that has well-oxygenated water percolating through it (Healey 1991). The eggs over-winter and hatch in the gravel to become juveniles with a yolk-sac. At about the time the yolk sac is absorbed, the juveniles emerge from the gravel and begin to forage on their own. The juveniles forage and move downstream into estuaries where they continue to forage before moving into the North Pacific Ocean where they reside for one to six years (Healey 1991).

Abundance and Productivity. Using peak recorded harvest landings in Puget Sound in 1908, Bledsoe et al. (1989) estimated that the historical run size of the ESU was 670,000. During a recent five-year period, the geometric mean of natural spawners in populations of PS Chinook salmon ranged from 222 to just over 9,489 fish. Most populations had natural spawners numbering in the hundreds (median recent natural escapement is 766), and, of the six populations with greater than 1,000 natural spawners, only two have a low fraction of hatchery fish. Estimates of the historical equilibrium abundance, based on pre-European settlement habitat conditions, range from 1,700 to 51,000 potential PS Chinook salmon spawners per population (Ford et al. 2011a).

Long-term trends in abundance and median population growth rates for naturally- spawning populations of PS Chinook salmon indicate that approximately half of the populations are declining and the other half are increasing in abundance. Eight of the 22 populations are declining over the short term, and up to 12 populations are experiencing long-term declines (Ford et al. 2011a). Factors contributing to the downward trends are widespread blockages of streams, degraded freshwater and marine habitat, poor forest practices in upper river tributaries, urbanization and agriculture in lower tributaries and main stem rivers, and the loss and degradation of estuarine and nearshore habitats. Hatchery production and release of PS Chinook salmon are widespread, and more than half of the recent total escapement returned to hatcheries.

All Puget Sound Chinook populations are well below recovery escapement levels (Ford et al. 2011a). Most populations are also consistently below recovery spawner-recruit levels identified. Across the ESU, most populations have declined in abundance since the last status review in 2005, and trends since 1995 are mostly flat (Ford et al. 2011a).

Spatial Structure and Diversity. The PS Chinook salmon ESU encompasses all runs of Chinook salmon from the Elwha River in the Strait of Juan de Fuca eastward, including rivers and streams flowing into Hood Canal, Puget Sound, and the Strait of Georgia in Washington. Of an estimated 31 original populations, there are 22 extant geographically distinct populations (Ford et al. 2011a).

There are two life history strategies known as stream type and ocean type (Healey 1991; Myers et al. 1998). Timing of adult returns is dependent on the life history type. Stream type individuals are commonly called spring-run Chinook salmon since adults with this life history migrate into near shore waters and return to natal streams in spring to early summer. The ocean type life history is commonly called the fall-run PS Chinook salmon since most of the adults move to their natal streams in late summer and early fall. Fall-run PS Chinook salmon spawn in late September through October (Healey 1991). Most PS Chinook salmon are ocean type.

The artificial propagation of fall-run PS Chinook salmon is widespread throughout the ESU. Transfers between watersheds within and outside the ESU have been commonplace throughout the last century. Nearly two billion Chinook salmon have been released into Puget Sound tributaries since the 1950s. The vast majority of these were from local returning fall-run adults. Returns to hatcheries have accounted for 57 percent of the total spawning escapement, although the hatchery contribution to spawner escapement is probably much higher in some populations due to hatchery derived strays on the spawning grounds. The electrophoretic similarity between Green and Duwamish River fall-run PS Chinook salmon and several other fall-run stocks in Puget Sound suggests that there may have been a significant and lasting effect from Green River hatchery transplants (Ford et al. 2011a).

Puget Sound Steelhead

Steelhead are anadromous *O. mykiss*. Puget Sound steelhead typically spend two to three years in freshwater before migrating downstream into marine waters. Once the juveniles emigrate, they move rapidly through Puget Sound into the North Pacific Ocean where they reside for several years before returning to spawn in their natal streams. Unlike other species of *Oncorhynchus*, *O. mykiss* are capable of repeat spawning. Averaged across all West Coast steelhead populations, eight percent of spawning adults have spawned previously. Coastal populations have a higher incidence of repeat spawning than inland populations (Busby et al. 1996).

Spatial Structure and Diversity. Puget Sound steelhead occupy all accessible large tributaries to Puget Sound and the eastern Strait of Juan de Fuca (WDFG 1932). Nehlsen et al. (1991) identified nine PS steelhead stocks at some degree of risk or concern.

The WDF et al. (1993) identified 53 stocks within the DPS, of which 31 were considered to be of native origin and predominantly natural production. Of the 31 stocks, they rated 11 as healthy, three as depressed, one as critical, and 16 as unknown.

There are two types of steelhead, winter steelhead and summer steelhead. Winter steelhead sexually mature during their ocean phase and spawn soon after arriving at their spawning grounds. Adult summer steelhead enter their natal streams and spend several months holding and maturing in freshwater before spawning. The PS steelhead DPS is composed primarily of winter-run populations.

Abundance and Productivity. Since 1992 there has been a general downward trend in steelhead populations in this DPS. Busby et al. (1996) reviewed the 21 populations in the Puget Sound DPS and found that 17 had declining trends and four had increasing trends. Marked declines in

natural run size are evident in all areas of the DPS. Even sharper declines are observed in southern Puget Sound and in Hood Canal. Throughout the DPS, natural steelhead production has shown a weak response to reduced harvest since the mid-1990's. Median population growth rates were estimated for several populations in the DPS, using the 4-year running sums method (Holmes 2001; Holmes and Fagan 2002). They estimated that the growth rate was less than 1 for most populations in the DPS, meaning the populations are declining.

No abundance estimates exist for most of the summer-run populations; all appear to be small, most averaging less than 200 spawners annually. Summer-run populations are concentrated in northern Puget Sound and Hood Canal; only the Elwha River and Canyon Creek support summer-run steelhead in the rest of the DPS. Steelhead are most abundant in northern Puget Sound, with winter-run steelhead in the Skagit and Snohomish rivers supporting the two largest populations (approximately 3,000 and 5,000 respectively). From 2005 to 2009, geometric means of natural spawners indicate relatively low abundance (4 of 15 populations with fewer than 500 spawners annually) and declining trends (six of 16 populations) in natural escapement of winter-run steelhead throughout Puget Sound, particularly in southern Puget Sound and on the Olympic Peninsula (Ford et al. 2011a). Widespread declines in abundance and productivity in most natural populations have been caused by the following factors:

1. Steelhead habitat has been dramatically affected by a number of large dams in the Puget Sound Basin that eliminated access to habitat or degraded habitat by changing river hydrology, temperature profiles, downstream gravel recruitment, and movement of large woody debris.

2. In the lower reaches of rivers and their tributaries, urban development has converted natural areas (e.g. forests, wetlands, and riparian habitat) into impervious surfaces (buildings, roads, parking lots, etc.). This has changed the hydrology of urban streams causing increases in flood frequency, peak flow, and stormwater pollutants. The hydrologic changes have resulted in gravel scour, bank erosion, sediment deposition during storm events, and reduced summer flows (Moscrip and Montgomery 1997; Booth et al. 2002; May et al. 2003).

3. Agricultural development has reduced river braiding, sinuosity, and side channels through the construction of dikes and the hardening of banks with riprap. Constriction of rivers, especially during high flow events, increases gravel scour and the dislocation of rearing juveniles. Much of the habitat that existed before European immigration has been lost due to these land use changes (Beechie et al. 2001; Collins and Montgomery 2002; Pess et al. 2002).

4. In the mid-1990s, WDFW banned commercial harvest of wild steelhead. Previous harvest management practices contributed to the decline of PS steelhead (Busby et al. 1996). Predation by marine mammals (principally seals and sea lions) and birds may be of concern in some local areas experiencing dwindling steelhead run sizes (Kerwin 2001).

5. Ocean and climate conditions can have profound impacts on steelhead populations. Changing weather patterns affect their natal streams. As snow pack decreases, in-stream flow is expected to decline during summer and early fall (Battin et al. 2007).

6. The extensive propagation of the Chambers Creek winter steelhead and the Skamania Hatchery summer steelhead stocks have contributed to the observed decline in abundance of native PS steelhead populations (Hard et al. 2007). Approximately 95 percent of the hatchery production in the PS DPS originates from these two stocks. The Chambers Creek stock has undergone extensive breeding to provide earlier and more uniform spawn timing. This has resulted in a large degree of reproductive divergence between hatchery and wild winter-run fish. The Skamania Hatchery stock is derived from summer steelhead in the Washougal and Klickitat rivers and is genetically distinct from the Puget Sound populations of steelhead. For these reasons, Hard et al. (2007) concluded that all hatchery summer- and winter-run steelhead populations in Puget Sound derived from the Chambers Creek and Skamania Hatchery stocks should be excluded from the DPS. NMFS included two hatchery populations that were derived from native steelhead, the Green River winter-run and the Hamma Hamma winter-run, as part of the DPS (72 FR 26722; May 11, 2007).

Rockfish

On April 27, 2010, NMFS listed the Puget Sound/Georgia Basin (PSGB) DPSs of yelloweye rockfish and canary rockfish as threatened and the PSGB bocaccio rockfish DPS as endangered under the ESA (75 FR 22276; April 27, 2010). The PSGB DPS of bocaccio is at high risk of extinction throughout all of its range, and the Puget Sound/Georgia Basin DPSs of yelloweye rockfish and canary rockfish are at moderate risk of extinction throughout all of their range (Drake et al. 2010). The PSGB DPSs include all yelloweye rockfish, canary rockfish, and bocaccio in Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill. Puget Sound can be subdivided into five interconnected basins separated by shallow sills: (1) The San Juan/Strait of Juan de Fuca basin, (2) Main Basin, (3) Whidbey Basin, (4) South Puget Sound, and (5) Hood Canal.

The life-histories of yelloweye rockfish, canary rockfish, and bocaccio are made up of a larval and pelagic juvenile stage, a juvenile stage, sub-adult stage, and an adult stage. Rockfish fertilize their eggs internally and extrude the young as larvae. Larvae can make small local movements to pursue food immediately after birth (Tagal et al. 2002) but move passively with prevailing currents (NMFS 2003). Shaffer et al. (1995) and Love et al. (2002) observed larvae under free-floating algae, seagrass, and detached kelp, but they also occupy the full water column (Moser and Boehert 1991; Weis 2004). Oceanographic conditions in Puget Sound keep most larvae near where they are born rather than dispersing them to adjacent basins (Drake et al. 2010). Larval rockfish occur throughout the year along the Pacific Coast and very likely occupy the action area throughout the year (Waldron 1972; Westrheim and Harling 1975; Wyllie Echerverria 1987; Moser and Boehert 1991; Love et al. 2002; Weis 2004). Predators of larval rockfish include herring, surf smelt, salmon, and other fish.

When bocaccio and canary rockfish reach sizes of 1.1 to 3.5 inches (approximately 3 to 6 months old), they settle onto shallow nearshore waters in rocky or cobble substrates with or without kelp (Love et al. 1991; Love et al. 2002). This habitat provides warmer temperatures, food, and refuge from predators (Love et al. 1991). Areas with floating and submerged kelp species support the highest densities of juvenile rockfish (Carr 1983; Halderson and Richards 1987; Matthews 1989; Hayden-Spear 2006). Unlike bocaccio and canary rockfish, juvenile yelloweye rockfish do not occupy intertidal waters (Love et al. 1991; Studebaker et al. 2009) but settle in waters near the upper depth range of adults (Yamanaka and Lacko 2001).

Subadult and adult yelloweye rockfish, canary rockfish and bocaccio occupy areas with moderate to extreme steepness, complex bathymetry, and rock and boulder-cobble complexes (Love et al. 2002). A measure of this habitat complexity is rugosity, the small-scale variations in the height of a surface. Adult rockfish are more likely to use benthic habitats with higher rugosity but also use in non-rocky substrates such as sand and mud (Washington 1977; Miller and Borton 1980; WDFW unpublished data). Yelloweye rockfish remain near the bottom and have small home ranges, while canary rockfish and bocaccio have larger home ranges, move long distances, and spend time in the water column (Love et al. 2002). Adults of each species occupy waters deeper than 120 feet (Love et al. 2002; Orr et al. 2000).

Rockfish feed on diverse assemblages of invertebrates and fish during their various life stages. Larvae feed on very small organisms such as zooplankton, copepods and phytoplankton. Juvenile rockfish feed on small invertebrates and fish. The sub adult and adult rockfish eat crab larvae, shrimp euphasids, jellyfish, other species of rockfish, and many other fish species (Washington et al. 1978; Lea et al. 1999; Love et al. 2002; Palsson et al. 2009).

Abundance and Productivity. The WDFW estimated that 50,655 yelloweye rockfish, 20,449 canary rockfish, and 4,487 bocaccio inhabit Puget Sound (Drake et al. 2010). Most of the fish were in the San Juan portion of the DPSs. These population estimates have large variances (or standard errors), and thus there remains uncertainty regarding the total abundance and distribution of ESA-listed rockfish in the Puget Sound/Georgia Basin DPSs.

Contaminants such as polychlorinated biphenyls (PCBs), chlorinated pesticides, polybrominated diphenyl ethers (PBDEs), and ploycholinated dioxins and furans appear in rockfish collected in urban areas of the Puget Sound, such as Port Gardner, Elliot Bay, and Commencement Bay (West et al. 2001; Palsson et al. 2009). These contaminants have been found to interfere with rockfish reproductive function (Palsson et al. 2009). Male rockfish accumulate more toxins than females, which is evidence that the transfer of toxins from females to larvae occurs during gestation (Palsson et al. 2009).

Future climate-induced changes to rockfish habitat could alter their productivity (Drake et al. 2010). Harvey (2005) created a generic bioenergetic model for rockfish which showed warm water conditions, such as El Nino, lowered growth rates and increased generation time. The negative effect of El Nino is common across rockfish species (Moser et al. 2000). Therefore, warmer water conditions from climate change will reduce ESA-listed rockfish population productivity and overall population viability (Drake et al. 2010).

Spatial Structure and Connectivity.

The severe reduction of listed rockfish throughout Puget Sound threatens their spatial structure and connectivity. For yelloweye rockfish, their small home ranges further threaten spatial structure and connectivity. Some adult and juvenile canary rockfish and bocaccio migrate long distances, which has the potential to improve spatial structure and connectivity (Drake et al. 2010).

Southern Resident Killer Whales

NMFS listed the SRKW Distinct Population Segment (DPS) as endangered under the ESA on November 18, 2005 (70 FR 69903) and designated them as depleted and strategic under the Marine Mammal Protection Act (68 FR 31980; May 29, 2003). NMFS issued the final recovery plan for SRKW in January 2008 (NMFS 2008). This section summarizes status information from the recovery plan, the five-year status review (NMFS 2011a), and other data.

The SRKWs are a long-lived species, with have a late onset of sexual maturity (NMFS 2008). Mothers and offspring maintain highly stable social bonds throughout their lives, which is the basis for the matrilineal social structure in the SRKW population (NMFS 2008). Groups of related matrilines form pods. Three pods (J, K, and L) make up the SRKW DPS. Vocal communication is advanced in SRKW and is important to their social structure, navigation, and foraging (NMFS 2008). They consume a variety of fish and one species of squid, but salmon, and Chinook salmon in particular, are their primary prey (Ford and Ellis 2006; Hanson et al. 2010).

Spatial Distribution and Diversity. The SRKW DPS is a single population that ranges as far south as central California and as far north as Southeast Alaska. They spend considerable time in the Salish Sea, mostly around the San Juan Islands, from late spring to early autumn and then move south into Puget Sound. Although the entire DPS can occur along the outer coast at any time of the year, occurrence along the outer coast is more likely from late autumn to early spring.

The estimated effective size of the population (based on the number of breeding individuals under ideal genetic conditions) is very small, less than 30 whales or about one third of the current population size (Ford et al. 2011b). The small effective population size, the absence of gene flow from other populations, and documented breeding within pods may elevate the risk from inbreeding (Ford et al. 2011b). In addition, the small effective population size may contribute to the lower growth rate of the SRKW population in contrast to the Northern Resident population (Ford et al. 2011b; Ward et al. 2009).

Abundance and Productivity. As of September 2013, there were 26 whales in J pod, 19 whales in K pod and 36 whales in L pod, for a total of 81 whales. The historical abundance of SRKW was between 140 and 400 whales (Krahn et al. 2004; Olesiuk et al. 1990). Between 1983 and 2010, population growth was variable, with an average annual population growth rate of 0.3 percent (The Center for Whale Research unpubl. data).

One of the delisting criteria in the SRKW recovery plan is an average growth rate of 2.3 percent for 28 years (NMFS 2008). This criterion has not been met (NMFS 2011a), and the recent low population growth rate of 0.3 percent is not sufficient to achieve recovery. Other factors limiting the growth rate of the population include the small number of breeding males, particularly in J and K pods, reduced fecundity, decreased sub-adult survivorship in L pod, and the total number of individuals in the population (NMFS 2008).

Limiting Factors. Several factors may be limiting SRKW recovery including the quantity and quality of prey, exposure to bioaccumulating toxic chemicals, and disturbance from sound and vessels. Oil spills are also a risk factor. Multiple threats are likely acting in concert to impact SRKWs. Although it is not clear which threat or threats are most significant to the survival and recovery of the SRKW DPS, all of these threats are potential limiting factors in the population (NMFS 2008).

Humpback Whale

NMFS listed humpback whales as endangered under the Endangered Species Conservation Act (ESCA) on June 2, 1970 (35 FR 18319). The ESA replaced the ESCA in 1973 and continued to list humpback whales as endangered. NMFS issued the final recovery plan for humpback whales in November 1991 (NMFS 1991).

Humpback whales occur in all major oceans of the world. In the North Pacific, humpback whales feed in coastal waters from California to Russia, including in the Bering Sea. There are four stocks in the North Pacific, the Central North Pacific stock, the Western North Pacific stock, the California/Oregon/Washington stock, and the American Samoa stock (Carretta et al. 2012). The California/Oregon/Washington stock winters in coastal waters of Mexico and Central America and migrates to feeding areas from California to southern British Columbia in summer and fall (Carretta et al. 2012). Humpback whales forage on a variety of crustaceans, other invertebrates, and fish (NMFS 1991). Humpback whales occupy shallow coastal waters in the summer and deeper offshore waters during their winter migrations.

Based on the available data, humpback whales appear to be increasing in abundance (Carretta et al. 2012). Calambokidis et al. (2008) estimated that the current population of humpback whales in the North Pacific is approximately 18,000 to 20,000 whales. More recently, Barlow et al. (2011) estimated the abundance to be over 21,000. The estimated growth rate for this stock is between seven and eight percent per year (Calambokidis et al. 2009).

Calambokidis et al. (2009) estimated the abundance of the California/Oregon/Washington stock to be 2,043. Within this stock, regional abundance estimates vary among the feeding areas. Average abundance estimates ranged from 200 to 400 individuals for southern British Columbia/northern Washington and 1,400 to 2,000 for California/Oregon (Calambokidis et al. 2008; Barlow et al. 2011). Factors which may be limiting humpback whale recovery include entanglement in fishing gear, collisions with ships, whale watch harassment, subsistence hunting, and anthropogenic sound (NMFS 1991).

2.2.2 Status of Critical Habitat

Puget Sound Chinook Salmon

NMFS designated critical habitat for the PS Chinook salmon ESU on September 2, 2005. While the geographic extent of each ESU's critical habitat is different, the primary constituent elements (PCEs) are the same. The following are the PCEs NMFS identified for PS Chinook critical habitat:

> PCE 1--Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;
>
> PCE 2--Freshwater rearing sites with (1) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, (2) water quality and forage that support juvenile development, and (3) natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
>
> PCE 3--Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;
>
> PCE 4--Estuarine areas free of obstruction and excessive predation with (1) water quality, water quantity, and salinity conditions that support juvenile and adult physiological transitions between fresh water and salt water, (2) natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels, and (3) juvenile and adult foraging opportunities, including aquatic invertebrates and prey fish, supporting growth and maturation;
>
> PCE 5--Nearshore marine areas free of obstruction and excessive predation with (1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation, and (2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels;
>
> PCE 6--Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Critical habitat throughout the Puget Sound basin has been degraded by numerous activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large woody debris, intense urbanization, agriculture, alteration of floodplain and stream morphology, riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, timber harvest, and mining. Changes in habitat quantity, availability, diversity,

stream flow, temperature, sediment load, and channel instability are common limiting factors of critical habitat.

Southern Resident Killer Whale

NMFS designated critical habitat for the SRKW DPS on November 29, 2006 (71 FR 69054). Critical habitat consists of three areas, the Summer Core Area in Haro Strait and waters around the San Juan Islands, Puget Sound, and the Strait of Juan de Fuca. NMFS identified the following physical and biological features essential to conservation, water quality to support growth and development, prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development and population growth, and passage conditions to allow for migration, resting, and foraging.

Water Quality. Water quality in Puget Sound is degraded (Puget Sound Partnership 2006; 2008). For example, toxic chemicals in Puget Sound persist and build- up in marine organisms, including SRKWs and their prey despite bans in the 1970s of some harmful substances and clean-up efforts. The primary concern for direct effects on whales from water quality is oil spills.

Prey Quantity, Quality, and Availability. Most wild salmon stocks throughout the Northwest are at fractions of their historical levels. Since 1994, NMFS has listed 28 ESUs and DPSs of salmon and steelhead in Washington, Oregon, Idaho, and California as threatened or endangered under the ESA. Overfishing, habitat loss, and hatchery practices are major causes of decline. Poor ocean conditions over the past two decades have also reduced wild populations. While wild salmon stocks have declined, hatchery production has been generally strong. Total Chinook salmon abundances increased significantly from the mid-1990s to the early 2000s, but have declined in the last several years (PFMC 2008).

Contaminants and pollution also affect the quality of SRKW prey in Puget Sound. Contaminants enter marine waters and sediment from numerous sources, but are typically concentrated near areas of dense human population and industrialization. Once in the environment, these substances accumulate up the food chain and reach high levels in long-lived apex predators like SRKWs. The size of Chinook salmon is also an important aspect of prey quality. In addition, vessels and sound may reduce the effective zone of echolocation and reduce availability of fish for SRKWs in their critical habitat (Holt 2008).

Passage. The SRKWs are highly mobile and use a variety of areas for foraging and migration. Human activities can interfere with movements of the whales and impact their passage. In particular, vessels and acoustic disturbance may present obstacles to whale passage, causing the whales to swim further and change direction more often. This increases energy expenditure and impacts foraging behavior (NMFS 2011b).

2.3 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section

7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The action area is extensively developed. Elliott Bay has approximately eight miles of shoreline. Prior to development, Elliott Bay consisted of intertidal mud, sand flats, and wetlands. Extensive filling, dredging, and grading has modified over 80 percent of the Elliott Bay shoreline (Kerwin and Nelson 2000). A 7,166-foot long seawall, comprised of concrete, steel sheet pile, and treated timber, runs along the shoreline of Elliot Bay, including the entire the project area. The historic construction of the seawall and the placement of fill to facilitate development and use of the waterfront for commerce and industry eliminated the natural shoreline. There is currently no natural shoreline in the project area. Overwater structures cover over 65 percent of the Elliott Bay shoreline (City of Seattle 2003 Urban Blueprint).

Elliott Bay receives contaminants from several sources including stormwater discharges, combined sewer overflows (CSO) events, vessel discharges, discharges from pier facilities, dumping of trash, and atmospheric deposition. Most water quality samples in Elliott Bay contain heavy metals (arsenic, cadmium, copper, lead, mercury, silver, and zinc), phthalates, and PAHs. Ambient dissolved copper and dissolved zinc concentrations in Elliott Bay are approximately 0.7 and 4.1 micrograms per liter (µg/L), respectively (Curl et al. 1988). These contaminants bioaccumulate in many marine animal species, including mussels, squid, fish larvae, Chinook salmon, coho salmon, osprey, gray whales, orcas, and harbor seals (NMFS 1993; KCEL 1998; Ross et al. 1998; EPA and PSWQAT 1999; Cullon et al. 2001).

The sediments of Elliott Bay exceed the State sediment management standards (SMS) for a wide range of constituents including mercury, PAHs, and PCBs. In 1989, the WSF placed a sediment cap at the southern portion of the ferry terminal to cap and contain the contaminated sediments. With the exception of data from one sampling station in 2004 where there was an exceedance of zinc, monitoring results show that metals and organic compounds are below State sediment quality standards (SQS), and the cap is intact and continues to effectively contain contaminants. Sampling at Pier 48 south of the Colman Dock indicates sediment quality exceedances for metals, PAHs, organics, and PCBs. No eelgrass or kelp occurs near the terminal.

Romberg (2005) reported on the recontamination of a sediment cap at Piers 53 to 55, the three piers located immediately north of the Seattle Terminal. The 4.5-acre cap, installed in 1992, isolated contaminated sediment near a historical City of Seattle CSO. Less than a year later, the WSF released a large amount of contaminated sediment onto the cap while removing a long row of creosote-treated piles with a clamshell bucket. The contaminated sediment substantially elevated the levels of metals and PAHs on the cap. After three years, the metals returned to background levels, and the PAHs were significantly reduced but still above the levels when the cap was new (Romberg 2005).

Nelson et al. (2004) studied juvenile Chinook salmon use of Elliot Bay and the lower Duwamish River and conducted beach seine sampling at several sites. At the south Elliott Bay site, they captured juvenile Chinook salmon from March through August and a few in late January. The highest abundance for natural juveniles was from mid-May to mid-June and then again from the end of May to mid-June for hatchery juveniles. Coded wire tags indicated that the hatchery fish

were from watersheds throughout Puget Sound. Rice et al. (2011) sampled for juvenile Chinook salmon in deep water areas in Puget Sound. They sampled three sites within Elliott Bay and found juvenile Chinook salmon from May through October (Figure 1). Adult Chinook migrate through Elliott Bay into the Duwamish River from mid-August through the end of November (Nelson et al. 2004).

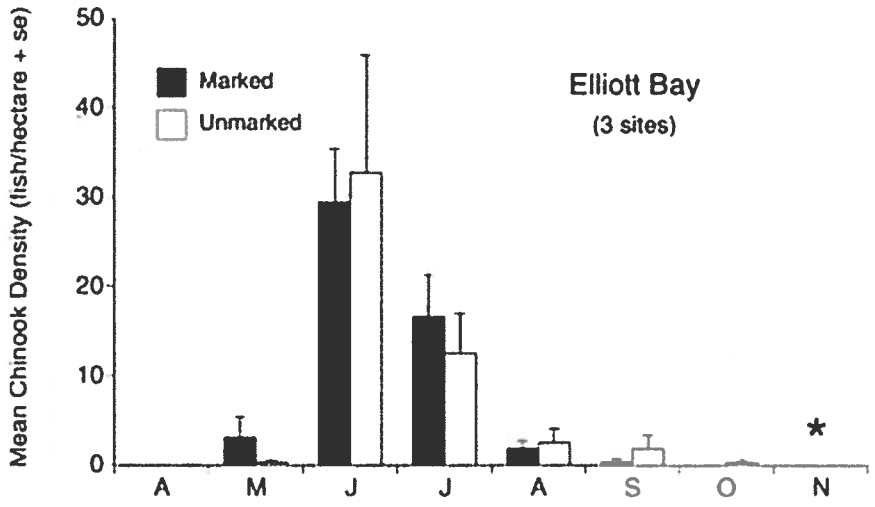

Figure 1. Marked and unmarked juvenile Chinook salmon within Elliott Bay in 2003 (Rice et al. 2011).

Available evidence shows that steelhead spend very little time in Elliot Bay. Adult steelhead spend little time staging in the marine areas prior to river entry, moving rapidly through nearshore habitats (Spence 1989), and steelhead smolts migrate rapidly to offshore marine habitats (Welch et al. 2004; Melnychuk et al. 2007; Pearcy 1992). Juvenile steelhead migrate out of the Duwamish River from February through August (Brennan et al. 2004; Ruggerone et al. 2006). Steelhead rapidly migrate through the lower Duwamish and estuary (Ruggerone et al. 2006). The Seattle Department of Transportation did not observe any steelhead during surveys from February to September 2011 (SDOT in litt.) and the October 2011 to December 2012 (Toft et al. in litt.) along the seawall in Elliot Bay. However, King County observed steelhead south of Elliott Point, near Golden Gardens, in Shilshole Bay, at Alki Point, and within Elliott Bay at the mouth of the Duwamish River.

Greene and Godersky (2012) sampled rockfish at six deep-water sediment disposal sites and 79 index sites from April through October. Table 2, below, provides density estimates for rockfish within Elliott Bay at both the deep-water sediment site and the Duwamish index site.

Table 2. Rockfish densities within Elliott Bay (Green and Godersky 2012)

Month	Elliott Bay Deep-water Rockfish Density (fish/1,000 m^3)	Duwamish Index Site Rockfish Density (fish/1,000 m^3)
April	101.0	52.7
May	126.8	261.6
June	31.4	6.3
July	69.0	20.2
August	26.8	31.7
September	88.5	7.1
October	0	6.5

Southern resident killer whales and humpback whales are likely to be present within the action area in Elliot Bay across to Bainbridge Island. This area has significant vessel traffic. In addition to the multiple daily runs of WSF vessels, there are many large container ships, cruise ships, and smaller recreational boats. Background noise levels due to vessel traffic at the terminal exceed the 120 dB_{rms} behavioral disturbance threshold for marine mammals. Laughlin (in litt.) reported background noise levels at the Seattle Ferry Terminal within the functional hearing range for SRKWs (137 dB_{rms}) and for humpback whales at (141 dB_{rms}).

The Whale Museum manages a long-term database of SRKW sightings and geospatial locations in inland waters of Washington. While these data are predominately opportunistic sightings from a variety of sources (public reports, commercial whale watching, Soundwatch, Lime Kiln State Park land-based observations, and independent research reports), SRKW are highly visible in inland waters and widely followed by the interested public and research community. The dataset does not account for the level of observation effort by season or location. However, it is the most comprehensive long-term dataset available to evaluate broad scale habitat use by SRKWs in inland waters. For these reasons, NMFS relies on the number of past sightings to assess the likelihood of SRKW presence in a project area and during work windows. A review of this dataset from 1990 to 2008 indicates that SRKW have used the action area during the months that in-water construction activities are proposed (Table 3).

Table 3. Total killer whale sightings per month in the project action area between 1990 and 2008 for the months corresponding to the in-water work window (Orca Network 2013).

Month	Number of sightings
August	4
September	8
October	20
November	65
December	66
January	41
February	17

NMFS has limited information about humpback whale foraging habits and space use in inside waters of Washington, and we do not have specific fine-scale information for the project area. In recent years, humpback whales using the inside waters of Washington with increasing frequency, primarily during the fall and spring. Humpback whales sightings in Elliot Bay are uncommon, but twenty-five sightings of several individuals have been observed in the vicinity of the Seattle Terminal in the past ten years. The sightings are from February to June and September of 2004, July of 2006, June and July of 2008, and February and December of 2010 (Orca Network 2013).

The existing terminal at Colman Dock substantially degrades the baseline of the action area. The terminal covers 6.8 acres of Elliot Bay. Of the 6.8 acre total, 3.2 acres is composed of creosote-treated timber decking and piles. This creosote-treated timber significantly degrades water quality in the action area. Water quality is a component of both SRKW and PS Chinook salmon (PCE 5) critical habitat. The Washington State Department of Ecology (Ecology) estimated that there are 100,000 creosote-treated piles in the marine waters of Puget Sound (Ecology 2012). While NMFS cannot determine how many creosote pile support the existing terminal, the similarly sized (3.2 acres) Tank Farm pier in Mukilteo, WA has approximately 3,900 piles. Ecology used data from Valle et al. (2007) to estimate the annual release of polycyclic aromatic hydrocarbons (PAHs) into Puget Sound. Valle et al. (2007) estimated the annual release of 0.482 kilograms (1.063 pounds) per pile. Using these numbers, NMFS estimates that the Seattle Terminal at Colman Dock releases approximately 1,880 kilograms (4,145 pounds) of PAHs into Elliot Bay each year.

In addition to water quality effects, the overwater shading of the existing terminal further degrades PCE 5 of PS Chinook salmon critical habitat in the action area. The sharp underwater light contrasts from overwater structures cause delays in migration from disorientation, fish school (dispersal resulting in a loss of refugia), and altered migration routes around the structures (Simenstad 1999). The characteristics of an overwater structure, including height and width, orientation, and piling type and number, can affect the severity of the shade-related impacts (Southard et al. 2006). The characteristics of the existing terminal, particularly its width and large number of closely spaced piles, make it a significant migration barrier to juvenile Chinook

salmon. The existing terminal also impairs benthic habitat from both the area of habitat the piles occupy and the area shaded by the pier. This reduces the production of benthic and epibenthic macroinvertebrates in the action area that juvenile Chinook salmon prey upon.

2.4 Effects of the Action

"Effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. During consultation, neither NMFS nor the USDOT identified any interrelated or interdependent actions.

The ESA prohibits the unauthorized take of threatened or endangered species and defines the term "take" to include harassment. Underwater sound from the proposed action will harass some ESA-listed marine mammals. The ESA does not define harassment. The US Fish and Wildlife Service promulgated a regulation defining harassment as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering," 50 CFR 17.3. The MMPA defines Level B harassment as, "any act of pursuit, torment, or annoyance which . . . has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild," 16 U.S.C. 1362(18)(A)(ii). This Opinion considers all potential take associated with the proposed action, including the take covered under the more inclusive MMPA definition of harassment.

2.4.1 Effects on Listed Species

Underwater Sound--Listed Fish Species

Impact pile driving can cause levels of underwater sound sufficient to injure or kill fish and alter their behavior (Yelverton et al. 1975; Hasting 1995; Turnpenny et al. 1994; Turnpenny and Nedwell 1994; Popper 2003; Hastings and Popper 2005). Death from barotrauma can be instantaneous or delayed up to several days after exposure. Even when not enough to kill fish, high sound levels can cause sublethal injuries. Fish suffering damage to hearing organs may suffer equilibrium problems, and may have a reduced ability to detect predators and prey (Turnpenny et al. 1994; Hastings et al. 1996). Hastings (2007) determined that a cumulative Sound Exposure Level (cSEL) as low as 183 dB (re: 1 μPa2-sec) was sufficient to injure the non-auditory tissues of juvenile spot and pinfish with an estimated mass of 0.5 grams.

Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Popper et al. (2005) found temporary threshold shifts in hearing sensitivity after exposure to cSELs as low as 184 dB. Temporary threshold

shifts reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success.

Cumulative SEL is a measure of the sound energy integrated across all of the pile strikes. The Equal Energy Hypothesis, described by NMFS (2007), is used as a basis for calculating cumulative SEL. The number of pile strikes is estimated per continuous work period. This approach defines a work period as all the pile driving between 12-hour breaks. NMFS uses the practical spreading model to calculate transmission loss.

NMFS, USFWS, and WSDOT agreed to interim criteria to minimize potential impacts to fishes from pile driving noise propagation (FHWG 2008). The interim criteria identify the following thresholds for the onset of physical injury using peak sound pressure level (SPL) and cSEL:

- Peak SPL: levels at or above 206 dB from any hammer strike; and
- cSEL: levels at or above 187 dB for fish sizes of two grams or greater, or 183 dB for fish smaller than two grams.

During Phase 1, the WSF will impact drive 396, 18-inch concrete piles over 51 days between August 1 and February 15 in order to construct the south trestle, temporary POF slip, and the permanent POF slip. When analyzing the sound levels for impact pile driving, NMFS uses underwater sound data from previous projects with the same or similarly- sized piles. Laughlin (2007) measured underwater sound from the impact pile driving of a 24-inch concrete pile at the Mukilteo Ferry Terminal in 2006. Noise levels were 184 dB_{peak} and 170 dB_{rms} at 10 meters from the source. NMFS calculated individual strike SEL, 159 dB_{sel}, by subtracting 25 dB from the peak dB.

NMFS uses the practical spreading model to determine the distance at which the noise will attenuate to below the injury thresholds. NMFS predicts that the sound levels from 18-inch concrete piles will be less than or equal to the sound levels for 24-inch concrete piles. Using these values, NMFS calculated the distance and the area that will be subjected to cSELs greater than or equal to 183dB (fish less than two grams) and 187dB (fish two grams and over). Impact pile driving of the concrete piles will subject the area within 109 feet to sound levels greater than or equal to 183dB and the area within 59 feet to sound levels greater than or equal to 187dB.

During all four phases, the WSF will drive 30-inch hollow steel piles and 30-inch concrete-reinforced steel piles (Table 4). They will use vibratory driving and then impact drive to verify the bearing capacity of the piles. The WSF will also employ a confined or unconfined bubble curtain during impact driving of steel piles. NMFS used data from past projects to analyze effects from impact pile driving at the east approach (Illingworth and Rodkin 2007; WSDOT unpublished data). Based on past data, NMFS predicts that the confined or unconfined bubble curtain will achieve a 10 dB reduction at this location. NMFS estimates that the maximum sound levels for a single strike for diving the 30-inch steel and 30-inch concrete reinforced steel piles will be 202 dB_{peak}, 185 dB_{rms}, and 176 dB_{sel} after attenuation from the bubble curtain. Using these values, NMFS calculated the distance and the area that will be subjected to cSELs greater than or equal to 183dB (fish less than two grams) and 187dB (fish two grams and over). Impact pile driving of the 30-inch piles will subject the area within 1,657 feet to sound levels greater

than or equal to 183dB and the area within 896 feet to sound levels greater than or equal to 187dB.

Table 4. Totals of 30-inch Steel Piles for each Phase of the Project

Phase	Number of Piles	Days	In-water Work Window
1	14	3	August 1 to February 15
2	69	12	August 1 to February 15
3	270	46	August 1 to February 15
4	234	40	August 1 to February 15

Adult and juvenile Chinook salmon and steelhead, larval listed rockfish species, and juvenile canary rockfish are likely to be present at different times during the August 1 and February 15 window. Underwater sound is likely to injure or kill these fish. NMFS cannot accurately estimate the number of individuals that will experience adverse effects from underwater sound because fish distribution is unpredictable and influenced by a number of environmental factors. Impact pile driving will occur episodically throughout the in-water work seasons. Furthermore, not all exposed individuals will experience adverse effects. Overall, only a very small percentage of the PS Chinook salmon ESU and the PS steelhead DPS will experience these adverse effects, and, as described in the baseline section, these individuals will only spend a very short period of time within the action area. Larval rockfish, due to their extremely small size, are more likely to be killed by impact pile driving. Juvenile and adult rockfish exposed to impact pile driving will experience similar effects as juvenile and adult salmonids.

Underwater Noise and Sound Pressures--Marine Mammals

Southern Resident Killer Whales. NMFS is currently developing comprehensive guidance on sound levels likely to disrupt normal behaviors, or cause injury to SRKWs. Until formal guidance is available, NMFS will use conservative thresholds of sound pressure levels from broad-band sounds known to cause behavioral disturbance (160 dB_{rms} for impulse sound and 120 dB_{rms} for continuous sound)[2] and injury (180 dB_{rms} for whales) (70 FR 1871; January 11, 2005). Laughlin (in litt.) reported background noise levels at the Seattle Ferry Terminal within the functional hearing range for SRKWs (137 dB_{rms}). Therefore, NMFS used 137 dB_{rms} as the threshold for this analysis.

Impact pile driving of the 30-inch steel piles will generate noise levels of 195 dB_{rms}, which is above the 180 dB_{rms} injury threshold. The sound will attenuate to below the injury threshold within 71 feet of the Seattle Terminal and below the disturbance threshold for impulsive sound at 1,522 feet. Given the very high levels of anthropogenic disturbance from both construction and routine activities, SRKWs are extremely unlikely to move to within 71 feet of the terminal and are therefore unlikely to be physically injured.

Impact pile driving of 18-inch concrete piles will generate noise levels of 170 dB_{rms} These values are above the 160 dB_{rms} disturbance threshold for impulse sound. The noise will attenuate

[2] Throughout this document, the reference value for dB_{rms} is 1 μPa.

to below the 160 dB_{rms} disturbance threshold with 152 feet. NMFS considers the chances of SRKWs to be that within that zone during the driving of the 18-inch concrete piles to be extremely unlikely because of the high levels of anthropogenic disturbance.

The WSF will use vibratory driving to install and remove several types of piles during the four phases of the project. Each phase will have one in-water work season, August 1 to February 15. Using the background noise level of 137 dB_{rms} in place of the 120 dB_{rms} disturbance threshold for continuous sound, the proposed vibratory pile installation and removal will produce sound levels that will disturb any SRKWs within certain distances of the sound source depending on the pile type and size. Depending on the type of pile, the sound will attenuate to background levels at approximately 500 feet and three miles from the ferry terminal. The WSF will monitor for marine mammals during pile driving. NMFS expects the WSF's monitoring will give them time to shut down pile -driving activities before SRKWs get within 1,000 feet of the terminal. Table 5, below, shows the number of days in each phase of the project that will have disturbance zones greater than 1,000 feet. This includes the disturbance from impulsive sound from the impact pile driving of the 30-inch steel piles.

Table 5. Duration (total days) of Periods with Disturbance Zones Greater than 1,000 Feet

Phase	Maximum Disturbance Zone	Days	In-water Work Window
1	3 miles	24	August 1 to February 15
2	1,522 feet	12	August 1 to February 15
3	3 miles	46	August 1 to February 15
4	1,522 feet	40	August 1 to February 15

NMFS expects that SRKWs exposed to sound above the 137 dB_{rms} background level will respond in ways similar to those documented for other mid-frequency hearing specialists. Southall et al. (2007) conducted a comprehensive literature review of the effects of sound on marine mammals. Behavioral responses in mid-frequency cetaceans from exposure to non-pulse sound can include moderate changes in speed of travel, direction, or dive profile, moderate to extended cessation or modification of vocal behavior, minor or moderate avoidance of the sound source, and change in group distribution (Southall et al. 2007).

The SRKWs exposed to the sound of vibratory pile driving may be displaced from the portion of the action area when noise levels are above the 137 dB background level. They may choose to avoid the area in favor of less "noisy" water further away from the Seattle Terminal. This is likely to result in lost forage opportunities in Elliot Bay. However, there are alternate foraging areas available. Hanson et al. (2010) found only six to 14 percent of Chinook salmon eaten by SRKWs in the summer were from Puget Sound, and the Chinook salmon in Elliot Bay are a small fraction of the Chinook salmon in Puget Sound. Therefore, the behavioral responses to increased noise from the pile removal will not reduce the reproductive success or increase the risk of physical injury or death for any individual SRKW.

The WSF will use tugs and barges to construct the project. Tugs are slow moving, follow a predictable course, do not target whales (in the manner that whale watching vessels do), and should be easily detected by SRKWs. Vessel strikes are extremely unlikely and any potential

encounters with SRKWs will be sporadic and transitory in nature. Most of the sound pressure produced by a tug towing a loaded barge will be below the level of peak hearing sensitivity for killer whales. When the tug is in motion, sound pressure levels will be transient and will attenuate to background levels a short distance from any one location. Therefore, the sound is unlikely to mask acoustic signals of biological significance to SRKWs.

Humpback Whale. As described in the Status of the Species section, NMFS does not have fine-scale information about humpback whale use of the project area, but their occurrence in the project area is uncommon. Based on this information, NMFS expects only a few individual humpback whales may forage or pass through the project vicinity when pile driving would occur. As described above, the impact pile -driving of the concrete steel piles will not exceed the injury threshold. Laughlin (in litt.) reported background noise levels at the Seattle Ferry Terminal within the functional hearing range for humpback whales of 141 dB_{rms}. Therefore, NMFS used 141 dB_{rms} as the threshold for this analysis.

The previous section described the different type of piles and the noise levels they will generate. Noise from the vibratory pile driving will attenuate to the 141 dB_{rms} background level within the distances shown in Table 6, below. As with SRKWs, NMFS expects the WSF's marine mammal monitoring plan will allow them to shut down pile driving activities before any humpback whales get within 1,000 feet of the terminal.

Table 6. Distances for Noise Attenuation 141 dB_{rms}

Phase	Maximum Disturbance Zone	Days	In-water Work Window
1	1.6 miles	24	August 1 to February 15
2	1,522 feet	12	August 1 to February 15
3	1.6 miles	46	August 1 to February 15
4	1,522 feet	40	August 1 to February 15

There are no studies that document the response of low-frequency sound specialists to pile driving. However, NMFS expects humpback whales exposed to sound above the 141 dB_{rms} background level to respond in ways similar to those documented for other low frequency hearing specialists exposed to underwater noise. Malme et al. (1983, 1984, and 1986) documented responses that range from slight deviation in course and deflection around the sound (migrating whales) to avoidance of the area (feeding whales). Therefore, NMFS anticipates that if humpback whales are exposed to sound from the vibratory pile -driving in the project vicinity, they will respond by avoiding the area. Similar to SRKWs, there are alternate foraging areas available. Therefore, the effects are anticipated to be short-term and will not reduce the reproductive success or increase the risk of injury or death of any individual humpback whale.

The WSF will use tugs and barges to construct the project. They are slow moving, follow a predictable course, and do not target whales. Therefore, vessel strikes are extremely unlikely and any potential encounters with humpback whales are expected to be sporadic and transitory in nature.

Contaminants

Listed fish near the Seattle Ferry Terminal are likely to be exposed to PAHs during pile removal. NMFS expects increased PAHs in the water column and sediments will remain within the area of increased suspended sediment caused by the project. Therefore, the water and substrate within 150 feet of the structure demolition will have increased levels of PAHs. The WSF will conduct 44 days of pile removal activity in Phase 1, 14 days in Phase 2, 87 days in Phase 3, and 126 days in Phase 4. NMFS expects that listed fish exposed to PAHs from the proposed action will experience immunosuppression and reduced growth which may lead to increased mortality.

Because they are shoreline-oriented and spend a greater amount of time within the action area, juvenile Chinook salmon will have the highest probability of exposure to PAHs. However, NMFS cannot discount the probability of exposure of adult and juvenile steelhead, adult Chinook salmon, and listed rockfish. Nevertheless, NMFS cannot predict the number of individual Chinook salmon, steelhead, and listed rockfish that will be exposed to PAHs because, the number of each species within the action area varies year- to- year, and NMFS cannot estimate the proportion of fish each year that will enter the impact zones. Overall, but the total number of fish should be small in relation to the total abundance of the affected populations.

Creosote-treated piles contaminate the surrounding sediment with PAHs up to two meters away from each pile (Evans et al. 2009). The removal of the creosote-treated piles mobilizes these PAHs into the surrounding water and sediments (Smith et al. 2008; Parametrix 2011). The project may also release PAHs directly from creosote-treated timber during the demolition of the terminal deck and from any of the piles that may break during removal (Parametrix 2011). The concentration of PAHs released into the surface water rapidly dilutes. Smith et al. (2008) reported concentrations of total PAHs of 101.8 μg/l up to 30 seconds after the removal of creosote piles and 22.7 μg/l up to 60 seconds after their removal. Romberg (2005) found a major reduction in sediment PAH levels three years after pile removal contaminated an adjacent sediment cap. However, Smith, et al. (2008) found that PAHs levels in the sediment after pile removal can remain high for six months or more.

There are two pathways for PAH exposure to listed fish species in the action area, direct uptake through the gills and dietary exposure (Lee et al. 1972; Karrow et al. 1999; Neff et al. 1976; Varanasi et al. 1993; Meador et al. 2006; McCain et al. 1990; Roubal et al. 1977). Fish rapidly uptake PAHs through their gills and food but also efficiently remove them from their body tissues (Lee et al. 1972; Neff et al. 1976). Juvenile Chinook salmon prey, including amphipods and copepods, uptake PAHs from contaminated sediments (Landrum and Scavia 1983; Landrum et al. 1984; Neff 1982). Varanasi et al. (1993) found high levels of PAHs in the stomach contents of juvenile Chinook salmon in the Duwamish estuary.

Salmonids are exposed to PAHs through their gills and through their digestive system, which results in immunosuppression and reduced growth. Karrow et al. (1999) characterized the immunotoxicity of creosote to rainbow trout (*Oncorhynchus mykiss*) and reported a lowest observable effect concentration for total PAHs of 17 μg/l. Varanasi et al. (1993) found greater immune dysfunction, reduced growth, and increased mortality compared to control fish. In order to isolate the effects of dietary exposure of PAHs on juvenile Chinook salmon, Meador et al.

(2006) fed a mixture of PAHs intended to mimic those found by Varanasi et al. (1993) in the stomach contents of field-collected fish. These fish showed reduced growth compared to the control fish.

In the long-term, the project will remove 7,400 tons of creosote-treated timber from Elliot Bay, including 2,178 creosote-treated timber piles and 1.75 acres of creosote-treated decking. This will improve the water and sediment quality over existing conditions near the terminal by reducing the levels of PAH contamination. However, approximately, 1,700 creosote-treated pile and 1.45 acres of creosote-treated decking will remain. The remaining piles will continue to release creosote into Elliot Bay at a rate of approximately 1,800 pounds per year.

Overwater Coverage

The project will not permanently change the amount of overwater cover but will allow the existing structure to remain for many years into the future. The structure will continue to cause a minor migration delay for fish traveling through the action area change the predation risks associated with overwater structures. The presence of the structure slightly reduces production of benthic and epibenthic macroinvertebrates in the action area that juvenile Chinook salmon and other listed fish prey upon. This slight reduction in prey base is not large enough to cause any physiological effects on individual fish. Although the proposed action does include some measures to improve light penetration, we are uncertain how effective this is likely to be in reducing the effects described above. Therefore, we expect the effects of overwater coverage described in the Baseline section (i.e. migration delays and reduced prey production) will continue at current levels in perpetuity. We do not expect these effects to be significant enough to impact population productivity or abundance.

Stormwater

The WSF will not add any PGIS as part of this project. They will treat the stormwater from the four acres of PGIS in the action area using wet vaults with oil-water separators underneath the trestle. The WSF will also sweep the terminal with a vacuum street sweeper quarterly. The WSF used the Highway Runoff Dilution and Loading model (HI-RUN) model to predict the post-treatment annual pollutant loading and effluent concentrations for the primary pollutants of concern; total suspended solids (TSS), total zinc, dissolved zinc, total copper, and dissolved copper (WSDOT 2009). The HI-RUN model uses a statistical procedure called Monte Carlo simulation, which is a method that estimates possible outcomes from a set of random variables. Using Monte Carlo simulation, the HI-RUN model calculates multiple model output scenarios by repeatedly sampling values for each input variable from computer-generated probability distributions. In this way, a probability distribution can be derived for the model output that indicates which predicted values have a higher probability of occurrence.

The HI-RUN analysis for the project showed substantial reductions in pollutant loadings and concentrations. Table 7 shows the existing and proposed concentrations of stormwater pollutants. These reductions will improve water quality conditions in the vicinity of the terminal over existing conditions. However, some pollutants such as dissolved copper and zinc will be present at levels slightly above those found to have adverse effects on salmon and steelhead in

freshwater (Hecht et al. 2007). Effects from exposure to metals such as copper and zinc may be less severe in saltwater, but significant uncertainty remains. In order to give the benefit of the doubt to the listed species, we will assume the exposure to these metals is occurring in freshwater. Any listed fish in the immediate vicinity of the discharge will suffer some adverse effects including reduced olfaction, increased predation, and reduced growth.

Table 7. Median Pre- and Post-Project Pollutant Concentrations for the Seattle Terminal

	Pollutant Concentrations (mg/L)				
	TSS	**TCu**	**DCu**	**TZn**	**DZn**
Existing	61.83	0.016	0.004	0.095	0.027
Proposed	5.63	0.005	0.003	0.023	0.016
Percent reduction	***91%***	***69%***	***25%***	***76%***	***41%***

2.4.2 Effects on Critical Habitat

Puget Sound Chinook Salmon

The action area contains the nearshore marine PCE of PS Chinook salmon critical habitat. The essential elements of this PCE include areas free of obstruction and excessive predation with (1) water quality and quantity conditions and foraging opportunities, including aquatic invertebrates and fishes, supporting growth and maturation, and (2) natural cover including submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels. The effects of the proposed action include beneficial effects of water quality and foraging elements of the nearshore marine PCE.

Removal of the creosote-treated timber and other piles will temporarily degrade water quality by releasing PAHs and other contaminants into the waters within 150 feet of the terminal. This will temporarily reduce prey quantity and quality. However, removing the 7,400 tons of creosote-treated timber from the action area will substantially improve water quality in the long-term. Similarly, the proposed action will result in better stormwater management resulting in an improvement in water quality. However, some stormwater pollutants, including copper and zinc will continue to be discharged into critical habitat resulting in a slight degradation of water quality. The project will not have a net long-term change in over-water cover but will allow the current adverse effects from the overwater structure (described above) to persist into the future. The terminal's overwater cover will continue to reduce the quality of this PCE into perpetuity.

Southern Resident Killer Whale

The proposed action affects critical habitat for SRKWs. As described above, the proposed action will have short-term adverse effects on Chinook salmon, the primary prey of SRKWs. These adverse effects include exposure to contaminants, some of which can bioaccumulate. This will

reduce the survivorship for exposed juvenile Chinook salmon and will increase the amount of contaminants in their tissues.

However, these effects to PS Chinook salmon are unlikely to have any measurable effect on the overall quantity and quality of SRKW prey. Only a very small percentage of the PS Chinook salmon ESU will experience these adverse effects, and these individuals will only spend a very short period of time within the action area. The PS Chinook salmon ESU comprises a small percentage of the SRKW diet. Hanson et al. (2010) found only six to 14 percent of Chinook salmon eaten by SRKWs in the summer were from Puget Sound. Therefore, NMFS concludes that both the short-term adverse effects and the long-term beneficial effects due to improved water quality on SR killer whale prey quantity and quality will be insignificant.

The sound from vibratory pile driving will interfere with SRKW passage. For example, exposed SRKWs are likely to redirect around the sound instead of passing through the area. However, as described above, the effects of the additional distance traveled is unlikely to cause a measureable increase in an individual's energy budget and thus will not have a measurable effect on the quality of this critical habitat feature, and the effects would therefore be temporary and minor.

2.5 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

NMFS does not expect any new, non-Federal activities within the action area because the area is already highly developed and additional development is unlikely or impossible. As described in section 2.3 Environmental Baseline, numerous non-Federal activities, including vessel traffic, stormwater discharges, CSO events, vessel discharges, and discharges from pier facilities, currently affect the action area. NMFS expects these activities to continue in perpetuity. These activities will degrade water quality and exert a negative influence on salmon and steelhead population abundance and productivity. They will also exert a negative influence on water quality feature of critical habitat for PS Chinook salmon and SRKW. Any future federal actions will be subject to section 7(a)(2) consultation under the ESA.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step of NMFS' assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the

conservation of the species. NMFS makes these assessments in full consideration of the status of the species and critical habitat (Section 2.2).

Puget Sound Chinook Salmon

The Puget Sound Chinook salmon ESU is at moderate risk of extinction. All Puget Sound Chinook populations are well below recovery escapement levels (Ford et al. 2011a). Most populations are also consistently below recovery spawner-recruit levels identified. Across the ESU, most populations have declined in abundance since the last status review in 2005, and trends since 1995 are mostly flat (Ford et al. 2011a).

Puget Sound Chinook salmon will be exposed to injurious levels of underwater noise from the impact pile driving. Impact pile driving of the 30-inch piles will subject the area within 1,657 feet to sound levels greater than or equal to 183dB and the area within 896 feet to sound levels greater than or equal to 187dB. Therefore, only a small percentage of juvenile Chinook salmon that use the action area will be exposed and experience the sublethal adverse effects described above. These sublethal effects to a very small proportion of the PS Chinook salmon that use the action area will not influence spatial structure, productivity, abundance or diversity in a way that diminishes viability of the affected populations of PS Chinook salmon.

Puget Sound Chinook salmon will be exposed to increased levels of PAHs in the water column during and immediately following pile removal activities. They will also be exposed to increased levels of PAHs in their prey items within the action area. Fish foraging in the area will be exposed to increased PAH levels in their prey from the start of construction to up to three years after. The exposed fish will likely experience immunosuppression and reduced growth which may lead to increased mortality. However, the area subjected to increased PAHs is a very small fraction of the total habitat available to juvenile PS Chinook salmon, and prey items from this area will make up a very small percentage of any individual fish's diet. Therefore, the effects from PAH exposure will influence spatial structure, productivity, abundance or diversity in a way that diminishes viability of the affected populations of PS Chinook salmon.

The removal of the creosote-treated timber will improve habitat conditions in the action area. Up to 7,400 tons of creosote-treated timber will be removed from the marine environment of Elliot Bay. This will lead to a long-term improvement to water quality. Overall, the effects of the proposed action, when added to the environmental baseline, status PS Chinook salmon, and cumulative effects, are not reasonably likely to appreciably reduce the abundance, productivity, spatial structure, or genetic diversity of the populations of PS Chinook salmon. The short-term effects of the action are too minor, even when added to threats that are part of the environmental baseline and any cumulative effects, to appreciably reduce the species' ability to survive and recover. The long-term beneficial effect of improved water quality will aid in species recovery by addressing a known limiting factor for the affected populations.

Puget Sound Steelhead

Puget Sound steelhead remain at moderate risk of extinction. From 2005 to 2009, geometric means of natural spawners indicate relatively low abundance (4 of 15 populations with fewer than 500 spawners annually) and declining trends (six of 16 populations) in natural escapement of winter-run steelhead throughout Puget Sound, particularly in southern Puget Sound and on the Olympic Peninsula (Ford et al. 2011a).

Puget Sound steelhead are larger than PS Chinook salmon when they enter the Sound. They spend very little time in nearshore areas and migrate rapidly to the ocean. While any individuals exposed to the stressors from this project will experience the same adverse effects as PS Chinook salmon, both the absolute number individuals and the percentage of the population that will be exposed to these stressors will be substantially lower. Therefore, the effects of the proposed action, when added to the environmental baseline, status PS steelhead, and cumulative effects, are not reasonably likely to appreciably reduce the abundance, productivity, spatial structure, or genetic diversity of the populations of PS steelhead. The short-term effects of the action are too minor, even when added to threats that are part of the environmental baseline and any cumulative effects, to appreciably reduce the species' ability to survive and recover. The long-term beneficial effect of improved water quality will aid in species recovery by addressing a known limiting factor for the affected populations.

Rockfish

The PSGB DPS of bocaccio is at high risk of extinction throughout all of its range, and the Puget Sound/Georgia Basin DPSs of yelloweye rockfish and canary rockfish are at moderate risk of extinction throughout all of their range (Drake et al. 2010). The ESA-listed rockfish individuals exposed to the stressors from this project will experience the same adverse effects as PS Chinook salmon. Larval rockfish, due to their extremely small size, are more likely to be killed by impacts pile driving and adult rockfish are more likely to be affected by contaminant exposure due to their year-round residence within Elliot Bay. While the proposed action may have some small effect on the species' abundance (by killing a relatively small number of larva) it is unlikely to kill juveniles using the nearshore or benthic habitats of the action area, or kill any adults. Therefore, it is not likely to have an appreciable effect on the likelihood of both survival and recovery of the species in the wild by effects on their productivity, diversity, or structure within the Puget Sound/Georgia Basin.

Southern Resident Killer Whales

Several limiting factors have been identified in the recovery plan for SRKW. These are quantity and quality of prey, toxic chemicals that accumulate in top predators, and disturbance from sound and vessels. Oil spills are also a risk factor. It is likely that multiple threats are acting together. Although it is not clear which threat or threats are most significant to the survival and recovery of SRKWs, all of the threats are important to address.

The entire SRKW DPS is a single population of 81 whales. The effective population size of less than 30 whales is very small, and this, in combination with the absence of gene flow from other

populations, may elevate the risk from inbreeding. A delisting criterion for the SRKW DPS is an average growth rate of 2.3 percent for 28 years (NMFS 2008). The current average growth rate of 0.3 percent, the risk of stochastic events, and genetic issues underscore the importance for the population to grow quickly.

A small number of SRKWs will be affected by pile driving activities. The most significant effect will be behavioral response, which can include changes in speed of travel, direction, or dive profile; moderate to extended cessation or modification of vocal behavior; minor or moderate avoidance of the sound source, and change in group distribution. Exposed killer whales may be displaced and precluded from foraging in the project vicinity, though there are alternate foraging areas available. Exposed individuals are also likely to alter their travel pattern around the sound instead of passing through the area. Any additional distance traveled is unlikely to cause a significant increase in an individual's energy budget, and the effects would be short-term. The likely behavioral responses, even considering potential for repeat exposures of individual whales, are not anticipated to reduce the reproductive success or increase the risk of injury or mortality for any individual SRKW.

As described above, the effects of the proposed action on prey quality or quantity will be insignificant. Additionally, vessels associated with the proposed action are extremely unlikely to affect SRKWs. Effects of the action, when added to threats that are part of the environmental baseline and any cumulative effects, will not appreciably reduce the species' ability to survive and recover.

Humpback Whales

The current abundance of humpback whales in the North Pacific is approximately 18,000 to 21,000 whales, of which approximately 2,000 individuals are part of the Washington/Oregon/California stock. Humpback whales are sighted with increasing frequency in the inside waters of Washington, primarily during the fall and spring months. However, occurrence is uncommon.

Based on the available information about foraging habits and space use of humpback whales inside waters of Washington, a few whales are likely to pass through and may forage in the project vicinity. The potential exposure of humpback whales to underwater sound may elicit behavioral responses within the range of previously documented responses by low-frequency hearing specialists to non-pulse sound. Based on a review of these documented responses, NMFS concludes that humpback whales exposed to sound from the vibratory pile driving may respond by avoiding Elliot Bay. Exposed humpback whales may be displaced and precluded from foraging in the project vicinity. However, there are alternate foraging areas available. Exposed humpback whales may also deflect around the sound instead of passing through the area. The likely short-term behavioral responses, even considering potential for repeat exposures of individual whales, will not reduce the reproductive success or increase the risk of injury or mortality for any individual humpback whale. Effects of the action, in addition to threats that are part of the environmental baseline or cumulative effects, will not appreciably reduce the species' ability to survive and recover.

Puget Sound Chinook Salmon Critical Habitat

NMFS has rated the conservation value of critical habitat in all of the nearshore of Puget Sound as "high." Increased contaminants will temporarily degrade PCE 5 (water quality) in the action area and reduce the quality of this PCE during construction and for three years after construction. The proposed action will improve the water quality component of this PCE in the long-term by reducing the input of PAHs from creosote-treated timber and stormwater pollutants. Overall, critical habitat will continue to function at current levels with a slight improvement in the future. Therefore, the proposed action will not significantly reduce the conservation value of critical habitat in the action area or at the ESU scale.

Southern Resident Killer Whale Critical Habitat

The proposed action's effect to SRKW critical habitat will be both unmeasurable and temporary. Critical habitat will continue to function at current levels. Therefore, the proposed action will not significantly reduce the conservation value of critical habitat in the action area or at the DPS scale.

2.7 Conclusion

After reviewing the current status of the listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon, PS steelhead, PSGB DPSs of rockfish, SRKWs, or humpback whales. Additionally, the action will not destroy or adversely modify PS Chinook salmon or SRKW critical habitat.

2.8. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a permit or exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by regulation to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(b)(4) and Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA, if that action is performed in compliance with the terms and conditions of this incidental take statement.

NMFS is not including an incidental take authorization for marine mammals at this time because the incidental take of marine mammals has not been authorized under section101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments. Following issuance of such regulations or authorizations for marine mammals, NMFS may append this Opinion to include an incidental take statement for marine mammals.

2.8.1 Anticipated Amount or Extent of Incidental Take

Effects of the action will coincide with the presence of PS Chinook salmon, PS steelhead, and listed rockfish species such that the incidental take is reasonably certain to occur. The take described below cannot be accurately quantified as a number of fish because NMFS cannot predict, using the best available science, the number of individuals of listed fish species that will be exposed to these stressors. Furthermore, even if NMFS could estimate that number, the manner in which each exposed individual responds to that exposure cannot be predicted.

In circumstances where NMFS cannot estimate the amount of individual fish that would be injured or killed by the effects of the proposed action, NMFS assesses the extent of take as an amount of modified habitat and exempts take based only on that extent. This extent is readily observable and therefore suffices to trigger reinitiation of consultation, if exceeded and necessary (see H.R. Rep. No 97-567, 97th Cong., 2d Sess. 27 (1982). The extent of injurious levels of underwater noise will be determined by monitoring the noise levels of impact pile driving at approximately 10 meters (or a similar distance). The extent of exposure to contaminants will be determined by monitoring for turbidity at 150 feet from the in-water activity.

NMFS exempts take for the following:

1. exposure to injurious levels of underwater noise from impact pile driving for the area within 1,657 feet of the Seattle Ferry Terminal for listed fish less than two grams, and the area within 896 feet for listed fish two grams or greater as calculated using the single strike Peak, SEL, and RMS noise levels, the number of strikes per day, and transmission loss according to the practical spreading model; and

2. exposure to contaminants in the water column within 150 feet of the terminal for a total of 271 days, over four in-water work seasons and exposure to contaminants in prey items within 150 feet of the terminal from the start of in-water work in 2015 to three years after the completion of the in-water work. The extent of take will be exceeded if turbidity exceeds 5 nephelometric turbidity units (NTUs) over background turbidity at 150 feet from the in-water work.

2.8.2 Effect of the Take

In Section 2.7, NMFS determined that the level of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitats.

2.8.3 Reasonable and Prudent Measures and Terms and Conditions

"Reasonable and prudent measures" (RPMs) are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

The USDOT shall minimize take of listed Puget Sound rockfish species, PS Chinook salmon, and PS steelhead. These reasonable and prudent measures are necessary and appropriate to minimize the take of these species. The USDOT shall:

1. minimize incidental take from impact pile driving; and
2. minimize incidental take from contaminants.

Terms and Conditions

1. To implement RPM 1, the USDOT shall:

   a) Submit an underwater noise monitoring plan as described in the Underwater Noise Monitoring Plan (WSDOT 2012) template prior to the start of construction;
   b) Monitor underwater noise as described in the NMFS-approved Underwater Noise Monitoring Plan;
   c) Submit the results of the underwater noise monitoring to NMFS by June 1 after each in-water work window (August 1 to February 15);
   d) Use a vibratory hammer to drive piles to the maximum extent practicable; and
   e) Use a confined or unconfined bubble curtain during impact pile driving of steel piles (except if driving in water that is less than 3 feet deep).

2. To implement RPM 2, the USDOT shall:

   a) Place a new sediment cap over all areas of sediment within the footprint of the project as required by the State of Washington's Sediment Management Standards (SMS);
   b) Test areas within 200 feet of sediment disturbing activities for contaminants before and after construction and place a sediment cap over areas as required by the State of Washington's Sediment Management Standards (SMS);
   c) Conduct all in-water work between August 1 and February 15;
   d) Monitor turbidity at 150 feet during in-water work to ensure the extent of take is not exceeded;
   e) Install floating booms during the demolition and removal of creosote-treated timber in or over the water;
   f) Equip the floating booms with absorbent pads to contain any oil sheens;
   g) Submit the following to NMFS: (1) the DMMP Compliance Sediment Characterization Report or equivalent, (2) the results of the pre- and post-project contaminant sampling of marine sediments in the project area, (3) a turbidity monitoring report by April 1 following each construction season, (4) a contaminants monitoring report which will include the BMPs implemented to control the release of contaminates into marine waters and the disposition of creosote-treated wood and contaminated sediments; and
   h) Report any violations of the WDFW's Hydraulic Project Approval or Ecology's requirements to NMFS.

2.9. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

NMFS has identified the following measures to further minimize or avoid adverse effects to listed species:

1. Use translucent structural glass or another light-penetrating surface for as much of the overwater portions of the Seattle Ferry Terminal as possible; and
2. Remove all creosote-treated timber from the Seattle Ferry Terminal.

2.10 Reinitiation of Consultation

As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the agency action on listed species or designated critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat not considered in this opinion, or 4) a new species is listed or critical habitat designated that may be affected by the action.

2.11 "Not Likely to Adversely Affect" Determinations

The southern DPS of green sturgeon have been documented in Puget Sound, but are uncommon. Puget Sound has a long history of commercial and recreational fishing and fishery-independent monitoring of other species that use habitats similar to this species, but very few have been observed. NMFS believes it is very unlikely that green sturgeon occur in the action area, and even more improbable that they will be exposed to the effects of this project. Therefore, NMFS concludes that the effects to the southern DPS green sturgeon are discountable.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The consultation requirement of section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual,

cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the Federal action agency and descriptions of EFH contained in the fishery management plan developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce for groundfish (PFMC 1998a), coastal pelagic species (PFMC 1998b), and Pacific Coast salmon (PFMC 1999).

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for groundfish, coastal pelagic species, and Pacific Coast salmon, but does not occur within a Habitat Area of Particular Concern.

3.2 Adverse Effects on Essential Fish Habitat

NMFS determined that the proposed action will have adverse effects to EFH designated for groundfish, coastal pelagic species, and Pacific Coast salmon, based on information provided in the BA and the analysis of effects presented in the ESA portion of this document. NMFS determined that the proposed action will adversely affect EFH by temporarily increasing the levels of underwater noise from impact pile driving within 1,657 feet, and by elevating contaminant levels within 150 of the Terminal, respectfully. The EFH will be improved by the removal of 7,400 tons of creosote-treated timber.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS expects that full implementation of these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in Section 3.2 above, approximately 3 square miles of designated EFH for Pacific coast salmon. These conservation recommendations are a subset of the ESA terms and conditions. NMFS recommends that USDOT conduct the following actions:

1. Submit an underwater noise monitoring plan as described in the Underwater Noise Monitoring Plan (WSDOT 2012) template prior to the start of construction;

2. Monitor underwater noise as described in the NMFS-approved Underwater Noise Monitoring Plan;

3. Submit the results of the underwater noise monitoring to NMFS by June 1 after each in-water work window;

4. Use a vibratory hammer to drive piles to the maximum extent practicable;

5. Use a confined or unconfined bubble curtain during impact pile driving of steel piles (except if driving in water that is less than 3 feet deep);

6. Place a new sediment cap over all areas of sediment within the footprint of the project as required by the State of Washington's Sediment Management Standards (SMS);

7. Test areas within 200 feet of sediment disturbing activities for contaminants before and after construction and place a sediment cap over areas with increased contaminant levels;

8. Conduct all in-water work between August 1 and February 15;

9. Monitor turbidity at 150 feet during in-water work;

10. Install floating booms during the demolition and removal of creosote-treated timber in or over the water;

11. Equip the floating booms with absorbent pads to contain any oil sheens;

12. Submit the following to NMFS: (a) the DMMP Compliance Sediment Characterization Report or equivalent, (b) the results the pre- and post-project contaminant sampling of marine sediments in the project area, (c) a turbidity monitoring report by April 1 following each construction season, (d) a contaminants monitoring report which will include the BMPs implemented to control the release of contaminates into marine waters and the disposition of creosote-treated wood and contaminated sediments; and

13. Report any violations of the WDFW's Hydraulic Project Approval or Ecology's requirements to NMFS.

14. Use translucent structural glass or another light-penetrating surface for as much of the overwater portions of the Seattle Ferry Terminal as possible; and

15. Remove all creosote-treated timber from the Seattle Ferry Terminal.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Federal agency must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations, unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(1)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The USDOT must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH conservation recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) (Data Quality Act) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Biological Opinion addresses these Data Quality Act (DQA) components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. These users include three agencies of the Federal government (NMFS, USDOT, and USACE), the WSDOT, the residents of the Cities of Bremerton and Seattle, King and Kitsap Counties, the State of Washington, and the general public.

Individual copies were provided to the above-listed entities. This consultation will be posted on NMFS Northwest Region website (http://www.nwr.noaa.gov). The format and naming adheres to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

4.3.1 Information Product Category--Natural Resource Plan.

4.3.2 Standards

This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01, et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

4.3.3 Best Available Information

This consultation and supporting documents use the best available information, as referenced in the Literature Cited section. The analyses in this Opinion/EFH consultation contain more background on information sources and quality.

4.3.4 Referencing

All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

4.3.5 Review Process

This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with Northwest Region ESA quality control and assurance processes.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Washington Fish and Wildlife Office
510 Desmond Dr. SE, Suite 102
Lacey, Washington 98503

FEB 18 2014

In Reply Refer To:
01EWFW00-2013-F-0262

Lindsey Handel
Federal Highway Administration
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711 South Capitol Way
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Dan Drais
Federal Transit Administration
Region 10
915 Second Avenue, Suite 3142
Seattle, Washington 98174

Dear Ms. Handel and Mr. Drais:

This letter transmits the U. S. Fish and Wildlife Service's Biological Opinion (Opinion) based on our review of the proposed Washington State Ferries Seattle Multimodal Terminal at Colman Dock Project, located in King County, Washington, and its effects on the bull trout (*Salvelinus confluentus*), designated bull trout critical habitat, and the marbled murrelet (*Brachyramphus marmoratus*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). The Federal Highway Administration and Federal Transit Administration January 7, 2013, letter request for formal consultation for bull trout was received on January 8, 2013, and was accompanied by a reference biological assessment form (Form) dated January 2013. An additional Form was received on March 20, 2013. Your request for formal consultation for marbled murrelet was received on May 15, 2013.

However, based upon subsequent revisions to the project description, received on June 26, 2013, informal consultation has been completed for the marbled murrelet. The Opinion includes concurrence with your initial "may affect, not likely to adversely affect" determination for marbled murrelet. The rationale for this concurrence is provided in the concurrence section of the Opinion.

This Opinion is based on information provided in Biological Assessment Forms, Marbled Murrelet Monitoring Plans (January 2013, March 2013), and additional information and reports as listed in the consultation history, including but not limited to: *Technical Memorandum – Preliminary Results of Elliott Bay Seawall Fish Survey* (SDOT 2011a), *2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 1* (WSF 2005a), *2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 2 (Appendices)* (WSF 2005b), *Elliott Bay Seawall Project - Survey of Aquatic Habitats and Biological Communities Along Elliott Bay Seawall* (SDOT 2011b), *Sediment Analysis Report – Seattle Multimodal Terminal at Colman Dock Project* (WSF 2012b), revised pile driving information and tables (June 26 and 27, 2013), meetings with the FTA-WSF project team on December 3, 2012, and other sources of information. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

If you have any questions about the enclosed Opinion or our shared responsibilities under the Endangered Species Act, please contact Julie Hampden at (360) 753-8570, or Emily Teachout at (360) 753-9583, of this office.

Sincerely,

FML Ken S. Berg, Manager
Washington Fish and Wildlife Office

Enclosure(s)

cc:
WSDOT, Seattle, WA (G. Ritchotte)

Endangered Species Act - Section 7 Consultation

BIOLOGICAL OPINION

U.S. Fish and Wildlife Service Reference:
01EWFW00-2013-F-0262

Washington State Ferries Seattle Multimodal Terminal at Colman Dock Project

King County, Washington

Agencies:

Federal Highway Administration
Federal Transit Administration

Consultation Conducted By:

U.S. Fish and Wildlife Service
Washington Fish and Wildlife Office
Lacey, Washington

Ken S. Berg, Manager
Washington Fish and Wildlife Office

Feb. 18, 2014
Date

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LIST OF ACROYNMS AND ABBREVIATIONS

Act	Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*)
BA	Biological Assessment
BMP	best management practices
CSL	Cleanup Screening Levels
CSO	combined sewer overflow
CUL	clean-up levels
DCu	dissolved copper
DMMP	Dredged Material Management Plan
DO	Dissolved oxygen
DZn	dissolved zinc
Ecology	Washington Department of Ecology
FHWA	Federal Highway Administration
FMO	foraging, migration, and overwintering
Form	biological assessment form
FTA	Federal Transit Administration
GHG	greenhouse gases
HPU	Hydraulic Power Unit
MHHW	mean higher high-water
MLLW	mean lower low-water
MTCA	Model Toxics Control Act
NTU	Nephelometric Turbidity Units
Opinion	Biological Opinion
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyls
PCE	primary constituent element
PGIS	pollutant-generating impervious surface
POF	passenger-only ferry
Project	Seattle Multimodal Terminal at Colman Dock Project
RPM	reasonable and prudent measures
SEL	Sound Exposure Level
Service	U.S. Fish and Wildlife Service
Services	U.S. Fish and Wildlife Service and National Marines Fisheries Service
SMS	Washington State Sediment Management Standards
SPL	Sound Pressure Level
SDOT	Seattle Department of Transportation
SPU	Seattle Public Utilities
SQS	Sediment Quality Standards
TCu	total copper
TL	transmission loss
TSS	total suspended solids
TZn	total zinc
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

INTRODUCTION

This letter transmits the U. S. Fish and Wildlife Service's (Service) Biological Opinion (Opinion) based on our review of the proposed Washington State Ferries (WSF) Seattle Multimodal Terminal at Colman Dock Project (Project) located in King County, Washington, and its effects on the bull trout (*Salvelinus confluentus*), designated bull trout critical habitat, and the marbled murrelet (*Brachyramphus marmoratus*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). The Federal Highway Administration (FHWA) and Federal Transit Administration (FTA) January 7, 2013, letter request for formal consultation for bull trout was received on January 8, 2013, and was accompanied by a reference biological assessment (BA) form (Form) dated January 2013. An additional Form was received on March 20, 2013. A request for formal consultation for marbled murrelet was received on May 15, 2013.

This Opinion is based on information provided in BA Forms, Marbled Murrelet Monitoring Plans (January 2013, March 2013) additional information and reports as listed in the consultation history, including but not limited to, *Technical Memorandum – Preliminary Results of Elliott Bay Seawall Fish Survey* (SDOT 2011a), *2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 1* (WSF 2005a), *2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 2 (Appendices)* (WSF 2005b), *Elliott Bay Seawall Project - Survey of Aquatic Habitats and Biological Communities Along Elliott Bay Seawall* (SDOT 2011b), *Sediment Analysis Report – Seattle Multimodal Terminal at Colman Dock Project* (WSF 2012b), revised pile driving information and tables (June 26 and 27, 2013), meetings with the FTA-WSF project team on December 3, 2012, and other sources of information. A complete record of this consultation is on file at the Washington Fish and Wildlife Office in Lacey, Washington.

CONSULTATION HISTORY

February 16, 2012 – WSF staff presented preliminary information on the project at a pre-BA meeting with the Service.

November 14, 2012 – The preliminary draft Form was received via email by the Service.

November 29, 2012 – Comments on the preliminary draft Form were transmitted via email from the Service to WSF.

December 3, 2012 – The Service met with the Project Team to discuss information needs for the BA.

December 3, 2012 – Supplemental information and documents provided to the Service via email including Technical Memorandum – Preliminary Results of Elliott Bay Seawall Fish Survey (SDOT 2011a), 2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 1 (WSF 2005a), 2005 South Cap Monitoring Report – Seattle Ferry Terminal Part 2 (Appendices) (WSF 2005b), Elliott Bay Seawall Project - Survey of Aquatic Habitats and Biological Communities Along Elliott Bay Seawall (SDOT 2011b).

January 7, 2013 – A letter requesting formal consultation and an accompanying Form was received by the Service on January 8, 2013.

January 15, 2013 – The Form was transmitted to the Service via email.

February 5, 2013 – Comments on the Form were transmitted via email from the Service to WSF.

March 20, 2013 – A response to comments, revised Form, revised noise calculations appendices, and revised marbled murrelet monitoring plan were provided to the Service via email.

March 26, 2013 – A sediment analysis report (WSF 2012b) was provided to the Service via email.

April 16, 2013 – A request from the Service to WSF for more information regarding pile materials was sent via email. A response from WSF was received by the Service via email.

May 15, 2013 – The Service advised, via email, that the WSF and FTA consider requesting formal consultation for the marbled murrelet based on information contained in the noise analysis. Clarification on the number and type of piles per phase, and timing of pile installation, was also requested. The FTA responded via email with a letter requesting formal consultation for the marbled murrelet.

June 27, 2013 – WSF provided revised pile driving information via email. The Service requested information on timing of pile installation. The requested information was received the same day. Based on the revised information, the Service proceeded with informal consultation for the marbled murrelet and initiated formal consultation for the bull trout.

CONCURRENCE

The Project (Figure 1) will replace the north trestle portion of the Seattle Terminal at Colman Dock as well as the main terminal building and auxiliary structures located on the trestle. The vehicular transfer span, overhead loading, and some marine components of Slips 2 and 3 will also be replaced. Passenger-only ferry (POF) facilities will be replaced at pier 50. The new POF facility will be connected to the future terminal building and the Marion Street pedestrian bridge by an overhead walkway to reduce the potential for pedestrian and vehicle conflict.

Figure 1. Project vicinity

Construction will occur in four phases over approximately seven years, with four seasons of in-water work between August 1 to February 15. An overview of the project is provided below and in Figure 2.

Phase 1 will begin in 2015 and will last approximately 12 months, with one season of in-water work. The existing POF slip, Slip 3, and wingwalls will be removed and the South Trestle will be partially demolished. Also during Phase 1, a platform for the POF slip will be constructed on the south side of the trestle. About 38,590 ft^2 of new trestle with concrete and steel piles and decking will be built to the south. Slip 3 will be reconstructed during this phase of the project. The Slip 3 transfer span will be replaced with a new standard hydraulic transfer span and a new bridge seat, and the overhead loading structures will be replaced. The two timber dogleg dolphins between Slips 2 and 3 will be replaced by two new steel pile dolphins. A temporary dolphin will be built to allow vessels to dock at Slip 2 during construction. Work will occur from the existing trestle as well as from up to two barges measuring 80 ft by 200 ft (16,000 ft^2 total) on the south side of the trestle. Barges will be anchored with spuds extending to the sea floor. Once the new section of trestle has been built a sediment cap will be placed underneath the structure.

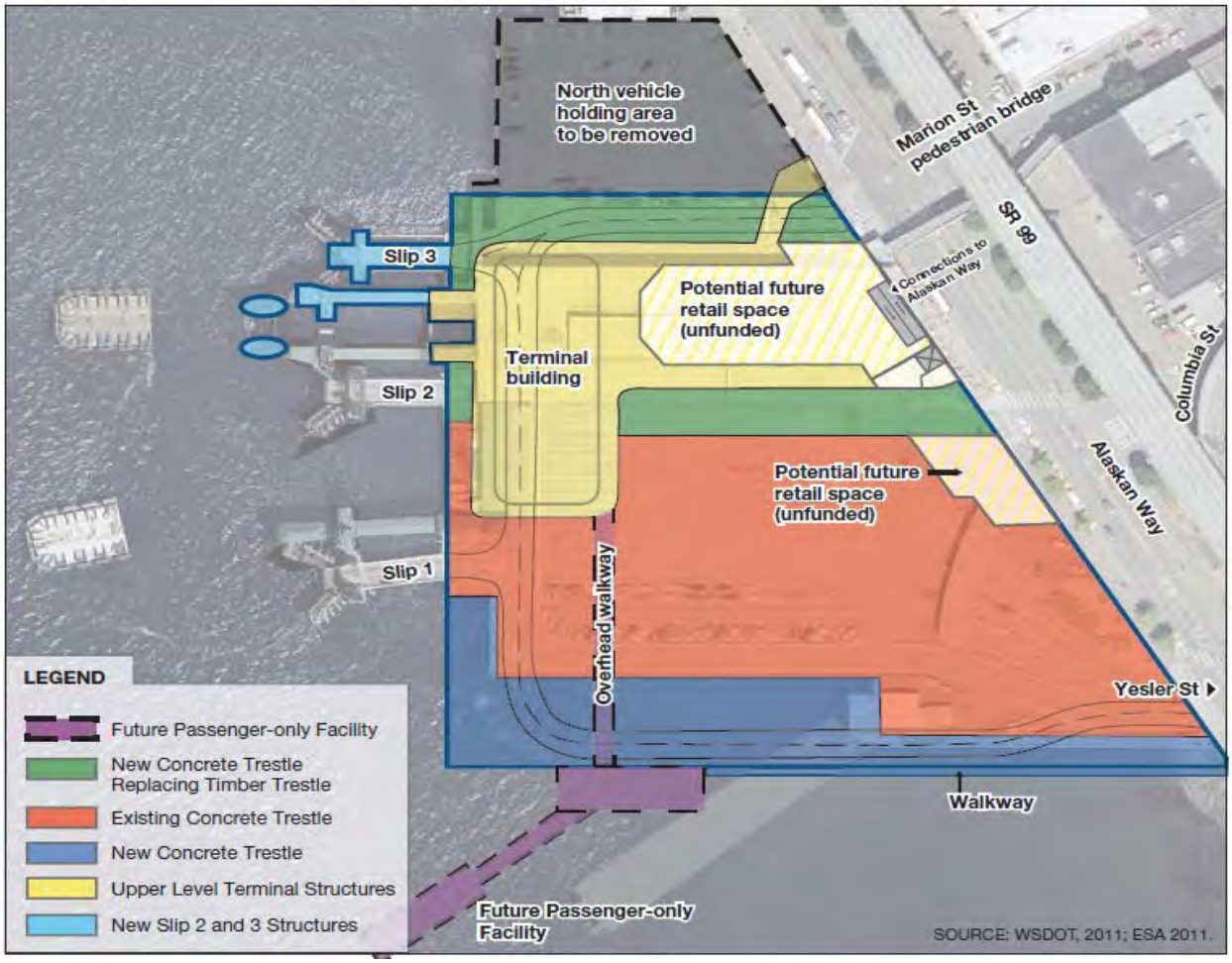

Figure 2. Overview of Project Components.

Phase 2 will take approximately 28 months during 2016-2018, with one season of in-water work. The Slip 1 walkway will be removed, as well as a portion of the trestle and piles underneath the new terminal building site. The pile foundation will be installed for the new terminal, and a third of the new terminal building will be constructed. The removed section of trestle will be replaced with a concrete trestle, the Slip 1 connector ramp will be reinstalled, and the elevated POF walkway will be constructed.

Phase 3 will last about 24 months during 2018-2020, with one season of in-water work. The entire terminal building will be demolished, and a portion of timber trestle will be replaced with a new concrete trestle. Two temporary vehicle bridges will be used during construction. The center third of the terminal building will be reconstructed and the Slip 2 vehicle and overhead spans reinstalled. Temporary pedestrian bridges will link the Marion Street overpass and Slip 3 to the new terminal building.

Phase 4 will last approximately 25 months during 2019-2021, with one season of in-water work. The remaining portion of the north trestle will be demolished and fill will be removed. Once the fill has been removed and the area restored an existing bulkhead will be removed. The final third of the new terminal building will be constructed, and temporary pedestrian bridges will be replaced with permanent structures.

WSF's standard Construction Minimization Measures, are described in detail in their BA Reference Section 2.3 (p. 73) and are incorporated here by reference. Additional best management practices (BMP) that will be incorporated into the project are highlighted on pages 18 and 19 of the Form and are hereby incorporated by reference.

The Project will construct a pier large enough to accommodate the new 144-vehicle ferries that will replace existing 124-vehicle ferry boats. These larger vessels will allow for additional passengers and vehicles due to their increased volume, but the level of ferry service (i.e. trips per day), and the level of service provided by associated roadways, and daily traffic patterns, are not projected to change significantly over time.

Sufficient information has been provided to determine the effects of the Project to marbled murrelet and to conclude whether the Project is likely to adversely affect that species. Our conclusion is based on information in the Forms and Reference BA, successful implementation of the BMPs and Minimization Measures, and the following rationale:

<u>Marbled Murrelet</u>

Low numbers of marbled murrelets occur in Elliott Bay year round. Habitat in the immediate vicinity of the Colman Dock is highly degraded, prey resources are limited, and human disturbance is persistent. These factors reduce the likelihood of marbled murrelet presence in the project area.

Elevated Underwater Sound

The Project will install numerous concrete and steel piles and steel shafts (see project description section) which will create elevated underwater sound levels. The Project will deploy bubble curtains during impact pile driving of steel piles and implement underwater sound, and marbled murrelet, monitoring. During impact pile driving of concrete piles, a pile cushion of similar device will be used to minimize underwater sound levels. These minimization measures result in smaller areas of potential effect, and an increased likelihood that injury of marbled murrelets can be avoided. However, the potential of exposure to marbled murrelets to underwater sound levels that cause either injury or significant behavioral effects remains.

To determine whether these effects can be expected, and if so, whether they will be significant, we first calculate an area of effect based on predicted sound levels from pile driving activity using information provided in the BA and subsequent submittals. Next, we overlay the calculated area of effect with data on densities of marbled murrelets in marine waters to determine probability of exposure.

Summer Period

To determine the cumulative probability of exposing one or more marbled murrelets to injurious sound levels during the summer (April to September), we calculated a 27 m (88 ft) area of potential auditory injury (area exceeding the 202 dB (Sound Exposure Level) SEL) from piling installation. This area was subsequently combined with seasonal density statistics, an assumed effectiveness percentage for marbled murrelet monitoring (78 percent), the number of piles driven within the summer season for the project in its entirety (198 piles), and the land mass within the area of effect.

We determined there was a mean probability of exposure to injurious sound levels of 0.0409. Based on this analysis, we consider during the summer extremely unlikely and therefore discountable.

Winter Period

We applied the same analysis for work during the winter. The cumulative probability for exposing one or more marbled murrelets to potential auditory injury as a result of sound levels exceeding 202 dB_{SEL} within the area of effect during pile driving activities in the winter is 0.1514 for the lower 95th confidence interval and 0.2352 for the mean confidence interval.

As such, we expect there is the potential for auditory injury. Due to the very low occurrence of birds in the area, we calculated the probability for exposure of one, two, three, etc. groups of birds. The mean probability of exposing one or fewer bird groups is 0.2321, the mean probability for exposure of two bird groups is 0.0001, and the probability of exposing three or more groups is zero.

Next we calculated the area surrounding the piles where there is potential for exposure, which is limited to within 27 m (88 ft) of the pile. Given the presence of the existing Colman Dock and terminal structures, much of the potential area of exposure for any given pile, lies beneath the physical footprint of these existing overwater structures. Similarly, given the highly industrialized nature of the shoreline, much of the remaining area of exposure for any given pile, lies between existing pier structures. Marbled murrelets are not anticipated to be present immediately adjacent to or underneath the ferry terminal structures or surrounding overwater structures. Given the small size of the potential impact area (27 m, 88 ft), the large footprint of Colman Dock, the highly industrialized character of the shoreline (between or under piers), the limited daily duration of pile driving (up to 4 hours), the implementation of onshore monitoring throughout pile driving and proofing activities, the lack of forage fish spawning habitat within the impact area, and the persistent boat and ferry traffic in the injury area, the likelihood of a foraging group occurring within this area during construction is considered extremely unlikely and therefore discountable.

In-Air Masking

The in-air sound produced by impact pile driving can result in masking effects, (i.e. producing sound levels sufficiently high that communication between birds becomes inhibited). For in-air masking, steel, concrete reinforced steel, and concrete piles that will be installed with an impact hammer are considered. Based upon recent guidance (USFWS 2013), for most projects in Puget Sound, the area where marbled murrelets are potentially be affected by masking during pile driving would extend up to 168 m (551 ft) from 36-inch diameter piles and up to 42 meters (138 ft) from 24-inch diameter piles being proofed or driven using an impact hammer. For this project, given the range of pile sizes and materials that will be impact driven, it is assumed masking will occur between 42 and 168 m from pile driving activities for each of the four in-water work seasons associated project: 55 days during the 2015-2016 in-water work window, 12 days for the 2016-2017 in-water work window, 46 days for the 2018-2019 in-water work window, and 40 days for the 2019-2020 in-water work window.

Though marbled murrelets will be exposed to the masking effects of in-air noise from impact pile driving, the response of marbled murrelets to the in-air masking effects are not expected to result in measureable effects because peak foraging periods will not be impeded and short-term, intermittent interference with communication is not expected to result in measureable effects to individual marbled murrelets.

Operational Noise

In the long term, operation of the ferry terminal will result in on-going noise impacts within the action area associated with ferry boats. Despite an increase in anticipated ridership in the future, there is not a direct correlation between increased ridership and increased ferry trips for the following reason: the multimodal functions of the new terminal will allow for more efficient use of the ferry by non-vehicle commuters and public transit users, and the larger ferries that will be supported by the new terminal facilities will accommodate a larger number of vehicles per trip, limiting the total number of ferry trips per day to levels similar to current conditions. Noise

levels associated with the new ferries are similar to and possibly lower than current ferry boats. As a result, noise levels generated by ferry traffic within the action area are anticipated to remain relatively constant, but the location of the noise will change from the existing ferry terminal and route to the proposed terminal location and route. This change in location will not measurably alter baseline conditions or generate new impacts to marbled murrelets within the action area. Therefore, noise effects resulting from ongoing ferry operations are considered insignificant.

Temporary Exposure to Elevated Turbidity, Contaminants and Degraded Water Quality

Installation and removal of piles and the bulkhead under the north trestle will result in temporary impacts to water quality. Based on the Form this increased turbidity and/or resuspended contaminants surrounding the piles will be confined to within 60 ft of the piles. Sediments that are resuspended during dredging under the north trestle will be confined behind an existing bulkhead. As a result, direct exposure to suspended sediments and elevated contaminant concentrations would also be limited to within 60 ft of the bulkhead during its removal.

Marbled murrelet foraging habitat within 60 ft of Colman Dock is expected to be highly degraded and very limited given the lack of suitable forage fish spawning habitat in this area, the high density of existing overwater structures, and the high level of disturbance generated by boat and ferry traffic. As a result, potential for short or long-term exposures to elevated concentrations of contaminants in the water column or via the food web at this location are considered discountable. Due to the small size of the potentially affected area relative to available forage resources and habitat within the action area, the existing cap over the south trestle helping to contain any residual contamination, and the proposed post-construction capping of the north trestle that will provide the same containment benefits, we do not expect the marbled murrelet prey base to be affected to a measurable extent.

Stormwater

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998). Stormwater discharges are indirect effects of the action.

The project will provide basic treatment for all pollutant-generating impervious surface (PGIS) in the project area, resulting in a large decrease of pollutant loads (Table 1). Project pollutant loads and concentrations were analyzed using the HI-RUN model approved by WSDOT, and the U.S. Fish and Wildlife Service and National Marine Fisheries Service (jointly the Services) per the 2009 Memorandum of Agreement. Sweeping was not factored into this analysis, so the results provided below likely overestimate pollutant loading.

Table 1. Median Pre- and Post-Project Pollutant Loads

TDA	Scenario	Pollutant Load (lb/yr)				
		TSS[1]	TCu[2]	DCu[3]	TZn[4]	DZn[5]
#4-24	Existing	1608	0.407	0.095	2.48	0.712
	Proposed	148	0.13	0.079	0.61	0.41
	Percent reduction	***91%***	***68%***	***17%***	***75%***	***42%***

[1] TSS - total suspended solids
[2] TCu - total copper
[3] DCu - dissolved copper
[4] TZn - total zinc
[5] DZn - dissolved zinc

End-of-pipe concentrations of pollutants of concern will also be similarly reduced by 25 percent for dissolved copper DCu to over 90 percent for total suspended solids TSS (Table 2).

Table 2. Median Pre- and Post-Project Pollutant Concentrations

Scenario	Pollutant Concentrations (mg/L)				
	TSS	TCu	DCu	TZn	DZn
Existing	61.83	0.016	0.004	0.095	0.027
Proposed	5.63	0.005	0.003	0.023	0.016
Percent reduction	***91%***	***69%***	***25%***	***76%***	***41%***

As a result, the Project is expected to improve water quality in the immediate vicinity of the project as a result of stormwater runoff treatment.

There is potential for direct exposure to stormwater constituents for marbled murrelets since they are potentially present within Elliott Bay; however, measurable effects resulting from the project are not expected and are therefore considered insignificant. Similarly, stormwater-related indirect effects to marbled murrelets resulting from effects to forage fish and other prey species resulting from exposure to stormwater discharges will not be measurable and are therefore considered insignificant.

In conclusion, the anticipated project effects (construction-related and operational noise, temporary turbidity, contaminant resuspension, water quality degradation, and stormwater discharges) will be either discountable or insignificant for the marbled murrelet.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

The WSF, FHWA, and the FTA propose to replace the north trestle portion of the Seattle Terminal at Colman Dock, as well as the main terminal building and auxiliary structures located on the timber trestle. The vehicular transfer span, overhead loading, and some marine components of Slips 2 and 3 will also be replaced. POF facilities will be replaced at pier 50. The new POF facility will be connected to the future terminal building and the Marion Street pedestrian bridge by an overhead walkway to reduce the potential for pedestrian and vehicle conflict. The Seattle Terminal is located in the City of Seattle, King County, Washington. The terminal is located in Township 24 North, Range 4 East, Section 6, in Elliott Bay (Figure 1). The Seattle Terminal is located at Colman Dock, Piers 50 and 52, on the Seattle waterfront.

The Seattle Terminal is WSF's largest ferry terminal and supports transportation across Puget Sound between downtown Seattle and communities in Kitsap County. It serves general and commercial purpose traffic, high occupancy vehicles, transit, bicyclists and pedestrians. The Seattle/Bainbridge route is WSF's busiest passenger route and has the largest annual ridership. In 2011, 8.5 million riders used the Seattle Ferry Terminal, including 4.2 million foot passengers.

The project's purpose is to preserve the role of the Seattle Ferry Terminal as a regional multimodal transportation hub, providing safe, reliable, and effective service for transit, general and commercial purpose transportation, high occupancy vehicles (vanpool/carpools), pedestrians, and bicyclists. The structures replaced by the project are at the end of their service life. They are deteriorating and seismically vulnerable, and the Slip 3 overhead loading structure does not meet the requirements of the Americans with Disability Act. The reconfigured facility will preserve the level of vehicle holding available today, enhance safety and operational efficiency, and provide better connections to transit. The new structures will be designed to meet current seismic bridge and building code requirements. The project will also address safety concerns related to conflicts between vehicles and pedestrian traffic and operational inefficiencies.

Project construction will occur in four phases over approximately seven years (approximately 86 months), with four seasons of in-water work. In-water work will only occur during the in-water work window for Elliott Bay, which is August 1 to February 15. The following discussion describes the main elements of the work by phase. An overview of the project components is provided in Figure 2 above.

<u>Phase 1</u>

Phase 1 is scheduled to begin in 2015 and will last approximately 12 months, with one season of in-water work (August 1 to February 15). During Phase 1, the existing POF slip, Slip 3, the Slip 2 right dogleg wingwall, and Slip 3 left dogleg wingwall will be removed, in addition the South Trestle will require partial demolition. The existing POF slip will be removed over 4 days and consists of ten 36-inch diameter and four 30-inch diameter steel piles that will be removed with a

vibratory hammer. Slip 3 will be removed over a 14 day period and consists of 24 H-piles, thirty-one 14-inch diameter steel, and forty-nine 12-inch diameter steel piles that will be removed with a vibratory hammer and sixteen 16-inch diameter concrete reinforced timber piles removed via direct pull. The Slip 2 and Slip 3 wingwalls will be removed over a 20-day period. Each consists of ninety-seven 13-inch diameter timber piles (194 total piles) that will be removed via vibratory hammer. The South Trestle demolition will include direct pulling of thirty-four 14 to 18-inch diameter concrete piles over a four-day period.

Also during Phase 1, a temporary platform for the POF slip will be constructed on the south side of the trestle. The existing POF pier and walkway, including supporting piles, will be removed and the float and gangway temporarily relocated east of their current location. Eleven 18-inch diameter concrete piles, driven with an impact hammer over two days, will be used to support the platform and walkway. Five 36-inch and two 30-inch steel piles, installed with vibratory driver over two days, will support the float and gangway (Table 3). After the new permanent POF slip is constructed, the temporary POF slip (two 30-inch steel piles and five 36-inch steel piles) will be removed with a vibratory hammer over two days and the 18-inch concrete piles will be direct pulled over two days.

About 38,590 ft^2 of new trestle with concrete and steel piles and decking will be built to the south (compensating for a roughly equivalent amount removed from the north). Approximately 253, 18-inch diameter concrete piles for the southern portion of the new trestle will be driven with an impact hammer over 32 days. It will take about 17 minutes to install each concrete pile (Table 3).

The new POF slip will be constructed during this phase using 132, 18-inch diameter concrete piles (impact driven over 17 days), five 36-inch steel piles, and two 30-inch steel piles driven with a vibratory hammer over one day. A light-penetrating surface, such as glass blocks, will be used for the 5,300 ft^2 POF walkway. An elevated walkway will be constructed to connect the POF slip to the new terminal building. The elevated walkway over the concrete trestle will be supported by four 72-inch drilled shafts. The time to install each shaft casing will be about one hour (walkway construction will be completed in Phase 2).

Slip 3 will be reconstructed during this phase of the project. The Slip 3 transfer span will be replaced with a new standard hydraulic transfer span and a new bridge seat, and the overhead loading structures will be replaced. The Slip 3 transfer span and overhead loading structure will be supported by four drilled shafts: two 80-inch diameter drilled shafts for the transfer span, and one 108-inch and one 84-inch diameter drilled shaft for the overhead loading. Steel casings for the drilled shafts will be vibrated into place. It will take approximately one hour to install each casing; installation will occur over three days (Table 3). Ten 30-inch steel piles driven with a vibratory hammer then proofed with an impact hammer for the bridge seat over a two day period. In addition, four 30-inch concrete reinforced piles will be driven with a vibratory hammer then proofed with an impact hammer over one day for the Hydraulic Power Unit (HPU) platform.

The two timber dogleg dolphins between Slips 2 and 3 will be replaced by two new steel pile dolphins. A temporary dolphin will be built to allow vessels to dock at Slip 2. Approximately seven 24-inch steel piles will be used for the temporary dolphin, and twelve 30-inch steel piles and six 36-inch steel piles will be used for the fixed dolphins.

Dolphin and gangway piles will not require impact proofing. Vibratory driving of steel piles will take approximately 37 minutes, depending on the size and embedment depth of the pile, with a pile driving rate of four to six piles per day. Vibratory pile removal of steel piles will last approximately 15 minutes per pile, with a removal rate of two to six piles per day (Table 3).

Work will occur from the existing trestle as well as from up to two barges measuring 80 ft by 200 ft (16,000 ft^2 total) on the south side of the trestle. Barges will be anchored with spuds extending to the sea floor.A sediment cap of clean sand will be placed underneath the new section of trestle once construction is complete.

Table 3. Number of type of piles that will be removed and installed during Phase 1 and approximate durations.

Element	Sub-Element	Pile Material	Installation/ extraction method	No. of piles	Time per pile (min)	Piles per day	Strikes per pile	Duration of activity
POF Slip removal		36-inch steel	Vibratory	10	15	6	---	2 days
		30-inch steel	Vibratory	4	15	2	---	2 days
Slip 3	Remove existing structures	H-piles	Vibratory	24	15	10	---	3 days
		14-inch steel	Vibratory	31	15	10	---	4 days
		16-inch concr/tmbr	Direct pull	16	15	10	---	2 days
		12-inch timber	Vibratory	49	15	10	---	5 days
	Transfer span	80-inch shaft	Vibratory	2	60	1	---	2 days
		30-inch steel	Vibe then impact	10	39	6	300	2 days
	Overhead Loading	108-inch shaft	Vibratory	1	60	1	---	1 day
		84-inch shaft	Vibratory	1	60	1	---	1 day
	HPU platform	30-inch steel/concrete	Vibe then impact	4	37	4	300	1 day
	Inner dolphin	30-inch steel	Vibratory	12	37	6	---	2 days
		36-inch steel	Vibratory	6	37	6	---	1 day
	Temp dolphin	24-inch steel	Vibratory	7	37	6	---	2 days
South trestle	Demolition	14-18-inch concrete	Direct pull	34	15	10	---	4 days
	Trestle support	18-inch concrete	Impact	253	17	8	1515	32 days
	Overhead walkway	72-inch shaft	Vibratory	4	60	1	---	4 day
Remove Slip 2 right dogleg wingwall		13-inch timber	Vibratory	97	15	10	---	10 days
Remove Slip 3 left dogleg wingwall		13-inch timber	Vibratory	97	15	10	---	10 days
POF slip construction	Temporary POF slip	18-inch concrete	Impact	11	17	8	1515	2 days
		30-inch steel	Vibratory	2	37	5		1 day
		36-inch steel	Vibratory	5	37	2	---	1 day
	Permanent POF slip	18-inch concrete	Impact	132	17	8	1515	17 days
		30-inch steel	Vibratory	2	37	2		1 day
		36-inch steel	Vibratory	5	37	4	---	2 days
Demolish temporary POF slip		18-inch concrete	Direct pull	11	17	8		2 days
		30-inch steel	Vibratory	2	37	5	---	1 day
		36-inch steel	Vibratory	5	37	2	---	1 day

Phase 2

Phase 2 will take approximately 28 months during 2016-2018, with one season of in-water work (August 1 to February 15 in 2016-2017). In Phase 2, the Slip 1 walkway will be removed, as well as a portion of the south (concrete) trestle and piles underneath the new terminal building site. The pile foundation will be installed for the new terminal, and the southern third of the new terminal building will be constructed. Approximately forty-five 18-inch diameter and eighty-four 16.5-inch diameter concrete piles will be removed (Table 4). The removed section of trestle will be replaced with a concrete trestle supported by approximately sixty-nine 30-inch diameter concrete-reinforced steel piles[1]. These piles will be installed with a vibratory hammer and proofed to the necessary depth with an impact hammer over twelve days. The Slip 1 connector ramp will be reinstalled, and the elevated POF walkway will be constructed. A barge will be anchored south of Slip 2 to support construction equipment necessary for the work.

Table 4. Number of type of piles that will be removed and installed during Phase 2 and approximate durations.

Element	Pile Material	Installation/ extraction method	No. of piles	Time per pile (min)	Piles per day	Strikes per piles	Duration of activity
Concrete trestle removal	18-inch diameter concrete	Direct pull	45	15	10	---	5 days
	16.5-inch diameter concrete	Direct pull	84	15	10	---	9 days
Install pile foundation for terminal building	30-inch concrete-reinforced steel	Vibe then impact	69	37	6	300	12 days

Phase 3

Phase 3 will last about 24 months during 2018-2020, with one season of in-water work (August 1 to February 15 in 2018-2019). During this phase the Slip 2 transfer span and overhead loading will be temporarily removed and the vehicle attendant crew building under the Slip 2 overhead loading will be demolished. The entire terminal building will be demolished, and a strip of the north (timber) trestle approximately 100 ft wide immediately north of the existing concrete trestle will be demolished and replaced with a new concrete trestle supported by about 236, 30-inch diameter concrete-reinforced steel piles (Table 5). In addition, twenty-four 30-inch concrete-reinforced steel piles will be used to support a stormwater treatment vault. Approximately 748, 12-inch diameter timber piles and seventy-six 12-inch diameter concrete-reinforced steel piles will be removed over 75 days. Piles will be vibrated out of the substrate to the extent possible to minimize disturbing contaminated sediments.

[1] Concrete-reinforced steel piles are hollow steel piles containing a plug at the bottom. Once they have been driven to the requisite depth a rebar frame will be inserted into the pile and concrete poured around the frame.

Two temporary vehicle bridges will span the 100-foot strip during construction. The center third of the terminal building will be reconstructed and the Slip 2 vehicle and overhead loading spans reinstalled using ten 30-inch diameter steel piles (Table 5). Temporary pedestrian bridges will link the Marion St overpass and Slip 3 to the new terminal building. A derrick and barge will be anchored with spuds south of the slip for this portion of the work.

The 270, 30-inch diameter concrete-reinforced steel piles and steel piles will be driven with a vibratory hammer then proofed with an impact hammer to the appropriate load-bearing depth. Using an average production rate six piles per day, a total of approximately 46 days of driving will be needed. It is expected that each pile will take approximately 37 minutes to drive (Table 5). However, given the limited space for equipment and the time needed to set up the pile driving equipment, the number of piles driven per each working day will be limited.

Table 5. Number of type of piles that will be removed and installed during Phase 3 and approximate durations.

Element	Pile Material	Installation/ extraction method	No. of piles	Time per pile (min)	Piles per day	Strikes per pile	Duration of activity
Remove existing timber trestle	12-inch timber	Vibratory	748	15	10	---	75 days
Remove foundation for existing building	12-inch concrete-reinforced steel	Vibratory	76	15	10	---	8 days
Construct new trestle	30-inch diameter concrete-reinforced steel	Vibe then impact	236	37	5	300	40 days
Reinstall slip 2 transfer span bridge seat	30-inch steel	Vibe then impact	10	37	6	300	2 days
Construct stormwater vault	30-inch diameter concrete-reinforced steel	Vibe then impact	24	37	5	300	4 days

Phase 4

Phase 4 will last approximately 25 months during 2019-2021, with one season of in-water work (August 1 to February 15 in 2019-2020). In Phase 4 the remaining portion of the north (timber) trestle will be demolished. Approximately 1,267 piles will be removed, consisting of 1,187, 12-inch diameter timber piles and 80 12-inch diameter concrete reinforced steel piles. Each pile will take about 15 minutes to remove. Approximately ten piles will be removed per day, totaling 118 to 126 days (Table 6).

Piles will be removed using vibratory methods to the extent possible to minimize suspending potentially contaminated sediments. Afterward, a section of fill measuring about 14,500 ft^2 (7,674 cubic yards) underneath the trestle contained behind a sheet pile bulkhead will be removed. The fill will be dredged while the bulkhead is still in place and either disposed of at an

open water site (if it meets Dredged Material Management Plan [DMMP] provisions) or hauled offsite to an approved upland location. Once the fill has been removed and the area restored to match the bathymetry on either side, the bulkhead will be removed.

After removal of the bulkhead, the remainder of the new trestle and a stormwater vault will be constructed using 237, 30-inch diameter concrete-reinforced steel piles that will be driven with a vibratory hammer then proofed with an impact hammer over a 40-day period (Table 6). The final third of the new terminal building will be constructed, and temporary pedestrian bridges replaced with permanent structures.

Table 6. Number of type of piles that will be removed and installed during Phase 4 and approximate durations.

Element	Pile Material	Installation / extraction method	No. of piles	Time per pile (min)	Piles per day	Strikes per pile	Duration of activity
Demolish north timber trestle	12-inch diameter timber	Vibratory	1,187	15	10	---	118 days
Remove foundation for existing building	30-inch concrete-reinforced steel	Vibratory	80	37	15	---	8 days
Construct new trestle	30-inch diameter concrete-reinforced steel	Vibe then impact	225	37	6	300	38 days
Construct stormwater vault	30-inch diameter concrete-reinforced steel	Vibe then impact	12	37	6	300	2 days

Stormwater Treatment

The project area currently generates stormwater runoff in one threshold discharge area, which discharges as untreated flow (apart from oil/water separators) from the deck of the trestle to Elliott Bay. Existing PGIS in the project area is about 4.03 acres. No new PGIS will be created by the project, so post-project PGIS will be the same as pre-project PGIS (the increase in over-water cover results from the POF). The project will provide basic treatment for all PGIS in the project area by installing wet vaults with oil/water separators underneath the trestle, thus providing for a 100 percent water quality retrofit of the existing PGIS. WSF will also sweep the terminal on a quarterly basis with a high-efficiency vacuum sweeper. No detention will be provided since Elliott Bay is exempt from flow control requirements.

Future Mitigation for Overwater Cover

Based on discussions with the City of Seattle and Washington Department of Fish and Wildlife, regarding permit conditions since the BA for this project was submitted, WSF will be required to mitigate for any increase in overwater cover created by the project by removing an equivalent amount of overwater cover within Elliott Bay or as close as possible to Elliott Bay within Puget Sound. To achieve this mitigation requirement, WSF will contribute to a King County fee-in-lieu program, and King County will be responsible for future Section 7 consultation and permitting for the applicable project under the Act. If WSF is unable to find an appropriate project through the fee-in-lieu program, WSF will find another opportunity to remove overwater cover and will reinitiate with the Services to address potential impacts of the overwater cover removal on listed species.

Conservation Measures

WSF's standard Construction Minimization Measures, are described in detail in their BA Reference Section 2.3 (p. 73) and are incorporated here by reference. Additional best management practices BMPs that will be incorporated into the project are highlighted on pages 18 and 19 of the Form and are hereby incorporated by reference.

However, to ensure in-water turbidity and suspended sediment or resuspended contaminants are confined to within 60 ft of piles and project elements, the following BMPs and monitoring protocol will be implemented:

The specifications will require that the contractor develop a demolition and dredging plan that details the BMPs to be used and water quality monitoring procedures in accordance with the project permits. Chemical analytical and turbidity monitoring results will be used to evaluate potential construction activity impacts to the water column and sediment surface at the 60 ft compliance radius that may trigger work stoppage and the implementation of additional BMPs. Plans will be submitted to the following agencies for review and approval prior to beginning work: WSF as well as the Washington Department of Ecology (Ecology). BMPs will include (but are not limited to):

- Split-hulled dredge material barges will be sealed and prohibit the release of untreated water,
- Absorbent booms will be in place to minimize impacts from potential releases that may occur during demolition or construction activities,
- In-water construction operations will be observed by a WSF representative at all times,
- Vibratory pile removal will be used to reduce sediment disturbance,
- Removed wood and adhered sediment will be disposed of at an approved upland facility,

- Turbidity monitoring samples will be collected twice a day from two locations: upgradient from the work area to evaluate background conditions and downgradient from the work area to evaluate impacts from work. Samples will be collected from the surface water, the middle of the water column, and from water two feet above the sediment surface at each location.
- Water column samples will be collected once daily for chemical analyses of polycyclic aromatic hydrocarbons (PAHs) and other contaminants of concern, if appropriate, based on the results of the dredge material characterization sampling.

The contractor will be required to submit water quality monitoring results daily to WSF for review, to Ecology as specified in permit requirements, and annually to the Service. It is possible that the frequency of water sampling/chemical analyses could be reduced if sampling indicates that water quality is not being affected by the activity.

The water quality monitoring program will include stopping work immediately and assessing the need for additional BMPs if:

- Measured turbidity at the compliance sample locations exceeds the 401 Water Quality Certification and WAC 173-201A-210 water quality criteria of 5 Nephelometric Turbidity Units (NTUs) when the background is less than 50 NTUs or less or a 10 percent increase in turbidity when the background turbidity is greater than 50 NTUs, 60 ft from the work area and/or
- Chemical analytical results for PAHs or other COCs, if applicable, identified based upon the results of the DMMP sediment characterization exceed applicable Washington State Water Quality Standards for Marine Surface Waters.

The need for and type of additional BMPs to be implemented will be discussed with Ecology after exceedances of the water quality monitoring turbidity and/or chemical analytical criteria are observed. Potential additional BMPs may include:

- Silt curtains
- Removable dams
- Sheet-pile enclosures
- Silt screens
- Pneumatic (bubble) curtains

In addition, marbled murrelet monitoring will be implemented during impact pile driving. Pile driving will not occur if marbled murrelets are present within a 27 m monitoring zone (see Appendix A: Protocol for Marbled Murrelet Monitoring During Impact Pile Driving).

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). In delineating the action area, we evaluated the farthest reaching physical, chemical, and biotic effects of the action on the environment.

The farthest reaching impacts result from pile driving in the marine environment. Impact driving of 30-inch steel piles and concrete reinforced steel piles (unattenuated) is assumed to be (212 dB_{peak}, 186 dB_{SEL}, and 195 dB_{RMS}). A bubble curtain or similar noise attenuation device will be employed during impact pile driving. The effectiveness of bubble curtains varies widely but they have proven more effective in softer sediments such as those that exist at the Seattle Terminal. Average noise reduction for bubble curtains is 12 dB; for this project bubble curtains are expected to reduce noise levels by at least 10 dB to produce peak noise levels of 202 dB_{peak} (190 dB_{RMS}). Underwater noise levels will be monitored during impact pile driving.

Background underwater noise levels at the Seattle Terminal were measured within different frequency ranges. The lowest level was in the 150 Hz to 20 kHz range and was therefore the frequency used to calculate the extent of underwater noise effects within the action area. Underwater noise levels within this range were 124 dB_{RMS} (WSF BAR 2012a p. 85). Using the practical spreading model, the 190 dB_{RMS} generated by impact pile driving of 30-inch diameter steel piles would attenuate to the background underwater sound level at approximately 182 miles from the source. However, the extent of underwater sound transmission will be constrained by Bainbridge Island and West Seattle, between two and eight miles to the west of the project (Figure 3).

Impact driving of steel piles will also generate the farthest reaching impacts on land and over water. Estimated in-air noise levels associated with pile driving are110 dBA_{peak} measured 50 ft away from the source (WSDOT 2012). Typical terrestrial ambient noise levels in the downtown Seattle area near the waterfront range from 71 to 83 dBA, which is consistent with the elevated noise levels of typical urban and downtown major metropolitan areas (Parsons Brinkerhoff Quade & Douglas, Inc. 2004). To define the terrestrial extent of the action area, a conservative noise level of 71 dBA was assumed to be the downtown Seattle ambient noise level. Assuming 6.0 dB attenuation per doubling distance for a hard site, the in-air sound is expected to attenuate to the ambient noise level at approximately 4,525 ft.

As part of the proposed action, clean dredged material may be disposed of at an approved DMMP location, likely the Elliott Bay disposal site. However, the DMMP has already been consulted on and the potential effects of disposal on listed species are not addressed in this Opinion because they are considered to be part of the *Environmental Baseline*, discussed below.

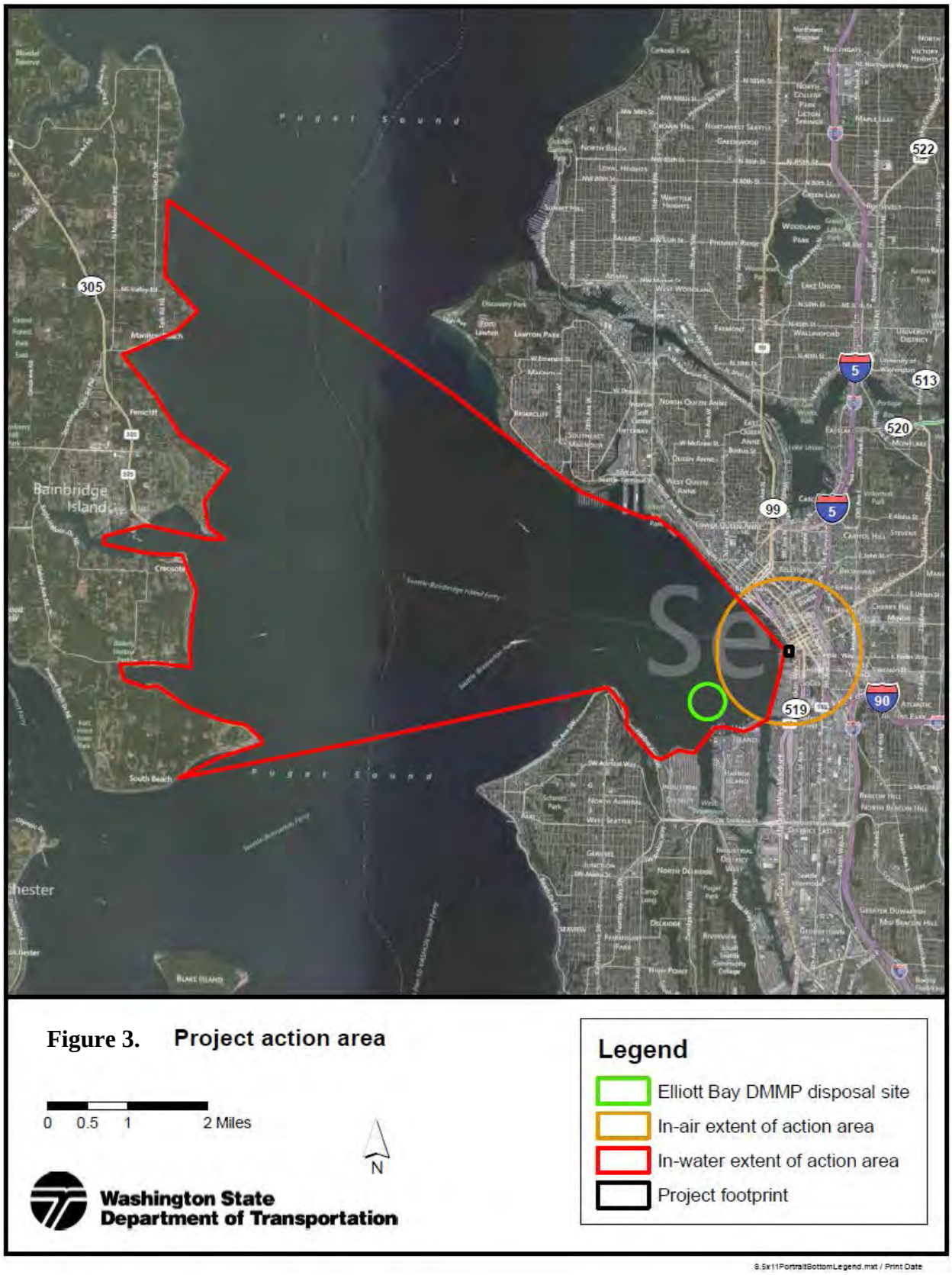

Figure 3. Project action area.

ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Opinion relies on four components: (1) the *Status of the Species*, which evaluates the bull trout and the marbled murrelet rangewide condition, the factors responsible for that condition, and their survival and recovery needs; (2) the *Environmental Baseline*, which evaluates the condition of the bull trout and the marbled murrelet in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the bull trout and the marbled murrelet; (3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the bull trout and the marbled murrelet; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the bull trout and the marbled murrelet.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of the species in the wild.

The jeopardy analysis in this Opinion emphasizes consideration of the rangewide survival and recovery needs of the bull trout and the role of the action area in the survival and recovery of the bull trout. It is within this context that we evaluate the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

This Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this Opinion relies on four components: 1) the *Status of Critical Habitat*, which evaluates the range-wide condition of designated critical habitat for the bull trout in terms of primary constituent elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; 2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; 3) the *Effects of the Action*, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PCEs and how that will influence the recovery role of affected

critical habitat units; and 4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on bull trout critical habitat are evaluated in the context of the rangewide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

The analysis in this Opinion places an emphasis on using the intended rangewide recovery function of bull trout critical habitat and the role of the action area relative to that intended function as the context for evaluating the significance of the effects of the proposed Federal action, taken together with cumulative effects, for purposes of making the adverse modification determination.

STATUS OF THE SPECIES: BULL TROUT

The status of the Coastal/Puget Sound bull trout is provided in Appendix B.

STATUS OF THE BULL TROUT CRITICAL HABITAT (RANGEWIDE)

The status of designated Coastal/Puget Sound bull trout critical habitat is provided in Appendix C.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR 402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area that have undergone section 7 consultation, and the impacts of State and private actions which are contemporaneous with the consultation in progress.

Environmental baseline information for the Seattle Terminal is provided in Section 4.16 of the WSF BAR 2012a (p. 425). Additional information has been collected since the WSF BAR was drafted: sediment studies have been conducted throughout the project area, and habitat mapping and fish surveys were conducted in 2010 in support of the City of Seattle's Elliott Bay Seawall Project. The Elliott Bay Seawall Project will likely be constructed prior to the Seattle Multimodal Project, which will change the environmental baseline in the project vicinity. These studies are summarized below.

The action area, and more specifically, Elliott Bay, is extensively developed. About eight miles (12.8 km) of shoreline is within Elliott Bay. Prior to development, Elliott Bay consisted of intertidal mud, sand flats, and wetlands. Extensive filling, dredging, and grading in Elliott Bay have resulted in some of the highest levels of shoreline modification in Puget Sound, documented at over 80 percent (Kerwin and Nelson 2000). Most shoreline modifications, such as seawalls and bulkheads, were placed to protect urban and residential development beginning in the early 1900's. Overwater structures currently occupy over 65 percent of the Elliott Bay shoreline (City of Seattle, 2003). The current conditions within Elliott Bay reflect the impacts accrued from over 100 years of development affecting shoreline and aquatic habitats and species along with sediment and water quality.

Depth and Circulation

Elliott Bay has a surface area of approximately 20 km^2 (7.7 mi^2) and a volume of approximately 2,491 hectare meters (20,200 acre-ft) (Baker 1982). The greatest depth of Elliott Bay is 283 m (930 ft) with an average depth of 62 m (205 ft). Depths along the seawall range from about -0.76 m (-2.5 ft) to about -9 m (-30 ft) mean lower low-water (MLLW). Depths at the outer edges of the piers are typically around -15 m (-50 ft). The hydraulic residence time in the inner harbor area of Elliott Bay typically ranges from 1 to 10 days, with variation associated with weather patterns. Several studies have found a counter-clockwise circulation pattern in Elliott Bay, with discharges from the Duwamish Waterway flowing north along the downtown seawall corridor before flowing westward to Puget Sound (Ecology 1995; URS Engineers and Evans-Hamilton 1986; Ebbesmeyer et al. 1998). Current flow velocities are typically low and parallel to the seawall (Silcox et al. 1981). Currents during flood tides are stronger and tend to be in more of a clockwise direction, while during ebb tides currents were weaker and counterclockwise (Winter 1977).

The average tidal range in Elliott Bay is 3.4 m (11.3 ft) (USACE 2008). The mean higher high-water (MHHW) is 2.75 m (9.02 ft) and MLLW is -0.71 m (-2.34 ft) [NAVD88] (NOAA 2011). The maximum recorded high tide elevation in Elliott Bay is 3.69 m (12.12 ft) (NAVD88) (NOAA 2011). The elevation of the top of the existing seawall and the adjacent Alaskan Way road surface is approximately 4.8 m (16 ft).

Human activities have significantly changed the natural processes and habitats in the action area. Hydrology has been modified as a result of filling in the nearshore zone, dredging, vessel currents and waves/wakes, reduction of flows from the Duwamish River (diversions of the Black and White rivers), and changes in stormwater runoff due to urbanization and rerouting of flows.

Shoreline Conditions

The entire project area is dominated by the seawall structure that extends for 2,184 m (7,166 linear ft) from Pier 48 in the south to Olympic Sculpture Park in the north (S. Washington to Broad streets). The existing seawall is a vertical structure comprised of concrete, steel sheet pile and treated timber. In addition, there are 12 overwater pier structures in the vicinity of Colman Dock: Seattle Fire Station No. 5, Pier 54, Pier 55, Pier 56, Pier 57, Waterfront Park, Seattle

Aquarium (Piers 59 and 60), Pier 62/63, Pier 66, Pier 67, Pier 69, and Pier 70. Cumulatively, the pier structures within the project footprint account for 60 percent of the linear length of the seawall and represent overwater coverage and shading of 50 to 60 percent of the area. The historic construction of this structure and the placement of fill to facilitate development and use of the waterfront for commerce and industry eliminated the natural shoreline. There is no natural shoreline in the project area.

The uplands of the project area are almost completely impervious surfaces. Extensive urbanization has eliminated most terrestrial and riparian plants in the project area. The only vegetation present is street trees and some planter boxes and potted plants on piers.

Substrate

The habitat mapping survey in 2010 documented riprap at the base of the seawall on either side of the terminal, with some areas of gravel and cobble. Sand/shell hash/silt is the primary substrate in deeper water, and covers most of the area in the vicinity of the seawall (SDOT 2011b). The area underneath the Seattle Terminal was not mapped, but is the same area that was capped in 1989 (CH2M Hill 2005).

Fine sediments, found in the deeper areas of Elliott Bay where currents are low, include the deposited organic material that tends to settle in marine waters (i.e., dead and decaying plankton). Silts and organic materials are mixed with sands in many parts of the action area (Anchor QEA 2012). Sandy bottoms are shaped by natural hydrologic characteristics and vessel currents that move sand throughout the environment. Natural input of sediment into the area from feeder bluffs is currently very limited (Anchor 2004).

Gravel is the natural substrate of the nearshore in many areas of Puget Sound due to the underlying geology and hydrologic/hydraulic processes. Cobble is similar to gravel in that it is a natural substrate of the nearshore environment. Cobble provides suitable substrate for a variety of macroalgae, invertebrates, and salmonid prey species.

There are no known natural rock outcrops or deposits within the project area; the source of rock along the seawall is from the placement of quarried stone for seawall and bank protection. Rock provides a sturdy substrate for bull kelp and other macroalgae to fasten to, substrate for various invertebrates, and refuge for a variety of invertebrates and fish. Natural large wood essentially does not occur in the action area due to active removal of wood as a navigation hazard, and the lack of recruitment from the nearshore riparian zone, which does not exist in the in the project area.

Sediment Quality

Three separate studies have analyzed surface and near-surface sediments within the project area for polycyclic aromatic hydrocarbons (PAHs), metals, and other contaminants. The north (timber) trestle area was sampled in 1999 and 2011. Samples from 1999 showed concentrations of PAHs and metals were below Washington State Sediment Management Standards (SMS)

Cleanup Screening Criteria (CSC) criteria, but PAHs did exceed Sediment Quality Standards (SQS) criteria (Herrera 1999). A boring from 2011 exceeded SMS criteria for dibenzofuran (Landau 2011).

Sediment samples were collected at five locations in the southern portion of the timber trestle area in 1999. All five samples exceeded SMS criteria for PAHs, four locations exceeded SMS criteria for hexachlorobutadiene, one location for 2,4-dimethylphenol, and one location for mercury and zinc. Bioassay testing at three of those locations was found to exceed Cleanup Screening Levels (CSL) for biological effects criteria. Two samples were also taken from the south timber trestle area in 2011. Exceedances of mercury, 2,4-diphenylmethol, and PAHs were found at one or both locations (Landau 2011).

A sediment cap of approximately 1.5 ft of clean commercially obtained sand was placed underneath the existing south (concrete) trestle in 1989. A study of the cap in 2004 indicated that the cap was largely intact, and a layer of new sediment 11 to 21 cm thick had accumulated on top of the cap. Six out of seven samples of cap material met SMS criteria. At one location on the eastern portion of the cap, mercury, lead, silver and zinc exceeded SMS criteria. Reports indicated the cap was thin in this area and the sample may have captured some contaminated material from below the cap. The study also noted the presence of marine organisms across the cap surface (CH2M Hill 2005).

Two surface sediment samples were collected in 2011 from the area just south of the existing trestle where the new concrete trestle will be constructed. Mercury, phenol, and 2,4-dimethylphenol exceeding SQS or CSL criteria were detected at one or both locations.

Macroalgae and Eelgrass

Sea lettuce (*Ulva lactuca*) and sugar kelp (*Saccharina latissima*) were the most commonly observed macroalgae in the 2010 habitat mapping survey. Sugar kelp and bull kelp (*Nereocystis luetkeana*) were documented on the north and northwest sides of the trestle. Sea lettuce, sugar kelp, bull kelp and red algae (*Rhodophyta*) were found in the area south of the trestle. Moderate to dense patches of algae were found in areas with adequate light and appropriate substrates. Dark areas under piers had little algal growth. Sea lettuce was the predominant species in shallower areas, and sugar kelp present in deeper subtidal areas. A small patch of bull kelp was found west of the northern portion of the trestle, and a few bull kelp stipes were observed south of the Seattle Terminal (SDOT 2011b). Numerous species of invertebrates and fish (described below) were observed in these habitats.

Epibenthos, Macrofauna, and Fish

Twenty-eight species of invertebrates were observed during seawall surveys including annelids (tubeworms), arthropods (crustaceans), cnidarians (jellyfish and anemones), echinoderms (starfish), poriferans (sponges), mollusks (cephalopods, gastropods, bivalves), and tunicates (SDOT 2011b). Over 21 species of fish were documented during snorkel surveys, including Chinook salmon (*Oncorhynchus tshawytscha*) and forage fish such as Pacific herring (*Clupea*

pallasi), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*). Shiner perch (*Cymatogaster aggregata*) were the most common fish observed, followed by forage fish and tubesnout (*Aulorhynchus flavidus*) (SDOT 2012a).

Forage fish such as Pacific herring, Pacific sand lance and surf smelt are present in Elliott Bay. There are no documented spawning areas within the project footprint, although surf smelt have been documented spawning just outside of Elliott Bay, west of Duwamish Head and near West Point (WDFW 2004). Pacific sand lance may spawn along the Alki and Magnolia shorelines. Anchor QEA (2011) observed large numbers of surf smelt and Pacific sand lance along the seawall in the project footprint in July 2011 (SDOT 2011b). This coincides with observations by University of Washington researchers that juvenile forage fish are present in large numbers during summer months along the seawall (J. Cordell, University of Washington, pers. comm. 2011 as cited in SDOT 2011b).

Water Quality

Water quality in Elliott Bay has been affected by decades of various land use activities and discharges. Ecology and King County have ambient marine water quality monitoring stations in Elliott Bay. Both of these agencies have focused their sampling on conventional parameters. Ecology monitors fecal coliform bacteria, chlorophyll, pheopigment, nitrate, ammonium, silicate, turbidity, temperature, salinity, pH, and dissolved oxygen). King County monitors temperature, salinity, water density, DO, nutrients, chlorophyll, and fecal coliform bacteria.

Temperature

Water temperature data in Elliott Bay were collected during surveys for non-indigenous species at seven sites in 2001 and were between 12°C (53.6°F) and 16°C (60.8°F) (WDNR 2001). Ecology conducted monthly surveys of water quality in Elliott Bay between 1991 and 2002. Results from these surveys showed that at 5 m (16.4 ft) depths, water temperature generally fluctuates between 7.7°C (45.8°F) and 16.4°C (61.5°F) (Ecology 2006).

Dissolved Oxygen

Dissolved oxygen in Elliott Bay ranges between approximately 5.5 and 10 mg/L in winter and spring, respectively (King County Department of Natural Resources and Parks [KCDNRP] 2009). Elliott Bay is listed as a Category 1 waterbody for DO in most areas and meets standards. However, one monitoring station in central Elliott Bay was listed as a Category 2 waterbody (Category 2 is for waters of concern, but do not require an improvement plan at this time) for DO in the 2006 list (Ecology 2006). King County data collected in 2002 and 2003 showed four instances of DO levels lower than minimum criteria. However, staff from Ecology's Marine Unit reviewed these data and determined that the sample location is subject to incursions of upwelling with low DO bottom waters. This upwelling shows no evidence of human-caused sources and is therefore likely a natural condition (Ecology 2006).

Chemical Contamination and Nutrients

Colman Dock is located within industrial and commercial areas of Seattle that were first developed between the 1870s and the early 1900s. In general, the waterfront area is underlain by fill that was placed in the early 1900s that covered and incorporated timber and debris previously used in the construction of piers, wharves, and trestles. As a result of the industrial and commercial uses of this area, historical land uses potentially resulted in releases of contaminated materials into the surrounding environment. Some of these legacy pollutants in sediments may be periodically resuspended in the water column due to wave action, vessels, and currents and negatively affect water quality.

Elliott Bay in the vicinity of the project also receives water runoff from several sources including stormwater discharges and groundwater flows. Other existing sources of potential contaminants to the nearshore water column in Elliott Bay include:

- Combined Sewer Overflow (CSO) events,
- Vessel discharges,
- Discharges from pier facilities,
- Dumping of trash and other materials from the uplands, and
- Atmospheric deposition.

Primary sources of nutrients (i.e., nitrogen and phosphorus) in Elliott Bay are from upwelling of nutrient-rich water, input from land sources, recycling and resuspension of nutrients between surface waters and sediments (Harris 1986), decomposition of plants and animals, and waste disposal. Nutrient-rich water from the Pacific Ocean provides a continuous supply of macronutrients to Puget Sound. During times of calm weather or reduced tidal action, reduced nutrient supply can limit photosynthesis in the surface waters in these areas (KCDNRP 2001). Increased river discharge, lack of wind, and neap tidal cycles (minimum tidal range during first and third quarter of the moon phase) enhance stratification and slow vertical mixing of nutrients to the surface (Rensel Associates and PTI Environmental Services 1991).

Heavy metals (arsenic, cadmium, copper, lead, mercury, silver, and zinc), phthalates, and PAHs (found in the creosote pilings) are detected in most water quality samples in Elliott Bay. Ambient dissolved copper (DCu) and dissolved zinc (DZn) concentrations for Elliott Bay are approximately 0.7 and 4.1 micrograms per liter (µg/L), respectively (Curl et al. 1988). A number of studies have observed bioaccumulation of PAHs, polychlorinated biphenyls (PCBs), and mercury in marine animals of Puget Sound and Elliott Bay, including mussels, squid, fish larvae, Chinook salmon, coho salmon, osprey, gray whales, orcas, and harbor seals (NMFS 1993; KCEL 1998; Ross et al. 1998; Cullon et al. 2001; Lambourn et al. 2001; PSP 2007).

Stormwater

As shown in Figure 4, there are nine major storm drain outfalls managed by the City of Seattle in the vicinity of the project, five separated storm drain outfalls, two CSOs, and two shared (CSO/stormwater) outfalls. The separated stormwater outfalls managed by the City of Seattle are at the ends of S. Washington Street, Seneca Street, Pine Street, Bell Harbor, and at the north end of the Bell Street pier. There are two CSO outfalls at Washington and Vine streets. In addition, there are currently approximately 50 small, individual outfalls that convey runoff directly to Elliott Bay (USACE 2008). These outfalls typically convey runoff from small areas of the roadway within the project area. Where the separated storm drain system and the combined sewer system share outfalls along the seawall, at University Street and Madison Street (the closest in proximity to the project), the separated storm drain connections to the outfall pipes occur downstream of the CSO diversion structure, and thus the separated storm drainage does not affect the occurrence or magnitude of the CSO discharge at those outfalls.

The water quality condition along the seawall is influenced by many contributing factors, both within and outside the project area. The project corridor is comprised almost entirely of impervious surfaces. The stormwater collection and conveyance network along the downtown waterfront was generally constructed in the 1930s and then upgraded in the 1980s as part of improvements to the Alaskan Way road surface, sidewalk, and seawall. Almost the entire existing Alaskan Way road surface within the project limits is classified as PGIS according to the City of Seattle's stormwater code (SMC 22.801.170). Runoff in the project vicinity, including the road surface, sidewalks, parking lots, driveways, trolley tracks, landscaping, and trail, drains to the separated stormwater system, and then to Elliott Bay, approximately 1.4 acres east of the Alaskan Way roadway in the vicinity of Pike and Pine streets, drains to the City of Seattle's combined sewer system, and a very limited amount of impervious surface infiltrates to the groundwater.

Outside, but flowing through the project area, stormwater and wastewater from Seattle and north King County, flows to, and is treated at, the West Point Treatment Plant in Seattle. Twenty-nine percent of the City of Seattle drains to the combined sewer system. With measurable rain occurring at least 100 days per year in the Seattle area, stormwater discharges are common along the waterfront during most months. Combined sewer overflows occur in varying frequencies when the capacity of that portion of the combined system is exceeded by stormwater inflows.

Four CSO outfalls are located along the seawall and discharge into Elliott Bay (Vine, University, Madison, Washington). The Madison CSO outfall is in the immediate vicinity of the project. Individual CSO outfalls in the project footprint have discharged from zero to nine times in a year based on recent data from 2008-2011 (City of Seattle 2012). The average annual number of CSO discharges based on these years were less than 2 for Vine, less than 1 for University, greater than 5 for Madison, and 0 for Washington. Overflows are most likely to occur from October to March coinciding with the greatest frequency and depth of precipitation, but may occur at other times of the year during heavy rain. In the years of 2008-2011, the average duration of CSO overflow events in the project footprint was approximately 5.9 hours and ranged from a few minutes to 28.3 hours (City of Seattle 2011, 2012).

Figure 4. Location of Major Outfalls along the Elliott Bay Shoreline

The key pollutants of concern in roadway runoff are total suspended solids, total copper, dissolved copper, total zinc, and dissolved zinc. The expected loading for impervious surfaces in the project vicinity (Alaskan Way) is shown in Table 7 (SDOT 2012b).

Table 7. Existing Stormwater Pollutant Loading from Alaskan Way

	Existing Conditions		
	Loads (pounds per year)		
	Lower Quartile	**Median**	**Upper Quartile**
Total Suspended Solids	4,051	5,239	7,023
Total Copper	0.97	1.19	1.81
Dissolved Copper	0.25	0.30	0.47
Total Zinc	5.32	6.97	9.22
Dissolved Zinc	1.44	1.80	2.92

Groundwater Quality

Groundwater within the project area can be found seven to fifteen ft (2.1 to 4.5 m) below the ground surface (SDOT 2012). Groundwater levels along the existing seawall vary with Elliott Bay tidal fluctuations and may be dependent on the existing seawall type and integrity (SDOT 2012). The groundwater is conveyed in discontinuous fill and native glacially overridden materials that have highly variable hydraulic conductivities. The water table (shallow groundwater surface) is flat for the most part, but is connected hydrologically to Elliott Bay tides (FHWA 2010) with groundwater level fluctuations typically in the 3-foot (0.9 m) range (SDOT 2012).

Groundwater flows are dependent on subsurface soils, with coarse-grained sand and gravel layers having higher groundwater discharge rates than occurs in fine-grained soils. Groundwater flow occurs horizontally towards Elliott Bay within the project footprint (SDOT 2012). Small groundwater seeps have been observed coming through the seawall.

Soil and groundwater contaminant levels that are less than the Model Toxics Control Act (MTCA) clean-up levels (CULs) for unrestricted land use are referred to as “below levels of concern.” Contaminant levels above the MTCA CULs for unrestricted land use are referred to as “above levels of concern” (SDOT 2012). Low to moderate levels (below levels of concern) of soil and groundwater contamination occur throughout the urban Seattle waterfront and within the project footprint. Concentrations of contaminants in soils do occur above residential or general use CULs in some areas based on the history of industrial activity along the waterfront. Sources of contamination are not well defined.

Near Colman Dock, metals that exceeded the MTCA CULs (i.e., they are above levels of concern) include arsenic, cadmium, copper, lead, mercury, and silver.

Noise

In-Air Ambient Noise

Typical terrestrial ambient noise levels in the downtown Seattle area near the waterfront range from 71 to 83 dBA, which is consistent with the elevated noise levels of typical urban and downtown major metropolitan areas (Parsons Brinkerhoff Quade & Douglas, Inc. 2004). Existing traffic on the Alaskan Way Viaduct is a predominant source of noise in the project vicinity. Existing sources of noise include mainly road traffic, with some local industry and high-altitude aircraft over-flights. Thus, we used 71 dBA to define the terrestrial extent of the action area, in the Action Area section above.

In-Water Ambient Noise

A range of ambient in-water noise levels have been reported for Elliott Bay. Near the Colman Dock ferry terminal, in-water noise levels were measured at 126 dB_{RMS} (Laughlin 2011a). We used this measured noise level to define the extent of the in-water action area, as described in the Action Area section above.

Status of Bull Trout in the Action Area

Anadromous adult and subadult bull trout utilize all marine waters of the action area for foraging, migrating, and overwintering. The extent of this utilization is poorly understood; however, Kraemer (in USFWS 1994) speculated that bull trout distribution in marine waters depends on the distribution of forage fish and their spawning beaches. Puget Sound bull trout prey on surf smelt, Pacific herring, Pacific sand lance, and other small schooling fish (Kraemer 1994; WDFW 1998). These prey species are present within the action area. Although foraging bull trout tend to seasonally concentrate in forage fish spawning areas, they are found throughout accessible estuarine and nearshore habitats.

Anadromous bull trout may seek and find more abundant forage in marine waters than in rivers (Kraemer 1994). Kraemer (1994) also found bull trout in the marine environment as far as 40 kilometers (25 miles) from their natal stream. McPhail and Baxter (1996) documented a char traveling as far as 150 kilometers (93 miles) through marine waters from the Squamish River of British Columbia to the Skagit River in Washington.

We expect that some level of mixing or interaction within marine waters occurs among anadromous individuals from various core areas. Although studies have documented bull trout moving into the downstream portions of another river via marine waters (WDFW 1998; Goetz 2004), we do not understand the full extent of this behavior. Goetz et al. (2012) tagged a 607 mm bull trout in the Snohomish River. On Oct 31, 2006, the bull trout was in the Snohomish River. By November 25, it migrated into the lower Duwamish River (approximately 35 miles [55 km]) where it stayed until the end of December. The bull trout then migrated back to the

Snohomish River by the end of January. The bull trout left the Duwamish River on December 27 and stayed within the action area until January 7, where it was located offshore of West Point, just north of Elliott Bay.

Based on these studies, anadromous bull trout from several different core areas may be present within the action area simultaneously. Marine waters in the action area are within foraging and migratory distances of the Stillaguamish, Snohomish-Skykomish, and the Puyallup River core populations. Their use of the marine environment in the action area is presumed to be related to the abundance of these core populations as well as the distance from the core area to the action area. More robust core populations such as the Snohomish-Skykomish are expected to utilize the marine environment in greater proportion than core populations that are extremely low in number (Chan, pers. comm. 2013). Puget Sound and the lower Green/Duwamish River are considered foraging, migration, and overwintering (FMO) habitat and do not have a spawning population (USFWS 2004).

The number of bull trout in the action area, and specifically Elliott Bay, is believed to be small, though captures in the Duwamish River indicate that bull trout migrate through the action area. In April 1978, Dennis Moore, Hatchery Manager for the Muckleshoot Tribe, talked with three anglers in the vicinity of North Wind Weir, river mile 7 of the Duwamish and identified four fish as adult char (Brunner 1999). One adult bull trout was captured in a Muckleshoot Tribal net near Pier 91 (Brunner 1999). In 2000, eight subadult bull trout were captured in the Duwamish River at the head of the navigation channel at the Turning Basin restoration site at river mile 5.3. These were subadult and adult fish that averaged 299 millimeters (11.8 inches) in length and were captured in August and September. A single char was caught at this same site in September of 2002 (Shannon in USFWS 2004). In May 2003, an adult char (582 millimeters) was captured and released at Kellogg Island (Shannon in USFWS 2004). Goetz et al. monitored the bull trout migrating through Elliott Bay in 2006, and a bull trout was observed on the newly installed habitat bench at the Olympic Sculpture Park in 2009 (Toft et al. 2012).

Status of Bull Trout Critical Habitat in the Action Area

As described above, habitat in the action area reflects a legacy of impacts and modifications resulting from over 100 years of development on the shores of Elliott Bay. Five PCEs are present in the action area. A brief description of the status of each is provided below.

PCE #2: Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

The Elliott Bay shoreline is highly modified with essentially 100 percent of the shoreline modified with riprap, bulkheads, and seawalls. Over 65 percent of the Elliott Bay shoreline has overwater structures (Williams et al., 2001). Approximately 3,870 ft of shoreline along Magnolia Bluff and 1,700 ft near West Point are the only unarmored sections of shoreline in Elliott Bay. Overwater structures, bulkheads and seawalls within Elliott Bay result in

obstructions to migratory bull trout along the shoreline. Noise and disturbance from vessel traffic is constant. In-water structures at Colman Dock include the trestle, the passenger-only ferry landing, overhead loading, three slips, and dolphins.

PCE#3: An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Habitat quality, both terrestrial and aquatic, in the action area is generally poor due to the extensive development in the area. The degraded habitat quality, especially vertical concrete seawalls, reduces natural production of invertebrates. Urbanization has resulted in the loss of riparian trees with only a few scattered trees, or clumps or trees, remaining along the shoreline. This lack of riparian vegetation limits inputs of terrestrial prey organisms. Productivity of aquatic macroinvertebrates is probably low due to the condition and type of substrates, lack of aquatic vegetation, vessel traffic, and the altered shoreline; however, tube worms, tunicates, and other aquatic macroinvertebrates have been observed during surveys (SDOT 2011a and SDOT 2011b) of the project area. Numerous fish species have also been documented in the project area. However, few documented forage fish spawning locations are found in the action area, with most found in and around Eagle Harbor on Bainbridge Island. One documented forage fish spawning area is found on Alki Beach of West Seattle. Juvenile salmonids, outmigrating from the Duwamish River from January through October, are one source of prey for bull trout.

PCE #4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

Natural cover in the action area is extremely limited. With approximately 100 percent of the Elliott Bay shoreline modified with riprap, bulkheads, and seawalls, almost all natural cover has been removed and replaced with overwater structures such as piers and docks. Some natural cover consisting of driftwood and logs exists along intertidal areas of the Duwamish Head and along the northern shoreline of Elliott Bay at the Olympic Sculpture Park and Mrytle Edwards Park. However, complex marine shoreline environments are almost entirely lacking in the immediate project vicinity. There is one small intertidal habitat in the area near Pier 48 south of the Seattle Terminal. Processes to establish and maintain complex marine shorelines have been lost due to bank hardening and associated infrastructure.

PCE #5: Water temperatures ranging from 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

Water temperatures within the action area fluctuate between 7.0°C and 16.5 C (44.6°F and 61.7°F). These temperatures are within those preferred by bull trout. Water temperatures within the action area are influenced by both the water temperatures of the Green/Duwamish River discharging into Elliott Bay, and the deep waters and tidal cycle of the action area.

PCE #8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

Elliott Bay water quality is considered excellent for aquatic life use per WAC 173-201A-612. However, water quality in Elliott Bay has been affected by decades of various land use activities and discharges. Between Alki Point and West Point, 18 King County and City of Seattle CSO outfalls discharge into Elliott Bay (King County 2013)). Two of these CSOs meet Washington State requirements of one discharge event per year. Not surprisingly, the Ecology's 2008 303(d) Category 5 list of parameters of concern for the bay includes fecal coliform. Numerous stormwater outfalls also discharge into Elliott Bay, many of these being small (less than 6 in diameter) pipes that originate from the residential, industrial, and commercial lands surrounding Elliott Bay. Stormwater and CSO discharges into the Green/Duwamish River also enter Elliott Bay and contribute to its water quality pollutant loading. Stormwater from the trestle discharges mostly untreated directly to Elliott Bay, and existing creosote-treated timber piles may leach PAHs into the water column, degrading water quality in the terminal vicinity.

Pollutants discharged into Puget Sound include petroleum products, polychlorinated biphenyls (PCBs), PAHs, Polychlorinated dibenzo-dioxins, heavy metals, fertilizers, animal wastes, pesticides, surfactants, hormones, medications, and sediment (Table 8) (Corps 2008).

Table 8. Pollutants of concern in Puget Sound

Pollutant	Sources
Lead, mercury, copper, zinc, and others	Vehicles, batteries, paints, dyes, stormwater runoff, spills, pipes
PAHs	Burning wood and fossil fuels, oil spills, leaking underground fuel tanks, creosote, asphalt, coal
PCBs	Hydraulic fluids, solvents, electrical coolants, lubricants
Dioxins & furans	Byproducts of combustion and industrial processes
Dichloro-diphenyltrichloroethane (DDT)	Pesticide
Phthalates	Plastic materials, food packaging, garden hoses, medical equipment, toys, personal care products
Polybrominated diphenyl ethers (PBDEs)	Flame retardant in electronics, textiles, plastics

Conservation Role of the Action Area for Bull Trout

Subadult and adult bull trout will use Elliot Bay for feeding, refuge, and as a migration route to other core areas or FMO habitat. Fish habitat within Elliott Bay has been extensively modified with approximately 97 percent of the original wetlands and shallow sub-tidal habitats filled (Kerwin and Nelson 2000). The substrate and sediment is limited due to contamination with PAHs, PCBs, and metals. The nearshore habitat is degraded due to shoreline armoring, a lack of riparian vegetation, and the presence of overwater piers and wharves.

Other Impacts Occurring within the Action Area

Impacts Associated with Nearby Projects

Numerous activities within the action area continue to impact the terrestrial and aquatic environment. While the upland area of downtown Seattle is almost 100 percent impervious surface, development continues. Smaller buildings are replaced by taller, higher occupancy residential and commercial buildings. Development spreads to the surrounding areas which currently are not as highly developed. The increase in development results in elevated noise levels from traffic, and increases in stormwater and contaminants entering Elliott Bay. Some developments, when sufficient area exists, improve stormwater runoff by constructing green stormwater infrastructure conveyance and flow control facilities, such as bioswales, bioretention cells, cascading planters, and other low impact development such as green roofs and permeable pavement sidewalks. Other projects use basic water treatment for stormwater. While individual projects improve water quality from their respective project sites, these specific areas constitute a very small portion of the overall area which drains to Elliott Bay.

Many projects within or along the shoreline require consultations with the Services. Some of these projects improved the aquatic environment by removing creosote treated timber piles, capping holes with clean sand and gravel, removing in-water debris, and minimize the number of piles under over water structures. Short-term projects (i.e. projects taking one construction season or less to complete) generally generate impacts that are insignificant and do not have any measurable affect to listed species. Other projects, such as State Route 99 South Holgate to South King Street, Alaskan Way Viaduct Bored Tunnel Alternative, King County Marine Terminal Wharf Maintenance (barge project), Seattle Seawall Project, Magnolia Bridge Replacement Project, and the Port of Seattle 10-year Programmatic have either long-term operational stormwater impacts, temporary and permanent impacts to habitat, or have construction impacts extending over multiple years.

Stormwater runoff increases pollutant loading and results in discharge of contaminants that impacts listed species and their prey species (See Effects of the Action Section). Construction for some of these larger projects results in prolonged increases in in-air and underwater sound levels from both vibratory and impact pile driving. Increased sound levels can result in injury or behavioral changes to listed species. Although individually, the specific projects listed above were found not to have any measurable affect to listed species, it is difficult to predict what their effects have been in aggregate or cumulatively.

Climate Change

Our analyses under the Endangered Species Act include consideration of ongoing and projected changes in climate. The terms "climate" and "climate change" are defined by the Intergovernmental Panel on Climate Change (IPCC). The term "climate" refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007a, p. 78). The term "climate change" thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007a, p. 78).

Scientific measurements spanning several decades demonstrate that changes in climate are occurring, and that the rate of change has been faster since the 1950s. Examples include warming of the global climate system, and substantial increases in precipitation in some regions of the world and decreases in other regions. (For these and other examples, see IPCC 2007a, p. 30; and Solomon *et al*. 2007, pp. 35–54, 82–85). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is "very likely" (defined by the IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide emissions from use of fossil fuels (IPCC 2007a, pp. 5-6 and figures SPM.3 and SPM.4; Solomon *et al*. 2007, pp. 21–35). Further confirmation of the role of GHGs comes from analyses by Huber and Knutti (2011, p. 4), who concluded it is extremely likely that approximately 75 percent of global warming since 1950 has been caused by human activities.

Scientists use a variety of climate models, which include consideration of natural processes and variability, as well as various scenarios of potential levels and timing of GHG emissions, to evaluate the causes of changes already observed and to project future changes in temperature and other climate conditions (e.g., Meehl *et al*. 2007, entire; Ganguly *et al*. 2009, pp. 11555, 15558; Prinn *et al*. 2011, pp. 527, 529). All combinations of models and emissions scenarios yield very similar projections of increases in the most common measure of climate change, average global surface temperature (commonly known as global warming), until about 2030. Although projections of the magnitude and rate of warming differ after about 2030, the overall trajectory of all the projections is one of increased global warming through the end of this century, even for the projections based on scenarios that assume that GHG emissions will stabilize or decline. Thus, there is strong scientific support for projections that warming will continue through the 21st century, and that the magnitude and rate of change will be influenced substantially by the extent of GHG emissions (IPCC 2007a, pp. 44–45; Meehl *et al*. 2007, pp. 760–764 and 797–811; Ganguly *et al*. 2009, pp. 15555–15558; Prinn *et al*. 2011, pp. 527, 529). (See IPCC 2007b, p. 8, for a summary of other global projections of climate-related changes, such as frequency of heat waves and changes in precipitation. Also, see IPCC 2011(entire) for a summary of observations and projections of extreme climate events.).

Various changes in climate may have direct or indirect effects on species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007, pp. 8–14, 18–19). Identifying likely effects often involves aspects of climate change vulnerability analysis. Vulnerability refers to the degree to which a species (or system) is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the type, magnitude, and rate of climate change and variation to which a species is exposed, its sensitivity, and its adaptive capacity (IPCC 2007a, p. 89; see also Glick et al. 2011, pp. 19–22). There is no single method for conducting such analyses that applies to all situations (Glick et al. 2011, p. 3). We use our expert judgment and appropriate analytical approaches to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

A description of potential climate related effects is provided below for bull trout.

Recent observations and modeling for Pacific Northwest aquatic habitats suggest that bull trout and other salmonid populations will be negatively affected by ongoing and future climate change. Rieman and McIntyre (1993, p. 8) listed several studies which predicted substantial declines of salmonid stocks in some regions related to long term climate change. More recently, Battin et al. (2007, pp. 6721-6722) modeled impacts to salmon in the Snohomish River Basin related to predictions of climate change. They suggest that long term climate impacts on hydrology would be greatest in the highest elevation basins, although site specific landscape characteristics would determine the magnitude and timing of effects. Streams fed by snowmelt and rain-on-snow events may be particularly vulnerable to the effects of climate change (Battin et al. 2007, p. 6724). Warming air temperatures are predicted to result in receding glaciers, which in time would be expected to seasonally impact turbidity levels, timing and volume of flows, stream temperatures, and species response. Changing climatic conditions are expected to similarly affect other North Puget Sound basins.

With the impacts of climate change, habitat connectivity and thermal refugia will become even more important to the growth and survival of fluvial and anadromous bull trout. If the current climate change models and predictions for Pacific Northwest aquatic habitats are accurate, bull trout will be affected as follows:

- Changes in distribution, reduced spawning habitat, and/or seasonal thermal barriers along migratory corridors resulting from increased stream temperatures.
- Short or long term changes in habitat and prey species availability due to larger or more frequent stochastic events.
- Shifts in seasonal availability of prey, resulting from changes in flow and the timing of out-migration.

EFFECTS OF THE ACTION

Regulations implementing the Act define "effects of the action" as "the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action that will be added to the environmental baseline" (50 CFR Section 402.02). This section details the anticipated effects to bull trout from the proposed action.

To describe the potential effects of the action on listed species and critical habitat, this Opinion applies an approach that first describes the effects to the physical, biotic, and chemical environment (potential "stressors"); the likelihood, intensity, and duration of exposure; the anticipated response(s) to exposure; and then, the biological relevance of those responses for individual bull trout and/or marbled murrelets and critical habitat PCEs, respectively. Effects at the level of the individual (or group of individuals) are then translated or assessed for significance to numbers (abundance), reproduction (productivity), and distribution at the scale of the larger population(s). For critical habitat, we describe expected temporary and permanent effects to the PCEs and, relative to the recovery role for the larger Critical Habitat Unit and critical habitat rangewide, whether the affected critical habitat will remain functional or retain the current ability to establish (or reestablish) functioning PCEs.

Complex actions that include multiple project elements and/or project locations have the potential to cause a variety of exposures (or exposure scenarios). The sub-sections that follow refer to some of the previously described project elements and items of work as a means of organizing the discussion of potential stressors, exposures, responses, and effects. Though the proposed action will affect a variety of habitats, for bull trout, the affected habitats represent non-core FMO habitat, and only subadult and adult bull trout are likely to be exposed to stressors that elicit a response. For marbled murrelets, the proposed action will affect marine foraging habitats, and thus foraging and loafing marbled murrelets in the action area are likely to be exposed to project related impacts, in particular in-air and underwater noise.

If an effect to the physical, biotic, and/or chemical environment (stressor), would occur at a place or time when exposure of an individual(s) is extremely unlikely, those potential exposures and effects are considered discountable. In general, it is more likely that temporary effects (stressors) and potential exposures can be found discountable. It is more difficult to conclude that permanent or long term effects (stressors) will not expose individuals over time.

If exposure is not discountable and an individual(s) are exposed to a stressor, the intensity and duration of that potential exposure are important considerations. Some low-intensity and/or short-duration exposures may elicit no response in the individual. Other exposures will or may elicit a response(s), and the biological relevance of those responses must be assessed.

A response is biologically relevant if it measurably affects an individual or a PCE. For example, when stressors elicit an avoidance response and/or prevent or discourage free movement or exploitation of preferred habitats, these responses can have significance for the individual (e.g., reduced foraging success or efficiency, delayed migration). Behavioral responses represent a

complex interaction with the affected environment. Determining their biological significance or relevance requires that we evaluate the condition and needs of the individual(s), the amount and quality of affected habitat, the duration and intensity of exposure, and the action or presence of other stressors.

Measurable adverse effects to individuals may reach the level of an adverse effect. Adverse effects result if the exposure and effect significantly disrupts normal or essential behaviors (e.g., feeding, moving, sheltering, migrating, spawning, rearing), if it results in significant sublethal physiological stress with potential consequences for growth or long term survival, or if it causes physical injury (e.g., gill abrasion, barotrauma) or mortality.

The sub-sections that follow discuss sequentially: insignificant and discountable effects (by project element and/or item of work); adverse effects to individuals (by project element and/or item of work); effects to the PCEs of critical habitat; and, a synthesis of effects and responses at the scale of the larger population(s) and Critical Habitat Unit. Some common potential stressors are discussed repeatedly (e.g., excess turbidity and sedimentation, effects to the prey base).

Insignificant and Discountable Effects (Bull Trout and Bull Trout Critical Habitat)

This sub-section identifies and discusses in some detail those potential exposures and effects that we conclude are extremely unlikely to occur, and are therefore discountable. This section also identifies and discusses those potential exposures and effects that we conclude will not measurably affect individual bull trout or their habitat, and are therefore insignificant.

Overwater Cover/Shading

Changes in over water cover are described above and summarized here. The new trestle and associated structures will create approximately 5,164 ft^2 of new overwater cover, but light penetrating surfacing will be installed over about 5,300 ft^2. However, the project will temporarily (for five years) increase overwater coverage in the action area by 38,590 ft^2. In the long term, overwater coverage within the action area will be maintained. As a result, the potential for these changes to measurably affect bull trout is considered insignificant. The Project-related overwater cover is anticipated to have insignificant effects on bull trout critical habitat, in particular because of the light penetrating surfacing that will be installed in the new POF areas.

Temporary shading will result from the use of barges and derricks during construction. Shading extent and location associated with barges and derricks will vary in each phase. In phase 1, a derrick and two barges (approximately 48,000 ft^2 in total area) will be stationed south of the trestle. During phases 2 and 3, a derrick and a barge (32,000 ft^2 in total area) will be situated south of slip 2. In phase 4, three barges and one derrick (64,000 ft^2 in total area) will be anchored adjacent to the north (timber) trestle north of Slip 3. Barges and derricks will be anchored on the western edge of the terminal in deeper water 30 to 40 ft below MLLW) and will be moved regularly to access different work areas. Due to the temporary nature of the effects

associated with barges, no permanent effects to habitat are anticipated from barge-related shading. As a result, these effects to bull trout and to bull trout critical habitat are considered insignificant.

Benthic Habitat

Benthic areas provide habitat for marine and forage fish that provide a food source for bull trout. Dredging and installation of piles will impact benthic habitat.

The Project will install 1,033 new piles in the water, remove over 2,500 piles, and remove 14,500 ft^2 of fill underneath the north trestle, resulting in a total of 12,650 ft^2 permanent gain of benthic habitat. This net benthic habitat gain will allow for the establishment of additional benthic macroalgae and macroinvertebrates throughout the action area. The temporary POF slip will create 65 ft^2 of benthic habitat impacts for approximately one in-water work season, until the new POF slip is constructed and the temporary benthic impacts are removed.

We do not expect that permanent features of the Project will prevent or discourage migration through the area, or expose bull trout to heightened predation risk or other acute or chronic stressors. Furthermore, because of the small amount and low quality of affected foraging habitat, the overall gains in potential foraging habitat, and because productive, alternative foraging opportunities are readily available within the action area, we conclude that these adverse effects to habitat will not significantly disrupt normal bull trout behaviors. In summary, the anticipated effects to benthic habitat resulting from the Project will result in slight improvements of available habitat and habitat quality within the action area, but these changes are not expected to measurably affect bull trout, their prey base, or the key functions provided by bull trout critical habitat.

Stormwater

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998). Stormwater discharges are indirect effects of the action.

Stormwater generated by roadways contains pollutants detrimental to aquatic life. The primary constituents of concern are total suspended solids (TSS), total copper (TCu), dissolved copper (DCu), total zinc (TZn), and dissolved zinc (DZn). The Services have established a freshwater behavioral threshold level for fish of 2µg/L above the background concentration for DCu and 5.6 µg/L above the background concentration for DZn (WSDOT 2012). However, standards for effects to salmonids have not yet been established for saltwater, so the freshwater standards were used for this analysis.

Existing PGIS at the Colman Dock totals 4.03 acres. Currently all runoff discharges untreated directly into Elliott Bay. Pollutant loads and concentrations for the Project were analyzed using the HI-RUN program approved by WSDOT and the Services per the 2009 Memorandum of Agreement. Stormwater runoff from existing holding lanes and PGIS generates approximately

1608 lb/yr of TSS, 0.407 lb/yr of TCu, 0.095 lb/yr of DCu, 2.48 lb/yr of TZn, and 0.712lb/yr of DZn. End-of-pipe constituent concentrations were calculated, but no projected pollutant concentrations in Elliott Bay or dilution zones were provided by the project proponent because this additional calculation was not "triggered" during the HI-RUN analysis. Currently runoff discharges as untreated flow (aside from oil-water separators) from the deck of the trestle into Elliott Bay.

The Project will provide basic treatment for all PGIS associated with the ferry terminal (4.03 acres). Stormwater runoff will be collected on the trestle and fed into trunk lines that outlet to wetvaults combined with an oil/water separator cell. Wet-vaults contain a permanent pool of water that dissipates energy and provides for the settling of particulate pollutants. As a result, the rate of annual loading and extent of water quality impacts in this portion of the action area will be reduced as follows: 148 lb/yr of TSS (91 percent reduction from current conditions), 0.13 lb/yr of TCu (68 percent reduction), 0.079 lb/yr of DCu (17 percent reduction), 0.61 lb/yr of TZn (75 percent reduction), and 0.41 lb/yr of DZn (42 percent reduction). No detention will be provided since stormwater discharges to Elliott Bay are exempt from flow control requirements.

In addition, WSF will sweep the holding areas and PGIS on a quarterly basis with a high-efficiency vacuum sweeper, which will reduce pollutants entering stormwater treatment BMPs. The level of reduction this vacuuming will generate is difficult to quantify but will positively contribute to a source reduction of potential stormwater runoff pollutants.

With consideration for the low numbers of adult and subadult bull trout potentially foraging or migrating in the immediate vicinity of Colman Dock, the limited extent of affected habitat (i.e., the immediate vicinity of the points of discharge), the improvements in water quality generated by the Project when compared to current conditions, and the frequency, duration, and intensity of potential exposures, we expect that stormwater discharges will have no measurable effect on bull trout individuals, or their prey base, and are therefore insignificant.

In addition, the treatment for impervious surface resulting from the project will result in decreased annual loadings of stormwater constituents discharged into Elliott Bay in perpetuity. As a result, baseline conditions will be slightly improved in the vicinity of the ferry terminal. Bull trout critical habitat adjacent to the Project will be positively affected in the immediate vicinity of the outfalls (up to 50 ft from the discharge points) because the Project will result in incremental improvements of environmental baseline conditions and PCE # 8 (sufficient water quality and quantity) in perpetuity within these small areas. Given the potential for fish to avoid areas affected by elevated concentrations of stormwater constituents, Project related stormwater improvements will also slightly improve PCE #2 (migration habitats) in the immediate vicinity of the outfalls. However, the scale of these Project-related impacts will not measurably improve the key functions provided by bull trout marine FMO habitat at the action area or larger scales. We expect stormwater discharges from Colman Dock will have no measurable effect on bull trout critical habitat or critical habitat PCEs, and are therefore insignificant.

Adverse Effects of the Action (Bull Trout and Critical Habitat)

While we expect that several of the included Project elements, and many associated items of work, will have no measurable, adverse effects on bull trout individuals, their prey base, or habitat, we do expect that measurable, adverse effects will result from Project construction activities. These activities include removal of pilings and installation of permanent steel and concrete reinforced steel piles.

Construction activities conducted below MHHW will produce stressors with potential adverse effects to bull trout, their prey base, and habitat. These stressors include: temporary elevated in-air and underwater noise levels; temporary effects to water quality (turbidity and low-level contamination) resulting from pile removal and installation activities; and increased bioavailability of contaminants within the action area as a result of potential redistribution of contaminants in the action area resulting from bed disturbance and sediment transport. These stressors have the potential to injure a limited number of subadult and adult bull trout. Temporary exposures will significantly disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter), by causing bull trout to avoid the action area, impeding or discouraging free movement through the action area, preventing individuals from exploiting preferred habitats, and/or exposing individuals to less favorable conditions.

The sub-sections that follow discuss these Project elements and activities, resulting stressors, exposures, and adverse effects in greater detail.

<u>Elevated Underwater Sound</u>

While constructing the terminal and associated pile structures (dolphins, etc.), the Project will install numerous piles below the MHHW including:

- Approximately 396, 18-inch diameter concrete piles driven with an impact hammer
- Approximately twenty 30-inch diameter steel piles and 570, 30-inch diameter concrete reinforced steel piles, driven with a vibratory hammer then proofed with an impact hammer, and
- Approximately sixteen 36-inch diameter steel piles (five of which will be temporary), sixteen 30-inch diameter steel piles (two of which will be temporary), and seven 24-inch diameter steel piles installed with a vibratory hammer.

In addition, four 72-inch shafts, two 80-inch diameter shafts, one 84-inch diameter shaft, and one 108-inch diameter shaft will be installed with a vibratory hammer below the MHHW. The Project will deploy bubble curtains during impact pile driving of steel piles and implement underwater sound, and marbled murrelet, monitoring. During impact pile driving of concrete piles, a pile cushion of similar device will be used to minimize underwater sound levels.

As of June 2008, the Service, FHWA, WSDOT, and other signatory agencies have endorsed application of interim criteria for estimating onset of injury developed by the Fisheries

Hydroacoustic Working Group (FHWG 2008). These interim criteria apply a SEL framework for assessing fish injury. The interim criteria for fish injury identify a single-strike Sound Pressure Level (SPL) of 206 dB_{peak} and 183 dB accumulated SEL for fish less than 2 grams. The interim criteria identify a single-strike SPL of 206 dB_{peak} and 187 dB accumulated SEL for fish greater than 2 grams (FHWG 2008).

We use the practical spreading model (Davidson 2004) to estimate the distance from piling installation operations (R; range) at which transmission loss (TL) can be expected to attenuate SPLs and SELs to below thresholds for injury and significant behavioral interference. The calculation [TL = 15*Log(R)] assumes that sound levels decrease at a rate of 4.5 dB per doubling distance. This method also assumes that single-strike SELs less than 150 dB do not accumulate to cause injury ("effective quiet") (Stadler, Pers Comm, 2009).

Based on pile-driving analysis provided by WSF on June 27, 2013, we used a single-strike SPL of 212 dB_{peak} and 195 dB_{rms}, a single-strike SEL of 186 dB, assumed 10 dB attenuation associated with deployment of bubble curtains during impact pile driving, and assumed as many as 1,800 strikes/day (six piles per day, 300 strikes per pile) during a single 10- or 12-hour workday. These assumptions regarding unattenuated pressures are within the range reported in the literature for similar operations and result in a potential injury area of 273 m (896 ft) from pile driving operations and 2,154 m (7,067 ft) for potential behavioral effects (CALTRANS 2007).

We expect that subadult and adult bull trout exposed to an accumulated SEL of 187 dB will be injured or killed. We also expect that subadult and adult bull trout, when exposed to single-strike SPLs of 150 dBrms or above, will experience a significant disruption of their normal behaviors (i.e., ability to successfully feed, move, and/or shelter). Pile driving with an impact hammer may cause bull trout to temporarily avoid the area, impede or discourage free movement through the area, prevent individuals from exploiting preferred habitats, and/or expose individuals to less favorable conditions.

The total energy content and sound wave forms that result from vibratory and impact pile driving are very different. Vibratory pile drivers impart less energy to the surrounding environment and produce a muted wave form. Where impact pile driving and proofing is concerned, the composition and size of the piling influences the sound wave form and total energy content. Smaller hollow steel pipe piles generally produce lower peak SPLs and impart less total energy than do larger hollow steel pipe piles. Wood, plastic, and concrete piles all typically produce lower peak SPLs and impart far less total energy than do comparatively-sized hollow steel pipe piles.

We expect that impact driving of steel and concrete reinforced steel piles may kill or injure subadult and adult bull trout to a distance of approximately 273 m (896 ft) from piling installation operations. However, the duration of impact pile driving, and therefore the duration of potential exposure to elevated underwater sound pressure levels, will be limited (worst case) to the following durations for each phase of the project:

- Phase 1 – nine hours over four days (up to four hours per day)
- Phase 2 – 42.5 hours over 12 days (up to 3.75 hours per day)
- Phase 3 – 166.5 hours over 46 days (up to 3.75 hours per day)
- Phase 4 – 146 hours over 40 days (up to 3.75 hours per day).

Impact driving of steel and concrete reinforced steel piles will also significantly disrupt normal bull trout behaviors (in particular foraging and migration) to a distance of approximately 2,154 m (7,067 ft), during these same periods.

For bull trout critical habitat, the temporary underwater sound impacts will not have lasting or measurable effects on the key functions provided by bull trout critical habitat, and are therefore considered insignificant. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the Project will have no effect on bull trout rearing and spawning habitat or these essential behaviors.

Temporary Exposure to Elevated Turbidity, Contaminants and Degraded Water Quality

Construction of the Project includes activities that will temporarily degrade water quality and result in measurable, adverse effects to bull trout and their habitat. These activities include installation and removal of piles.

A general description of the effects to fish associated with each anticipated water quality stressor (i.e. turbidity and contaminants) is provided below, followed by a characterization of the anticipated extent of these effects, and a discussion of anticipated exposure and biological response.

Turbidity

Although few studies have specifically examined the issue as it relates to bull trout, increases in suspended sediment affect salmonids in several recognizable ways. The effects of suspended sediment may be characterized as lethal, sublethal or behavioral (Bash et al. 2001; Newcombe and MacDonald 1991; Waters 1995).

Lethal effects include gill trauma (physical damage to the respiratory structures), severely reduced respiratory function and performance, and smothering and other effects that can reduce egg-to-fry survival (Bash et al. 2001). Sublethal effects include physiological stress reducing the ability of fish to perform vital functions (Cederholm and Reid 1987), increased metabolic oxygen demand and susceptibility to disease and other stressors (Bash et al. 2001), and reduced feeding

efficiency (Bash et al. 2001; Berg and Northcote 1985; Waters 1995). Sublethal effects can act separately or cumulatively to reduce growth rates and increase fish mortality over time. Behavioral effects include avoidance, loss of territoriality, and related secondary effects to feeding rates and efficiency (Bash et al, 2001, p. 7). Fish may be forced to abandon preferred habitats and refugia, and may enter less favorable conditions and/or be exposed to additional hazards (including predators) when seeing to avoid elevated concentrations of suspended sediment.

Exposure concentration and duration will strongly influence whether temporary exposures cause lethal or sublethal effects. Information is limited and there are important sources of uncertainty. These sources of uncertainty include grain size, the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, and the rate or degree of contaminant desorption to the surrounding water column. Additional sources of uncertainty include the effect of intermittent, episodic, or transient exposures (Burton et al. 2000, p. ab; Marsalek et al. 1999, p. 34), variations in tolerance among exposed individuals, populations, and/or species (Ellis 2000, p. 89; Hodson 1988, p. ab; Lloyd 1987, p. 502), and, the potential for additive or synergistic effects among water quality stressors (Burton et al. 2000, p. ab; Ellis 2000, p. 88; Lloyd 1987, p. 494). Burton et al. (2000, p. ab) have emphasized the importance of "real-world" patterns of exposure. Lloyd (1987, pp. 492, 501) suggests that water quality stressors can exert a greater effect when dissolved oxygen levels are low. Hicks (1999 in WSDOT 2010, p. H-18) reports avoidance behavior in salmonids responding to dissolved oxygen levels below 5.5 mg/L.

Estimate of the Extent of Effects – Turbidity

Pile removal activities for each phase of the project are summarized below:

- Phase 1 will remove fifteen 36-inch diameter steel piles, six 30-inch diameter steel piles, 24 H-piles, nine 14-inch diameter steel piles, 49 12-inch diameter timber piles, and 194 13-inch diameter timber piles over 46 days throughout the August 1 to February 15 in-water work window.
- Phase 2 will remove 45 18-inch diameter concrete piles and 84 16.5-inch diameter concrete piles over 14 days.
- Phase 3 will remove 748 12-inch diameter timber piles over 75 days and 76 12-inch diameter steel-concrete piles over eight days.
- For Phase 4 will remove 1,187 12-inch diameter timber piles over 118 days and 80 12-inch diameter steel-concrete piles over 8 days.

Pile installation activities during Phase 1 are summarized as follows:

- Proofing or impact pile installation of (10) steel or (4) steel-concrete piles for Phase 1 would extend over nine hours during four days and for 396 concrete piles will extend over 2.25 hours per day during 51 days.

- Vibratory installation of (16, 36-inch steel, 16, 30-inch diameter steel, seven 24-inch steel) piles will take up to 3 hours per day over 11 days.
- The transfer span casings (two 80-inch diameter shafts) will take two days to install (vibratory).
- Installation (vibratory) of the overhead loading structure shafts (one 184-inch diameter shaft, one 84-inch shaft) and south trestle shaft (one 72-inch diameter shaft) will take three days.

Phase 2 will install (impact) 69, 30-inch diameter concrete piles, up to 3 ¾ hours per day, 35 hours total, over 12 days.

Pile installation during Phase 3 includes impact installation of 260, 30-inch diameter steel-concrete piles and ten 30-inch diameter steel piles, up to 3.75 hours per day, 166.5 hours total, over 46 days.

Pile installation during Phase 4 includes impact installation of 237, 30-inch diameter steel-concrete piles, up to 3.75 hours per day, over 40 days.

Based on the Form, increased turbidity will be confined to within 60 ft of the piles. Potential for elevated turbidity during Phase 1 spans 118 days during five months (August to November and January) of the August 1, 2015 to February 15, 2016 work window within 60 ft of the existing and new POF slip, Slip 3 (transfer span, overhead loading facility, HPU platform, inner dolphin, temporary dolphin, and left dogleg wingwall), South trestle, and Slip 2 right dogleg wingwall. For Phase 2 this potential persists for 26 days from August to December 2016 within 60 ft of the pile foundation for the new terminal building. For Phases 3 and 4, elevated turbidity is possible for 80 days throughout the entire 2018-2019 in-water work window and for 166 days throughout the entire 2019-2020 in-water work window, within 60 ft of the old building foundation, new trestle, Slip 2 transfer span bridge seat, stormwater vault, and north trestle demolition areas.

Extent of Exposure and Biological Response - Turbidity

Adult and subadult bull trout may occupy the waters immediately surrounding the ferry terminal at any time of year. Data to estimate the number of bull trout that may forage, migrate, and overwinter in this portion of the action area are limited; however, recent telemetry studies (Goetz et al. 2012) documented the presence of winter migrants in the vicinity of the Project between November and January, and other data documents bull trout presence in the lower Duwamish River and nearshore areas between April and September (Brunner 1999, Shannon in USFWS 2004). As a result, given the location of the affected area (near to the Duwamish Waterway where juvenile salmon provide a forage base for bull trout or provide overwintering habitat) and duration of anticipated in-water work, the potential of bull trout presence during in-water work elements of the Project cannot be discounted, nor can the potential exposure of individual bull trout to Project related turbidity impacts.

A number of site-specific conditions will influence the spatial extent of potential turbidity and water quality exposures. Acute exposures are usually most intense in the initial mixing zone where sediment resuspension creates a three-dimensional plume that dissipates vertically, horizontally, and longitudinally (Bridges et al. 2008, pp. 6-8, 15, 18). The size and shape of the temporary plume, and therefore the spatial extent of potential exposures, will be influenced by the following: the quantity and composition of resuspended sediment, the quantity and composition of released interstitial pore water, the rate or degree of desorption to the surrounding water column, particle size and resettling rate, discharge volume, current, tidal flux, degree of turbulence, height of release to the water column, water temperature and salinity, and operational considerations (Bridges et al. 2008, pp. 5, 7-9, 13, 20, 42).

Pile removal and installation will produce conditions of high turbidity that are most intense closest to the operations. Exposed individuals may suffer significant, sub-lethal physiological stress. Turbidity generated during pile installation and removal tends to be limited to about a 25-foot radius of the pile. However, one pile removal project at the mouth of Jimmycomelately Creek in Clallam County, WA, created sediment plumes that extended 60 to 150 ft from the pile (Weston Solutions and Pascoe Environmental Consulting 2006). Current velocities in Elliott Bay are very low, about 0.008 ft/sec (Shepsis, pers. comm. 2012), and are not a significant factor in sediment transport. Therefore this project conservatively assumes that sediments will extend 60 ft from the base of the pile during pile pulling, and we expect that acute water quality exposures with the potential to injure or kill subadult and adult bull trout will occur within a 60-foot radius.

Elevated turbidity levels will persist during working hours, for the durations described above for each phase, during four six-month in-water work windows over seven years. Given the long duration of in-water construction (four in-water work windows over seven years) and intensive pile removal activities at this location, especially during Phases 3 and 4, individual fish will experience one or more exposure events during their migration through the Project area. Given the limited survey data for bull trout in marine areas, it is difficult to predict how many bull trout will be affected by elevated turbidity. We assume all bull trout within a 60-foot radius of sediment disturbing project activities will be exposed to water quality conditions resulting in physical effects including gill abrasion, leading to reduced respiratory function and performance.

Project-related dredging will remove approximately 7,674 cubic yards of material in a 14,500 square-foot area beneath the existing north trestle. Dredging will be contained behind an existing bulkhead, minimizing turbidity related impacts to listed species. Once fill has been removed to the open water DMMP site in Elliott Bay, or to an approved upland location, and the area restored to match the bathymetry on either side, the bulkhead will be removed. Because these activities will be contained behind an existing bulkhead, and bulkhead removal will occur over a very short timeframe (i.e. days to a week) we expect sediment and turbidity impacts to listed species associated dredging and related bulkhead removal will not be measurable, and are therefore considered insignificant.

Contaminants

Recent sampling efforts detected contaminated sediments throughout the project area. As a result, in-water Project elements have the potential to result in low-level contamination via suspension or resuspension of contaminated sediments into surrounding water and sediments. The northern portion of the north timber trestle area exceeded Sediment Quality Standards (SQS) criteria for PAHs and SMS for dibenzofuran. The southern portion of the north (timber) trestle area exceeded SMS criteria for PAHs, hexachlorabutadiene, 2,4-dimethylphenol, mercury, and zinc. In addition, bioassay testing at some of the sampling locations indicated exceedance of CSL for biological effects criteria. One sample location at the existing south (concrete) trestle exceeded SMS criteria for mercury, lead, silver, and zinc. Two samples taken where the new concrete trestle will be constructed on the southern side of the project, exceeded SQS and CSL criteria for mercury, phenol, and 2,4-dimethylphenol.

Dibenzofuran is frequently referred to as a dioxin. Dioxins are a group of synthetic organic chemicals that contain 210 structurally related individual chlorinated dibeno-p-dioxins and chlorinated dibenzofurans (USEPA 1999). Dioxins in surface waters and sediments are accumulated by aquatic organisms and bioaccumulated through the aquatic food chain. Dioxin exposure is associated with a wide array of adverse health effects in experimental animals including death. Experimental animal studies have shown toxic effects to the liver, gastrointenstinal system, blood, skin, endocrine system, immune system, nervous system, and reproductive system (USEPA 1999).

Hexachlorobutadiene is moderately to very toxic to aquatic organisms. Fish species and crustaceans were found to be the most sensitive, with 96-h LC50 values ranging from 0.032 to 1.2 for crustaceans and 0.09 to approximately 1.7 mg/litre for fish. The kidney was demonstrated to be an important target organ in fish (World Health Organization, 1994).

Information regarding the concentration, persistence, fate and effects of 2,4-dimethylphenol in the environment is limited. Acute toxicity levels for 2,4-dimethylphenol for the fathead minnow were 16,750 µg/l for the 96 hour LC 50 value and 13,650 µg/l for the 192 hour LC 50 value (USEPA 1980). Acute toxicity (96-hr LC50, µg/L) for *Oncorhynchus mykiss* was 7,800-11,000 (Holcombe et al. 1987 b). However, acute toxicity to other freshwater life occurs at concentrations as low as 2,120 µg/l. No data are available concerning the chronic toxicity of 2,4-dimethylphenol and no salt water organisms have been tested (USEPA 1980).

Mercury deposition in a given area depends on mercury emitted from local, regional, national, and international sources. Microbial processes can turn mercury that is introduced into surface waters via various airborne sources into methylmercury, which is then accumulated by organisms and bioaccumulated within food chains (USEPA, 2013). Methylmercury can accumulate in fish at levels that may harm the fish and the other animals that eat them. Effects of methylmercury exposure on wildlife can include mortality (death), reduced fertility, slower growth and development and abnormal behavior that affects survival, depending on the level of exposure

(EPA, 2013). Methylmercury can also affect the endocrine system of fish, which plays an important role in fish development and reproduction, may be altered by the levels of methylmercury found in the environment (USEPA, 2013). Acute toxicity (96-hr LC50, µg/L) of phenol to fish, specifically rainbow trout, *Oncorhynchus mykiss*, was 4,230 - 12,200 (Holcombe et al. 1987 a).

Zinc occurs naturally in the environment and is an essential trace element for most organisms. However, in sufficient concentrations and when bioavailable for uptake by aquatic organisms, excess zinc is toxic. Toxicity in the aquatic environment and for exposed aquatic organisms is influenced by water hardness, pH, organic matter content, levels of dissolved oxygen, phosphate, and suspended solids, the presence of mixtures (i.e., synergistic effects), trophic level, and exposure frequency and duration (Eisler 1993). Bioavailability of zinc increases under conditions of high dissolved oxygen, low salinity, low pH, and/or high levels of inorganic oxides and humic substances. Most of the zinc introduced into aquatic environments is eventually partitioned into sediments (Eisler 1993). Effects of zinc exposure include 1) weakened immune function and impaired disease resistance (Ghanmi et al. 1989), 2) impaired respiration, including potentially lethal destruction of gill epithelium (Eisler 1993), 3) altered blood and serum chemistry, and enzyme activity and function (Hilmy et al. 1987a; Hilmy et al. 1987b), 4) interference with gall bladder and gill metabolism (Eisler 1993), 5) hyperglycemia, and 6) jaw and branchial abnormalities (Eisler1993).

Hansen et al. (2002) determined 120-day lethal concentrations of zinc for test subjects that included bull trout and rainbow trout fry. Multiple pairs of tests were performed with a nominal pH of 7.5, hardness of 30 mg/L, and at a temperature of 8 °C. Bull trout LC50 values measured under these conditions ranged from 35.6 to 80.0 µg/L, with an average of 56.1 µg/L. Hansen et al. (2002) found that rainbow trout fry are more sensitive to zinc (i.e., exhibit a lower LC50) than are bull trout fry. The authors also report that older, more active juvenile bull trout are more sensitive than younger, more docile juvenile bull trout based on observed changes in behavior at the juvenile life stage. The authors argue that the timing of zinc and cadmium exposure and the activity level of the exposed fish are germane to predicting toxicity in the field.

There are no known studies or data describing adult bull trout response to lethal or near-lethal concentrations of zinc. Active feeding and increased metabolic activity are apparently related to sensitivity. It is unknown whether sensitivity to zinc varies between adult, subadult, and juvenile bull trout. Activity level may be a better predictor of sensitivity than age. In addition to the physiological effects of zinc exposure, studies have also documented a variety of behavioral responses. Among these, Eisler (1993) includes altered avoidance behavior, decreased swimming ability, and hyperactivity. The author also suggests zinc exposure has implications for growth, reproduction, and survival.

Creosote contains numerous constituents that are known to be toxic to aquatic organisms (Eisler 1987; Germain et al. 1993; Brooks 1994; Brooks 2000; Johnson et al.2002). Creosote is composed primarily of PAHs (about 65 to 85 percent), with smaller percentages of phenolic compounds (ten percent), and nitrogen-, sulfur-, or oxygenated heterocyclics (Brooks 1994). Variations in physical and chemical characteristics of PAHs are generally related to molecular

weight (Eisler 1987). With increased molecular weight, aqueous solubility decreases, solubility in fats increases, and resistance to oxidation and reduction decreases. Lower molecular weight (2-3 ring) PAHs are more mobile and can have significant acute toxicity to some organisms, whereas the higher molecular weight (4-7 ring) PAHs do not. However, all known PAH carcinogens, cocarcinogens, and tumor producers are in the high molecular weight PAH group.

Acute exposure to PAHs through the water or sediment can result in narcosis (Van Brummelen et al. 1998), suppressed immune function (Karrow et al. 1999), hormone disruption, and hepatic tumors in fishes (Kahn et al. 1986; Stein et al. 1990; Johnson et al.2002). PAHs are ubiquitous in the marine environment and primarily originate from combustion products and petroleum (Meador et.al. 1995, Burgess 2007). The toxic effects of PAHs to aquatic species depends on several factors, including route of exposure, duration and concentration of exposure, chemical composition, organism sensitivity, life stage affected, organism potential for detoxification/excretion, and the physical condition of the particular organism during exposure (DNR 2008).

Studies have shown that high concentrations of toxic chemicals in sediments are adversely affecting Puget Sound biota via detritus-based food webs (Johnson et al. 2002). Meador et al. (1995) provided a thorough review of the literature on factors governing the bioaccumulation of PAHs in marine organisms (invertebrates and fish). The study concluded that the major routes of exposure for marine species were through the uptake of waterborne chemicals and through the diet. Direct uptake of sediment-bound chemicals (e.g., through ingestion or absorption through the integument of worms and fish) appears to be negligible. Because PAHs tend to adsorb to sediments when sediment is undisturbed, only a portion of parent PAH compounds are readily bioavailable to marine organisms.

Overall, the laboratory and field studies indicate that creosote-treated wood structures can leach PAHs and other toxic compounds into the environment (Poston 2001). Chemicals in creosote break down in water very slowly. They tend to cling to particles of matter, making sediments the primary location for these contaminants to collect in aquatic environments (DNR 2008). Accumulation of PAHs in sediment is relatively limited spatially (within approximately 30 ft of structures) and has not generally been associated with measured, significant, biological effects except in close proximity or direct adhesion to the structures (Stratus 2006).

However, when these sediments are disturbed, PAH compounds can potentially desorb into the water column and can be redeposited in surface sediments (Romberg 2005). Weston (2006) reported that during pulling of creosote pilings at the site of an old log yard operation, elevated PAH concentrations persisted for five minutes in the water column after the piles were pulled before returning to background levels. All measured water quality concentrations stayed below the Washington State standards of 300 parts per billion. Smith (2008) evaluated PAHs and phenols in sediments, timber, water and oyster tissue before and after removal of creosote treated posts. Smith determined that PAHs in surface sediments increased from 24.1 mg kg^{-1} dry weight

to 45.5 mg kg^{-1} dry weight after post removal and to 59.7 mg kg^{-1} dry weight six months later. He also determined that the total PAHs (primarily low-molecular weight) dispersed to the environment when a creosote post was pulled out was at least 0.67 g.

Resident benthic organisms are exposed to PAHs through their diet, through exposure to contaminated water in the benthic boundary layer, and through direct contact with the sediment (Johnson et al.2002). PAHs may bioaccumulate in aquatic invertebrates within these benthic communities (Varanasi et al. 1993; Meador et al. 1995). Bottom dwelling marine fish such as English sole, which feed on benthic invertebrate prey, could be exposed to high levels of PAHs. Most nonbenthic fish tissue contains relatively low concentrations of PAHs, and accumulation is usually short term because these organisms can rapidly metabolize and excrete them (DNR 2008, Lawrence and Weber 1984, West et al. 1984 as cited in Eisler 1987). Generally, vertebrates quickly metabolize some of the lighter PAH compounds (McElroy et al. 1991). Accordingly, once salmon enter free swimming life stages in freshwater when they are not closely associated with bottom sediments or enter an open-water marine life stage, the potential to be exposed to contaminants from treated wood at levels that adversely affect them is very low (Poston 2001).

Estimate of the Extent of Effect – Contaminants

The modeling completed to estimate turbidity and sedimentation impacts associated with pile removal and driving has been used to estimate the extent of potential short-term contaminant exposures resulting from resuspension and redistribution of contaminants and contaminated sediment in the action area.

Contaminants at the northern portion of the north timber trestle that exceeded established criteria included PAHs and dibenzofuran. Contaminants on the southern portion of the north (timber) trestle area exceeding criteria included PAHs, hexachlorabutadiene, 2,4-dimethylphenol, mercury, and zinc. Contaminants at the existing south (concrete) trestle that exceeded established criteria included mercury, lead, silver, and zinc. And contaminants exceeding established criteria on the southern side of the south concrete trestle area (where the new trestle will be built), included mercury, phenol, and 2,4-dimethylphenol. Accumulation of PAHs in sediment is assumed to be relatively limited spatially (within approximately 30 ft of the structure) (Stratus 2006).

Based on the Form, during vibratory installation and removal of piles, increased turbidity and/or resuspended contaminants surrounding the piles will be confined to within 60 ft of the piles for a duration of up to six months over four in-water work windows. Resuspension of PAHs will likely be confined to a much smaller radius around the pile, based upon a recent study (Weston Solutions and Pascoe Environmental Consulting 2006).

Sediments that are resuspended during dredging will be contained behind an existing bulkhead. At completion of the dredge operation, once bathymetry within the bulkhead matches the surrounding environs, the Project will remove the bulkhead.

Dredge spoils will be disposed of offshore in compliance with DMMP standards at an approved site. Authorized use of the DMMP open-water disposal site(s) is subject to independent section 7 consultation (USFWS Reference. No. 13410-2010-I-0542; *Puget Sound Dredge Disposal Analysis Program*). Though the Elliott Bay site is included in the action area, the effects associated with offshore disposal at this site are not addressed in this document because they were addressed in this prior consultation. Any dredge spoils that do not meet DMMP criteria will be disposed of at existing commercial facilities permitted to accept contaminated waste.

Extent of Exposure and Biological Response - Contaminants

Given the expected presence of bull trout in the action area, the industrial history of the Project site, and the physical and temporal extent of turbidity and sediment effects described above, we expect that bull trout in the action area will be exposed to elevated levels of contaminants and/or contaminated sediments as a result of Project activities. Given that toxic effects of PAHs and other contaminants to aquatic species depends on several factors, including route of exposure, duration and concentration of exposure, chemical composition, organism sensitivity, life stage affected, organism potential for detoxification/ excretion, and the physical condition of the particular organism during exposure (DNR 2008), it is difficult to accurately predict the direct or indirect effects to individual bull trout resulting from suspended or resuspended contaminants from Project activities.

The areas defined above, represent the extent of short-term contaminant exposure resulting from Project activities. Given the types of contaminants identified at the Project site, we expect that Project activities within these areas will result in the disruption of respiratory functioning, endocrine development and functioning, toxic effects to the liver, gastrointenstinal system, blood, skin, immune system, nervous system, and reproductive system in adult or sub-adult bull trout. Given the limited survey data for bull trout in marine areas, it is difficult to know how many bull trout will be affected by contaminant exposure. Instead, we expect that all adult and sub-adult bull trout within a 60-foot radius of sediment disturbing project activities would be exposed to water quality conditions potentially resulting in physical effects, including but not limited to the effects listed above.

Temporary increases in contaminant concentrations within a 60-foot radius of sediment disturbing project activities are expected to disrupt normal bull trout behaviors (i.e., ability to successfully feed, move, and/or shelter) during periods of active in-water construction. We expect elevated contaminant concentrations (associated with pile installation and removal) will cause bull trout to temporarily avoid the area, may impede or discourage free movement through the area, and prevent individuals from exploiting preferred habitats. Elevated contaminant concentrations will also expose individuals to less favorable conditions (contaminated food-chain), at minimum, over four in-water work windows during a seven year period. However, the area of behavioral disruption is extremely small relative to the available marine habitat and forage base within Elliott Bay, such that avoidance of or altered movement around the 60-foot radius area surrounding construction activities is not expected to result in any measurable effects to bull trout.

In summary, exposure to elevated turbidity and contaminants over periods of weeks or months (over 118 days during Phase 1, 26 days during Phase 2, 80 days during Phase 3, and 166 days during Phase 4) within 60 ft of the Tank Farm pier is expected to physically injure any bull trout within this distance as a result of gill abrasion or respiratory injury (turbidity) and biological systems development and functioning (contaminants). Although a limited number of bull trout may be exposed, prey resources are limited, and bull trout are documented to move rapidly through the marine environment in the Project vicinity, the duration of the project is long so we expect that exposure is reasonably certain to occur.

Degraded water quality conditions over these extended periods of time will affect migration (PCE #2). Similarly, Project construction will temporarily degrade PCE # 8 (water quality and quantity) within these areas over the same period of time. However, the extent of these impacts will not measurably affect the key functions of bull trout critical habitat within the action area or larger scales. Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore pile installation and removal, stone column installation, and dredging will have no effect on bull trout rearing and spawning habitat or these essential behaviors.

Indirect Effects

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. Indirect effects may occur outside of the area directly affected by the action (USFWS and NMFS 1998). The indirect effects associated with stormwater are discussed above in the *Insignificant and Discountable Effects* sections of the document.

Effects of Interrelated & Interdependent Actions (Bull Trout and Critical Habitat)

Interrelated actions are defined as actions "that are part of a larger action and depend on the larger action for their justification"; interdependent actions are defined as actions "that have no independent utility apart from the action under consideration" (50 CFR section 402.02).

No interrelated or interdependent actions are associated with or part of the proposed project.

Summary of Effects of the Action (Bull Trout)

Based on location, extent of impacts, and proximity to bull trout core areas and local populations, we conclude that a few individuals will be exposed to the action's short term effects. The risk of physical effects (i.e. injury, gill abrasion, or reduced endocrine function) is not discountable. We expect a low number of bull trout (i.e., a few individuals at most) will be killed or injured within 541 m (1,775 ft) of pile driving and within a 18 m (60 ft) of sediment disturbing activities. These subadult and adult bull trout may originate from the Skagit, Snohomish/Skykomish, Stillaguamish or Puyallup bull trout core areas.

Exposures resulting in sublethal physiological stress, and/or a significant disruption of normal behaviors is expected to impact individual growth or long term survival. Exposure to project-related stressors will cause individual bull trout to avoid preferred habitats and reduce foraging

efficiency, impeding free movement through the area or slowing migration and will expose individuals to less favorable conditions like contaminated food chains, elevated turbidity or elevated contaminant concentrations that result in decreased respiratory or endocrine function. The affected subadult and adult bull trout may originate from any of 13 bull trout local populations (Canyon Creek, N. Fork Stillaguamish River, S. Fork Stillaguamish River, Upper Deer Creek, N. Fork Skykomish River, Salmon Creek, S. Fork Skykomish River, Troublesome Creek, upper Puyallup and Mowich Rivers, Carbon River, upper White River, West Fork White River, and Greenwater River local populations.

Summary of Effects of the Action (Bull Trout Critical Habitat)

Construction activities conducted below MHHW will produce stressors with that will temporarily adversely affect bull trout critical habitat. These stressors include elevated underwater SPLs, and effects to water quality (turbidity and low-level contamination) resulting from pile removal and installation activities and sediment transport. These exposures are expected to cause bull trout to avoid the these areas, impede or discourage free movement through the action area, prevent individuals from exploiting preferred habitats, and expose individuals to less favorable conditions. As a result, foraging, migration and overwintering functions provided by the designated critical habitat in the Project area will be temporarily degraded, inhibited, or obstructed.

Suitable bull trout rearing and spawning habitats are not present in the action area, and therefore the Project will have no effect on bull trout rearing or spawning habitat, or these essential behaviors. A discussion of how each PCE is affected by Project activities is provided below.

An earlier section identified the PCEs of bull trout critical habitat and described their baseline condition in the action area (Status of Critical Habitat in the Action Area). The following sub-sections discuss the effects of the action with reference to the five PCEs which are present and may be affected.

PCE 2: Migratory habitat with minimal physical, biological, or water quality impediments.

Migration habitat will be temporarily degraded by noise from impact pile driving; water quality impacts associated pile installation and removal, and a temporary increase in overwater cover. The project will result in a small permanent increase in overwater cover, effects of which will be minimized by incorporating light penetrating surfacing into the design of the new POF walkway.

PCE 3: Abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

We expect a decrease in forage fish and water quality due to impacts from pile removal and installation, but impacts will be temporary, anticipated effects would be limited to within 60 ft of sediment disturbing activities, and effects to the overall forage base within Elliott Bay are considered insignificant due to the limited suitability of habitat in the affected area for forage fish spawning.

PCE 4: Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

There is no complex marine shoreline habitat in the project footprint. The marine shoreline environment has been greatly altered and is armored for the length of the project area. The project will remove a section of fill underneath the north timber trestle, increasing shoreline habitat in the action area.

PCE 5: Water temperatures ranging between 2 to 15°C (36 to 59°F), with adequate thermal refugia available for temperatures at the upper end of the range.

The Project will have no measurable effects to short or long term function of this PCE. Within the action area this PCE will retain its current level of function.

PCE 8: Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited: The marine waters of Possession Sound near the ferry terminal are designated "Extraordinary" for aquatic life use per WAC 173-201(a).

The project will provide stormwater treatment for all PGIS in the project area, improving water quality in the immediate vicinity of the project.

In summary, we expect that the action will result in adverse effects to critical habitat resulting from temporary effects to PCEs #2 (migration habitats with minimal impediments), PCE #3 (food base), and #8 (water quantity and quality). The limited temporal extent of project impacts will not preclude bull trout access to or use of habitats (PCE #2) within the action area for more than the approved in-water work window in any given construction year or once the project is completed. The limited physical extent of project disturbance and water quality effects will not measurably affect the forage base (PCE #3) because suitable forage fish spawning habitat will not be affected. The limited temporal and physical extent of water quality effects will not measurably affect water quality conditions (PCE #8) within Elliott Bay because they will be temporary and confined to a very small area (within 60 ft of project activities) within Elliott Bay. As a result, the Project will not destroy or adversely modify bull trout critical habitat.

The critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area in downtown Seattle is almost entirely developed and provides little to no habitat for listed species. However, some of the projects planned in the project vicinity may create additional PGIS that will increase pollutant loading to Elliott Bay. The Seattle Public Utilities (SPU) combined sewer system upgrades would improve water quality in Elliott Bay by reducing the number of overflow events that discharge untreated sewage to the Bay. These projects are summarized in Table 9 below.

Table 9. Non-Federal projects in the action area.

Project	Project Proponent	Description	Impacts to Listed Species
Alaskan Way Surface Street Improvements	SDOT	Alaskan Way widened to six-lanes	Additional PGIS
Elliott/Western Connector	SDOT	Pike Street to Battery Street roadway connector to be four-lanes wide with a grade-separated crossing of the BNSF mainline railroad tracks.	Additional PGIS
Alaskan Way Promenade/Public Space	SDOT	Pedestrian promenade located west of the new Alaskan Way surface street between S. King Street and Pike Street.	None
First Avenue Streetcar Evaluation	SDOT	Planned to run along First Avenue between S. Jackson Street and Republican Street.	None
Seattle Combined Sewer System upgrades	SPU	Seattle planned urban development	This project would improve water quality along the Seattle waterfront by reducing the number of combined sewer overflow events.
Seattle planned urban development	Private	North Parking Lot Development at Qwest Field.	None

We expect the actions described above will result in insignificant effects to marbled murrelet individuals and that these effects will not translate to measurable effects to Conservation Zone 1, Stratum 3 populations.

We expect these same activities, except the CSO upgrades, will result in adverse effects to individual bull trout by perpetuating degraded baseline conditions within the action area, by potentially exposing bull trout to additional stormwater runoff and loading or elevated concentrations of stormwater constituents. We do not expect that these effects to individual bull trout will translate to measurable adverse effects to core areas or associated bull trout populations. The CSO upgrades will result in short-term insignificant effects but long-term beneficial effects to individual bull trout and improve baseline conditions within the action area by reducing CSO overflow events. We do not expect these improvements will translate to measurable effects to core areas or associated bull trout populations.

We expect that the actions described above, except the CSO improvements, will result in adverse effects to critical habitat resulting from temporary effects to PCEs #2 (migration habitats with minimal impediments) and #8 (water quantity and quality), but that the extent of these impacts will not destroy or adversely modify bull trout critical habitat. The CSO improvement projects will slightly improve baseline conditions by improving PCE #8. The critical habitat rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve its intended recovery role for the bull trout.

INTEGRATION AND SYNTHESIS OF EFFECTS

The Project will modify an existing structure along a highly developed, urban shoreline. It will be implemented over a seven year period in four construction phases, each of which includes in-water and overwater work. Bull trout are known to migrate and forage within the action area throughout the in-water work windows proposed for the project (August 1 to February 15). Though this species occurs in the action area, in the vicinity of Colman Dock, baseline habitat conditions are considerably degraded and will persist in their current state for the foreseeable future. Slight, localized, improvements in sediment and water quality conditions may result from the capping of contaminated areas under Colman Dock and the proposed CSO improvement projects, but it is not anticipated that these improvements would measurably affect habitat conditions in the action area.

The Project will result in periods of elevated underwater sound levels sufficiently high to result in injury of bull trout, and short-term disruption of normal behavior patterns for bull trout. The Project will also result in degraded water quality conditions that are injurious to bull trout.

Affected bull trout may originate from the Snohomish/Skykomish, Stillaguamish, or Puyallup River bull trout core areas. Given the small number of bull trout affected, we expect that no measurable effect to numbers (abundance) will be evident at the scale of any local population or core area. We also expect that for most exposed bull trout, potential incremental effects to

growth and long term survival will not be measurable, and there will be no measurable effect to numbers (abundance) or reproduction (productivity) that will be evident at the scale of local populations or core areas.

The Project will replace a portion of an existing structure in Elliott Bay. Measurable effects to marine FMO (or migrating or foraging individuals) will be temporary, and we expect that no measurable short or long term effects to distribution will be evident at the scale of the local populations or core areas.

The action will result in adverse effects to critical habitat associated with temporary and permanent adverse effects to PCEs #2 (migration habitats with minimal impediments), PCE #3 (food base), and #8 (water quantity and quality). Given the nature, size, and duration of these effects, we expect that critical habitat in the action area, the critical habitat unit, and rangewide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of degraded but sporadically occupied habitat) to serve its intended recovery role for the bull trout.

CONCLUSION

After reviewing the current status of bull trout, the environmental baseline for the action area, the effects of the proposed Colman Dock Project, and the cumulative effects, it is the Service's Biological Opinion that the Project, as proposed, is not likely to jeopardize the continued existence of the bull trout, and is not likely to destroy or adversely modify designated bull trout critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. Harm is defined by the Service as an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Federal Highway Administration, Federal Transit Administration, and Washington State Ferries so that they become binding conditions of any grant or permit issued to the WSF, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA and FTA have a continuing duty to regulate the activity covered by this incidental take statement. If FHWA and FTA 1) fail to assume and implement the terms and conditions or 2) fail to require the WSF to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the WSF and its Federal partners must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

The Service anticipates that take in the form of harm and harassment of adult and subadult bull trout from the Stillaguamish, Snohomish/Skykomish, and Puyallup core areas will result from the Project.

The Service expects that incidental take of bull trout will be difficult to detect or quantify for the following reasons: 1) the low likelihood of finding dead or injured individual; 2) delayed mortality, and 3) losses may be masked by seasonal fluctuations in numbers. Where this is the case, we use a description of the affected habitat (i.e., physical extent, frequency and duration) and the intensity of temporary exposures as a surrogate indicator of take.

1. Incidental take of bull trout in the form of harm as a direct effect of exposure to elevated underwater SPLs resulting from impact pile driving and proofing of approximately 590 steel and concrete reinforced steel piles installed between August 2015 and February 2020 over 110 working days.

    - All adult and subadult bull trout within 273 m (895 ft) of piling installation operations will be harmed as follows:
        - For four days during the Phase 1 in-water work window (August 1, 2015 to Febraury 15, 2016)
        - For 12 days during the Phase 2 in-water work window (August 1, 2016 to February 15, 2017)
        - For 46 days during the Phase 3 in-water work window (August 1, 2018 to February 15, 2019)
        - For 40 days during the Phase 4 in-water work window (August 1, 2019 to February 15, 2020)

2. Incidental take of bull trout in the form of harassment as a direct effect of exposure to elevated underwater SPLs resulting from impact pile driving and proofing. Approximately 590 steel and concrete reinforced steel piles will be installed between August 2015 and February 2020 over 110 working days.

- All adult and subadult bull trout within 2154 m (7,066 ft) of piling installation operations will be harassed as follows:
    - For four days during the Phase 1 in-water work window (August 1, 2015 to Febraury 15, 2016)
    - For 12 days during the Phase 2 in-water work window (August 1, 2016 to February 15, 2017)
    - For 46 days during the Phase 3 in-water work window (August 1, 2018 to February 15, 2019)
    - For 40 days during the Phase 4 in-water work window (August 1, 2019 to February 15, 2020)

3. All sub-adult or adult bull trout within 18m (60 ft) of various structures as specified below, in the form of harm from exposure to elevated turbidity and sedimentation, from pile removal and installation activities, resulting in gill abrasion and/or reduced respiratory function.

    - For 118 days of the Phase 1 in-water work window (August 1, 2015 to February 15, 2016) within 60 ft of the passenger only facility, south trestle, and Slip 3
    - For 26 days of the Phase 2 in-water work window (August 1, 2016 to February 15, 2017) within 60 ft of the new terminal building foundation (north trestle)
    - For 80 days of the Phase 3 in-water work window (August 1, 2018 to February 15, 2019) within 60 ft of the new (north) trestle, stormwater vault, and Slip 2
    - For 166 days of the Phase 4 in-water work window (August 1, 2019 to February 15, 2020) within 60 ft of the new (north) trestle and stormwater vault

4. All sub-adult or adult bull trout within 18m (60 ft) of various structures as specified below, in the form of harm from exposure to elevated contaminant concentrations, from pile removal and installation, resulting in reduced endocrine function and/or development or other physiological injury.

    - For 118 days of the Phase 1 in-water work window (August 1, 2015 to February 15, 2016) within 60 ft of the passenger only facility, south trestle, and Slip 3
    - For 26 days of the Phase 2 in-water work window (August 1, 2016 to February 15, 2017) within 60 ft of the new terminal building foundation (north trestle)
    - For 80 days of the Phase 3 in-water work window (August 1, 2018 to February 15, 2019) within 60 ft of the new (north) trestle, stormwater vault, and Slip 2
    - For 166 days of the Phase 4 in-water work window (August 1, 2019 to February 15, 2020) within 60 ft of the new (north) trestle and stormwater vault

EFFECT OF THE TAKE

In the accompanying Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species, destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Project incorporates design elements and conservation measures which we expect will reduce permanent effects to habitat and avoid and minimize impacts during construction. We expect that the FTA and WSF will fully implement these measures and therefore they have not been specifically identified as Reasonable and Prudent Measures (RPM) or Terms and Conditions.

The Service believes the following reasonable and prudent measure(s) are necessary and appropriate to minimize the impact of incidental take of bull trout:

1. Minimize and monitor incidental take caused by elevated sound pressure levels from impact driving and proofing of steel and concrete reinforced steel piles.

2. Minimize and monitor incidental take caused by degraded surface water quality conditions during construction resulting in exposure to elevated turbidity and sedimentation and elevated contaminant concentrations during construction.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the FHWA and FTA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

The following terms and conditions are required for the implementation of RPM 1:

1. The FHWA, FTA and WSF shall not exceed the 187 dB SEL injury threshold for bull trout 273 m (895 ft) from pile driving activities. Adequate attenuation will be achieved to ensure these SPLs at these distances are not exceeded by using a noise attenuation device such as a bubble curtain (i), temporary noise attenuation pile (ii), or functional equivalent (iii).

    i. A bubble curtain utilizing air compressor(s), supply lines to deliver air, distribution manifolds or headers, perforated aeration pipe(s), and a frame; the bubble curtain shall:

        (1) Include a frame which facilitates transport and placement of the system, keeps the aeration pipes stable, and provides ballast to counteract the buoyancy of the aeration pipes in operation.

(2) Include an aeration pipe system consisting of multiple layers of perforated pipe rings, stacked vertically in accordance with the following:

Water Depth (m)	**No. of Layers**
less than 5	2
5 to less than 10	4
10 to less than 15	7
15 to less than 20	10
20 to less than 25	13

(3) Arrange the pipe rings (in all layers) in a geometric pattern such that the pile being driven is completely enclosed by bubbles for the full depth of the water column and with a radial dimension such that the rings are no more than 0.5 meter from the outside surface of the pile.

(4) Ensure that the lowest layer of perforated aeration pipe is in contact with the substrate (without sinking into the substrate) and shall accommodate for sloped conditions.

(5) Size the air holes 1.6 mm (0.0625-inch) in diameter and space them approximately 20 mm (0.75-inch) apart. Air holes with this size and spacing shall be placed in four adjacent rows along the pipe to provide uniform bubble flux.

(6) Provide a bubble flux of 3.0 cubic meters per minute per linear meter of pipe in each layer (32.91 cubic feet per minute per linear foot of pipe in each layer). The total volume of air per layer is the product of the bubble flux and the circumference of the ring:

$Vt = 3.0\ m^3/min/m * \text{Circ of the aeration ring in m}$
or
$Vt = 32.91\ ft^3/min/ft * \text{Circ of the aeration ring in ft}$

(7) Provide meters as follows:

(a) Pressure meters shall be installed at all inlets to aeration pipelines and at points of lowest pressure in each branch of the aeration pipeline.

(b) Flow meters shall be installed in the main line at each compressor and at each branch of the aeration pipelines at each inlet. In applications where the feed line from the compressor is continuous from the compressor to the aeration pipe inlet the flow meter at the compressor can be eliminated.

(c) Flow meters shall be installed according to the manufacturer's recommendation based on either laminar flow or non-laminar flow.

ii. A temporary noise attenuation pile. Design specifications and monitoring reports or other information documenting equivalent function shall be submitted to the Service for review a minimum of 60 days prior to impact pile driving and proofing.

iii. A functional equivalent to the design described above (2.a.i.). Design specifications and monitoring reports or other information documenting equivalent function shall be submitted to the Service for review a minimum of 60 days prior to impact pile driving and proofing.

2. Contact the Service within 24 hours if hydroacoustic monitoring indicates that SPLs will exceed the extent of take exempted in the Opinion. The FHWA and FTA shall consult with the Service regarding modifications to the proposed action in an effort to reduce SPLs below the limits of take and continue hydroacoustic monitoring.

3. The FHWA, FTA and WSF will submit a monitoring report to the Service's Washington Fish and Wildlife Office in Lacey, Washington by April 1 following each construction season. The report shall include, at a minimum, the following: (a) size and type of piles driven and proofed, (b) detailed description of the noise attenuation device, including the design specifications identified above, (c) the impact hammer force used to drive and proof piles, (d) description of monitoring equipment, (e) distance between hydrophone and pile, (f) depth of the hydrophone, (g) distance from the pile to the wetted perimeter, (h) the depth of water, (i) depth into the substrate the pile was driven and proofed. (j) the results of the hydroacoustic monitoring including the frequency spectrum, SPLs, single strike and cumulative SELs. The report must include the ranges and means for peak, rms, and SELs for each pile.

The following terms and conditions are required for the implementation of RPM 2:

1. The FHWA, FTA and WSF will submit a surface water quality monitoring report (focused on turbidity and suspended sediment) to the Service's Washington Fish and Wildlife Office in Lacey, Washington by April 1 following each construction season. The report shall include, at a minimum, the following: (a) dates, times and locations of construction activities, (b) monitoring results, sample times, locations and measured turbidities (in NTUs), (c) summary of construction activities and measured turbidities associated with those activities, and (d) summary of corrective actions taken to reduce turbidity.

   If in cooperation with other permit authorities, the FTA, FHWA, and WSF develop a functionally equivalent monitoring strategy (e.g. intensive monitoring by project area or activity, followed by validation and routine monitoring), they may submit this plan to the Service for review and approval in lieu of the above monitoring requirements. This strategy must be submitted to the Service a minimum of 60 days prior to construction. In order to be approved for use in lieu of the above requirements, the plan must meet each of the same objectives.

2. The FHWA, FTA and WSF will submit a monitoring report (focused on PAHs and contaminants of concern) to the Service's Washington Fish and Wildlife Office in Lacey, Washington by April 1 following each construction season. The report shall include, at a minimum, the following: (a) dates, times and locations of construction activities, (b) monitoring results, sample times, locations and analytical results, (c) summary of construction activities and measured water chemistry and turbidity associated with those activities, and (d) summary of corrective actions taken to reduce water chemistry effects and turbidity.

   If in cooperation with other permit authorities, the FTA, FHWA, and WSF develop a functionally equivalent monitoring strategy (e.g. intensive monitoring by project area or activity, followed by validation and routine monitoring), they may submit this plan to the Service for review and approval in lieu of the above monitoring requirements. This strategy must be submitted to the Service a minimum of 60 days prior to construction. In order to be approved for use in lieu of the above requirements, the plan must meet each of the same objectives.

3. The FHWA, FTA, and WSF shall provide and maintain on-site the materials and equipment necessary to ensure at all times there is sufficient capacity for the temporary storage and proper segregation of generated wastes (including water in contact with contaminated or potentially contaminated sediments).

4. The FHWA, FTA, and WSF shall ensure that all equipment used to handle contaminated waste streams (i.e. sediments and water) including containment and transport BMPs, storage containers and temporary on-site treatment facilities or BMPs, are properly decontaminated prior to handling any uncontaminated wastes.

5. The FHWA, FTA and WSF shall document all waste handling, containment, testing, storage, treatment and disposal operations according to all applicable State and Federal requirements. The FTA shall submit a monitoring report to the Service's Washington Fish and Wildlife Office in Lacey, Washington (Attn: Transportation Branch), by April 1 following each construction season. The report shall include, at a minimum, the following: (a) a description of the treatment facilities and/or BMPs utilized on site, (b) a quantitative waste characterization or profile for any sediments and water disposed at an in-water dredged material disposal site, and (c) a summary of corrective actions taken to minimize or contain the spread of contaminants.

The Service expects that the amount or extent of incidental take described above will not be exceeded as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the causes of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

The Service is to be notified within three working days upon locating a dead, injured or sick endangered or threatened species specimen. Initial notification must be made to the nearest U.S. Fish and Wildlife Service Law Enforcement Office. Notification must include the date, time, precise location of the injured animal or carcass, and any other pertinent information. Care should be taken in handling sick or injured specimens to preserve biological materials in the best possible state for later analysis of cause of death, if that occurs. In conjunction with the care of sick or injured endangered or threatened species or preservation of biological materials from a dead animal, the finder has the responsibility to ensure that evidence associated with the specimen is not unnecessarily disturbed. Contact the U.S. Fish and Wildlife Service Law Enforcement Office at (425) 883-8122, or the Service's Washington Fish and Wildlife Office at (360) 753-9440.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

The Project will remove thousands (2,178) of creosote piles. The Project presents a unique opportunity to better understand the short term and long term effects associated with removal of creosote piles in the marine environment. The Service recommends that FTA and WSF develop, or collaborate with another entity to develop a comprehensive study to examine the short and long term effects on water quality, sediment quality, and biological resources associated with removal of creosote piles.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the (request/reinitiation request). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

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APPENDIX A: MARBLED MURRELET MONITORING PLAN

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U.S. Fish and Wildlife Service – Washington Fish and Wildlife Office

Protocol for Marbled Murrelet Monitoring During Impact Pile Driving (Revised 8/13/2012)

Seattle Multimodal Project **July 15, 2013**

1.0 Objective

The intent of the monitoring protocol is to:

1. Comply with the requirements of the Endangered Species Act Section 7 consultation for the Washington State Department of Transportation/Ferries Division (WSF) Seattle Multimodal Project.
2. Detect all marbled murrelets (murrelets) within 33 meters (109 ft) of impact pile driving of concrete piles and within 27 m (90 ft) of impact driving of 30-inch steel piles.
3. To avoid injury of murrelets from exposure to elevated underwater sound pressure associated with pile driving by communicating immediately with the Construction Contractor.
4. Track incidental take exempted through the Incidental Take Statement found in the final Biological Opinion for the project so that the WSF will know when take occurs and/or when take exemptions might be exceeded.

2.0 Adaptive Approach

The individuals that implement this protocol will assess its effectiveness during implementation. They will use their best professional judgment throughout implementation and will seek improvements to these methods when deemed appropriate. Any modifications to this protocol will be coordinated between the WSF and the Washington Fish and Wildlife Office.

3.0 Monitoring

3.1 Activities to be Monitored

Application of this protocol is required as specified through the Endangered Species Act consultation process for individual projects. It may apply projects that involve either in-water impact pile driving when injurious sound pressure levels are expected and to projects that involve either vibratory or impact pile driving when in-air sounds are expected to cause masking effects.

3.2 Equipment

- Binoculars - quality 8 or 10 power;
- Spotting scopes;
- Two-way radios with earpieces;
- Range finder;
- Log books;
- Seabird identification guide;
- Life vest or other personal flotation device;
- Cellular phone to contact WSF, the Construction Contractor, or WFWO.

3.3 Locations

Impact driving of concrete and steel piles will create noise levels high enough to warrant monitoring. The project will occur in four phases over six years, with different number of piles installed during each phase (Table 1).

Table 1. Numbers and types of piles that will be driven with an impact hammer during different project phases.

Project phase	Project component	Pile type	Number of piles
Phase I	Slip 3 transfer span	30-inch steel	10
	HPU platform	30-inch steel	4
	South trestle	18-inch concrete	253
	POF slip	18-inch concrete	132
	Temporary POF slip	18-inch concrete	11
Phase II	Terminal building pile foundation	30-inch steel	69
Phase III	Trestle	30-inch steel	236
	Slip 2		10
	Stormwater vault		24
Phase IV	Trestle	30-inch steel	225
	Stormwater vault		12

Noise levels generated by impact driving of piles are relatively low, and the monitoring zone can be monitored by two land-based observers. During monitoring of concrete piles observers will be stationed on the south edge of the dock (Figure 1). During impact driving on steel piles, monitors will be located on the western edge of the dock (Figure 2). Due to limitations that could result from construction activity or other site specific variables, the monitoring locations may be refined in the field. In that case, final monitoring locations will be noted on an aerial photo or plan sheet, and documented in the final monitoring report.

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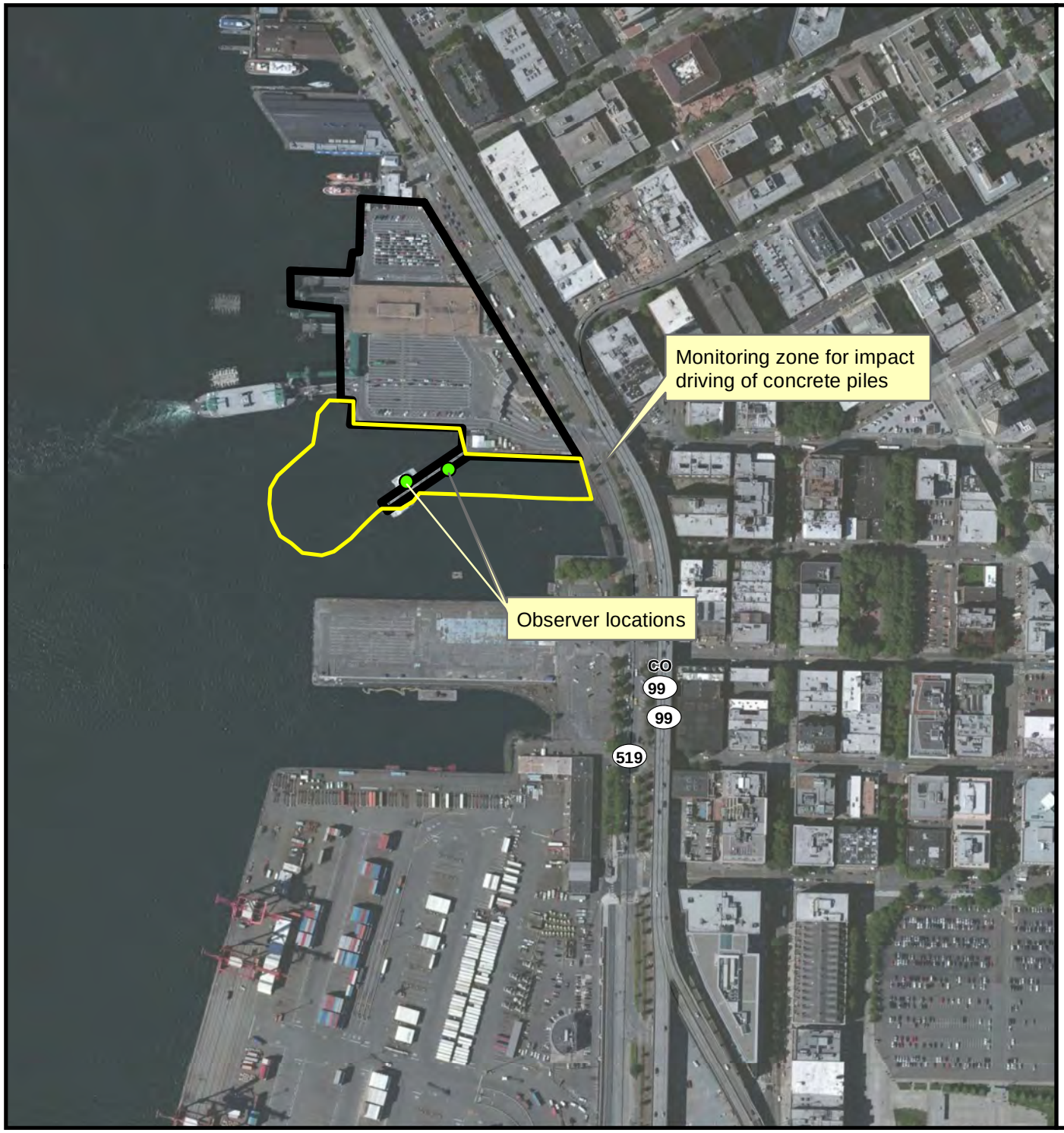

Figure 1. Monitoring zone and observer locations for impact driving of concrete piles.

N

0 0.0325 0.065 0.13 Miles

Washington State Department of Transportation

8.5x11LandscapeSideLegend.mxt / Print Date

Figure 2. Monitoring zone and observer locations for impact driving of 30-inch steel piles.

N

0 0.025 0.05 0.1 Miles

Washington State Department of Transportation

8.5x11LandscapeSideLegend.mxt / Print Date

3.4 Monitoring Techniques

The monitoring zone for impact driving of concrete piles can be covered by two biologists based on land, one of whom will be the lead biologist. The lead biologist shall be responsible for communicating with the Construction Contractor and the WFWO. The biologists will be positioned at a vantage point on the dock. The vantage point will allow for an unobstructed view of the monitoring zone at all times. Evaluations of murrelet survey effectiveness indicate there is a reasonable probability of detecting murrelets within 50 meters when the sea state is at a Beaufort scale of 2 or better. The Beaufort scale is presented in Table 1 below.

Two land-based biologists will monitor during impact pile driving activities. The biologists will scan for murrelets within the monitoring zone using a scope and binoculars. The biologists will sweep the monitoring zone prior to each pile driving attempt to ensure that no murrelets are in the monitoring zone. If no murrelets are within the zone, the lead biologist will communicate to the WSF Site Inspector, who will communicate to the Construction Contractor that pile driving may commence. During pile driving the lead biologist will continue scanning the area for murrelets. If murrelets are seen within the monitoring zone during pile driving, the lead biologist will communicate to the WSF Site Inspector, who will communicate to the Construction Contractor that he/she is to cease pile driving. Pile driving will not resume until the murrelets have left the monitoring area.

Murrelets are especially vulnerable to disturbance when they are molting and flightless. Molting occurs after nesting in late summer, typically July through September in Puget Sound populations. Extra precaution will be exercised during this period.

Table 1 – Beaufort Wind Scale develop in 1805 by Sir Francis Beaufort of England (0=calm to 12=hurricane)

Force	Wind (knots)	Classification	Appearance of wind effects on the water	Appearance of wind effects on land	Notes specific to on-water seabird observations
0	<1	Calm	Sea surface smooth and mirror like	Calm, smoke rises vertically	Excellent conditions, no wind, small or very smooth swell. You have the impression you could see anything.
1	1-3	Light air	Scaly ripples, no foam crests	Smoke drift indicates wind direction, still wind vanes	Very good conditions, surface could be glassy (Beaufort 0), but with some lumpy swell or reflection from forests, glare, etc.
2	4-6	Light breeze	Small wavelets, crests glassy, no breaking	Wind felt on face, leaves rustle, vanes begin to move	Good conditions, no whitecaps, texture/lighting contrast of water make murrelets hard to see. Surface could also be glassy or have small ripples, but with a short, lumpy swell, thick fog, etc.
3	7-10	Gentle breeze	Large wavelets, crests beginning to break, scattered whitecaps	Leaves and small twigs constantly moving, light flags extended	Surveys cease, , scattered whitecaps present, detection of murrelets definitely compromised, a hit-or-miss chance of seeing them owing to water choppiness and high contrast. This could also occur at lesser wind with a very short wavelength, choppy swell.
4	11-16	Moderate breeze	Small waves 0.3 to 1.1m becoming longer, numerous whitecaps	Dust, leaves, and loose paper lifted, small tree branches move	Poor conditions, end surveys, whitecaps abundant, sea chop bouncing the boat around, etc.
5	17-21	Fresh breeze	Moderate waves 1.1 to 2.0 m taking longer form, many whitecaps, some spray	Small trees begin to sway	

3.5 Limitations

No monitoring will be conducted during inclement weather that creates potentially hazardous conditions as determined by the lead biologist. No monitoring will be conducted when visibility is significantly limited such as during heavy rain, fog, or in a Beaufort sea state greater than 2. Monitoring will not start until one hour after sunrise and will cease one hour before sunset.

3.6 Documentation

The biologists will document the number and general location of all murrelets. Additional information on other seabirds and behaviors will be collected during documentation to improve general data knowledge on seabird presence and distribution as well as project impacts on various seabirds. The biologists will record information using the Seabird Monitoring Data Collection Form and reference completed Seabird Monitoring Site/Transects Identification and Seabird Land-Based Monitoring Site Forms. Forms are included in the Appendix.

Data Collection

All murrelets within transects or monitoring sites will be continuously documented during impacting activities. The time, number of birds, location, and observed behavior will be noted on the Seabird Monitoring Data Collection Form. Documentation will be updated when a murrelet changes behavior, changes location, or leaves the area. To the extent possible, the observer will also record each murrelet "take" incident observed, as defined in the final Biological Opinion. This may include obvious disturbance responses from pile driving or other construction activities, and injury or mortality that can be attributed to project-related activities.

The observers will also note all seabirds within the area that appear to be acting abnormally during any project activities. For example, if a seabird is listing, paddling in circles, shaking head, or suddenly flushing at the onset of activity, note the information on the Seabird Monitoring Data Collection Form. For all birds except murrelets, providing a genus level (grebe, loon, cormorant, scoter, gull, etc) of identification is sufficient.

General information on other seabird behavior and distribution within the monitoring area will be collected. Every two hours at minimum during pile driving activities, the observers will document other seabird presence, behavior, and distribution in the monitoring area. This information can be collected more frequently. Many seabirds may linger in an area for several hours. If this is the case, note the time, species, and in the comments section identify that this is the same group from earlier and document any notable changes in behavior.

3.7 Timing and Duration

Monitoring will commence at least 30 minutes before the initiation of pile driving (but not before daylight) and will continue until pile driving is completed each day (but not after nightfall). The monitoring set-up (i.e., number and location of observers) should allow for the entire monitoring area to be covered within five minutes.

3.8 Contingency

In the unlikely event that a murrelet is perceived to be injured by pile driving, all pile driving will cease and WFWO will be contacted as soon as possible.

The WSF will work with WFWO to make necessary changes to the monitoring plan as described in section 2.0 above. Pile driving cannot resume until the plan has been amended, unless the WFWO cannot be reached, then the Lead Biologist determines the course of action and continues to ensure consistency with the consultation.

4.0 Beach Surveys

Searches for diving seabird carcasses along nearby beaches will be conducted following pile driving activities. The biologist will walk accessible beaches within 0.5 mile of the pile driving location. Beach surveys will be conducted during low or receding tides, if possible, to maximize the chances of finding beached carcasses. Beach surveys will be conducted each day following in-water impact pile driving (as is practical based on the timing of tide events and pile driving activities.) Beach surveys are of secondary priority and will not be conducted if such activities would interfere with the implementation of murrelet monitoring or if the timing of low/receding tides imposes unreasonable schedule demands on the biologist.

Any dead murrelets or other diving seabirds found during the beach surveys (or during monitoring activities) will be collected by monitoring staff and delivered, as soon as possible, to the WFWO in Lacey, Washington for examination. Collected carcasses will be put in plastic bags, and kept cool (but not frozen) until delivery to the WFWO. The observer will follow the chain-of-custody process included in the consultation documents.

5.0 FWS Communication

Prior to the initiation of monitoring the WSF and a representative from the WFWO will meet to review the proposed monitoring locations and any logistical concerns that may have developed during monitoring preparation. The WSF will keep the WFWO informed of the progress and effectiveness of the monitoring activities and of the number and disposition of murrelet take that is documented throughout the duration of the project.

The WSF will notify the WFWO of any problems and/or necessary modification to the monitoring protocol. The WSF will coordinate with the WFWO in the development of a modified approach and will seek WFWO approval for such modifications.

Primary points of contact at the WFWO are:
1. Ryan McReynolds – phone (360) 753-6047
2. Emily Teachout – phone: (360) 753-9583
3. Deanna Lynch – phone: (360) 753-9545

Primary points of contact at the WSF are:
1. Rick Huey – phone: (206) 515-3721 or (206)-330-5149 (cell)
2. Burt Miller – phone: (206) 515-3756
3. Kojo Fordjour– phone: (206) 515-3650

6.0 Personnel Qualifications and Training

All observers must be certified under the Marbled Murrelet Marine Protocol. Observers will have appropriate qualifications, including education or work experience in biology, ornithology, or a closely related field; at least one season (2-3 months) of work with bird identification being the primary objective (i.e. not incidental to other work). Observers must have experience identifying marine birds in the Pacific Northwest, as well as understanding and documenting bird behavior.

All observers will attend the marbled murrelet marine monitoring protocol training and pass the written and photo examination with 90% proficiency. Upon successful completion, observers will be certified. Certification is valid for one year.

Recertification is required annually, unless the observer can document that he/she implemented the monitoring protocol for at least 25 monitoring days in the previous year. Recertification can then be delayed for one year; however, recertification can only be delayed for one year.

Certifications will be considered expired after one year, unless the WFWO is notified by the biologist that greater than 25 days of survey were done within one year of their certificate date. If an observer does conduct greater than 25 days of survey the certificate will be valid for an additional year from the certificate date. To extend a certification the biologist sends an email to the attention of Emily Teachout (emily_teachout@fws.gov) with the dates of the surveys they conducted and the date of their original certificate. The WFWO will maintain a list a certified observers and it will be available on our website.

The WSF is expected to provide all observers with a copy of the consultation documents for the project. Observers must read and understand the contents of the consultation documents related to identifying, minimizing, and reporting "incidental take" of murrelets.

7.0 Reporting

At the completion of each in-water work window for which there has been impact pile driving, the WSF will forward a monitoring report to the WFWO within 30 days. Reports shall be sent to the attention of (WFWO Branch Manager). The report shall include:

- Observation dates, times, and conditions
- Description of the any "take" (as described in the final Biological Opinion) identified by the biologist
- Copies of field data sheets or logs

Note: Questions and comments regarding this protocol should be directed to Emily Teachout at the USFWS, Washington Fish and Wildlife Office (360-753-9583); emily_teachout@fws.gov

APPENDIX B: STATUS OF THE SPECIES – BULL TROUT

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Appendix B: Status of the Species (Bull Trout)

Listing Status

The coterminous United States population of the bull trout (*Salvelinus confluentus*) was listed as threatened on November 1, 1999 (64 FR 58910). The threatened bull trout generally occurs in the Klamath River Basin of south-central Oregon; the Jarbidge River in Nevada; the Willamette River Basin in Oregon; Pacific Coast drainages of Washington, including Puget Sound; major rivers in Idaho, Oregon, Washington, and Montana, within the Columbia River Basin; and the St. Mary-Belly River, east of the Continental Divide in northwestern Montana (Bond 1992, p. 2; Brewin and Brewin 1997, p. 215; Cavender 1978, pp. 165-166; Leary and Allendorf 1997, pp. 716-719).

Throughout its range, the bull trout are threatened by the combined effects of habitat degradation, fragmentation, and alterations associated with dewatering, road construction and maintenance, mining, grazing, the blockage of migratory corridors by dams or other diversion structures, poor water quality, entrainment (a process by which aquatic organisms are pulled through a diversion or other device) into diversion channels, and introduced non-native species (64 FR 58910). Although all salmonids are likely to be affected by climate change, bull trout are especially vulnerable given that spawning and rearing are constrained by their location in upper watersheds and the requirement for cold water temperatures (Battin et al. 2007, pp. 6672-6673; Rieman et al. 2007, p. 1552). Poaching and incidental mortality of bull trout during other targeted fisheries are additional threats.

The bull trout was initially listed as three separate Distinct Population Segments (DPSs) (63 FR 31647; 64 FR 17110). The preamble to the final listing rule for the United States coterminous population of the bull trout discusses the consolidation of these DPSs with the Columbia and Klamath population segments into one listed taxon and the application of the jeopardy standard under section 7 of the Endangered Species Act (Act) relative to this species (64 FR 58910):

> Although this rule consolidates the five bull trout DPSs into one listed taxon, based on conformance with the DPS policy for purposes of consultation under section 7 of the Act, we intend to retain recognition of each DPS in light of available scientific information relating to their uniqueness and significance. Under this approach, these DPSs will be treated as interim recovery units with respect to application of the jeopardy standard until an approved recovery plan is developed. Formal establishment of bull trout recovery units will occur during the recovery planning process.

Current Status and Conservation Needs

In recognition of available scientific information relating to their uniqueness and significance, five segments of the coterminous United States population of the bull trout are considered essential to the survival and recovery of this species and are identified as interim recovery units: 1) Jarbidge River, 2) Klamath River, 3) Columbia River, 4) Coastal-Puget Sound, and 5) St.

Mary-Belly River (USFWS 2002a, pp. iv, 2, 7, 98; 2004a, Vol. 1 & 2, p. 1; 2004b, p. 1). Each of these interim recovery units is necessary to maintain the bull trout's distribution, as well as its genetic and phenotypic diversity, all of which are important to ensure the species' resilience to changing environmental conditions.

A summary of the current status and conservation needs of the bull trout within these interim recovery units is provided below and a comprehensive discussion is found in the U.S. Fish and Wildlife Service's (Service) draft recovery plans for the bull trout (USFWS 2002a, pp. vi-viii; 2004a, Vol. 2 p. iii-x; 2004b, pp. iii-xii).

The conservation needs of bull trout are often generally expressed as the four "Cs": cold, clean, complex, and connected habitat. Cold stream temperatures, clean water quality that is relatively free of sediment and contaminants, complex channel characteristics (including abundant large wood and undercut banks), and large patches of such habitat that are well connected by unobstructed migratory pathways are all needed to promote conservation of bull trout at multiple scales ranging from the coterminous to local populations (a local population is a group of bull trout that spawn within a particular stream or portion of a stream system). The recovery planning process for bull trout (USFWS 2002a, pp. 49-50; 2004a, Vol 1 & 2 pp. 12-18; 2004b, pp. 60-86) has also identified the following conservation needs: 1) maintenance and restoration of multiple, interconnected populations in diverse habitats across the range of each interim recovery unit, 2) preservation of the diversity of life-history strategies, 3) maintenance of genetic and phenotypic diversity across the range of each interim recovery unit, and 4) establishment of a positive population trend. Recently, it has also been recognized that bull trout populations need to be protected from catastrophic fires across the range of each interim recovery unit (Rieman et al. 2003).

Central to the survival and recovery of bull trout is the maintenance of viable core areas (USFWS 2002a, pp. 53-54; 2004a, Vol. 1 pp. 210-218, Vol. 2. pp. 61-62; 2004b, pp. 15-30, 64-67). A core area is defined as a geographic area occupied by one or more local bull trout populations that overlap in their use of rearing, foraging, migratory, and overwintering habitat. Each of the interim recovery units listed above consists of one or more core areas. There are 121 core areas recognized across the coterminous range of the bull trout (USFWS 2002a, pp. 6, 48, 98; 2004a, Vol. 1 p. vi, Vol. 2 pp. 14, 134; 2004b, pp. iv, 2; 2005, p. ii).

Jarbidge River Interim Recovery Unit

This interim recovery unit currently contains a single core area with six local populations. Less than 500 resident and migratory adult bull trout, representing about 50 to 125 spawning adults, are estimated to occur in the core area. The current condition of the bull trout in this interim recovery unit is attributed to the effects of livestock grazing, roads, incidental mortalities of released bull trout from recreational angling, historic angler harvest, timber harvest, and the introduction of non-native fishes (USFWS 2004b). The draft bull trout recovery plan (USFWS 2004b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout within the core area, 2) maintain stable or increasing trends in abundance of both resident and migratory bull trout in the core area, 3) restore and maintain

suitable habitat conditions for all life history stages and forms, and 4) conserve genetic diversity and increase natural opportunities for genetic exchange between resident and migratory forms of the bull trout. An estimated 270 to 1,000 spawning bull trout per year are needed to provide for the persistence and viability of the core area and to support both resident and migratory adult bull trout (USFWS 2004b).

Klamath River Interim Recovery Unit

This interim recovery unit currently contains three core areas and seven local populations. The current abundance, distribution, and range of the bull trout in the Klamath River Basin are greatly reduced from historical levels due to habitat loss and degradation caused by reduced water quality, timber harvest, livestock grazing, water diversions, roads, and the introduction of non-native fishes (USFWS 2002a). Bull trout populations in this interim recovery unit face a high risk of extirpation (USFWS 2002a). The draft Klamath River bull trout recovery plan (USFWS 2002a) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and strategies, 4) conserve genetic diversity and provide the opportunity for genetic exchange among appropriate core area populations. Eight to 15 new local populations and an increase in population size from about 2,400 adults currently to 8,250 adults are needed to provide for the persistence and viability of the three core areas (USFWS 2002a).

Columbia River Interim Recovery Unit

The Columbia River interim recovery unit includes bull trout residing in portions of Oregon, Washington, Idaho, and Montana. Bull trout are estimated to have occupied about 60 percent of the Columbia River Basin, and presently occur in 45 percent of the estimated historical range (Quigley and Arbelbide 1997, p. 1177). This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in central Idaho and northwestern Montana. The Columbia River interim recovery unit has declined in overall range and numbers of fish (63 FR 31647). Although some strongholds still exist with migratory fish present, bull trout generally occur as isolated local populations in headwater lakes or tributaries where the migratory life history form has been lost. Though still widespread, there have been numerous local extirpations reported throughout the Columbia River basin. In Idaho, for example, bull trout have been extirpated from 119 reaches in 28 streams (IDFG in litt. 1995). The draft Columbia River bull trout recovery plan (USFWS 2002c) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of the bull trout within core areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

This interim recovery unit currently contains 97 core areas and 527 local populations. About 65 percent of these core areas and local populations occur in Idaho and northwestern Montana. The condition of the bull trout within these core areas varies from poor to good. All core areas have

been subject to the combined effects of habitat degradation and fragmentation caused by the following activities: dewatering; road construction and maintenance; mining; grazing; the blockage of migratory corridors by dams or other diversion structures; poor water quality; incidental angler harvest; entrainment into diversion channels; and introduced non-native species. The Service completed a core area conservation assessment for the 5-year status review and determined that, of the 97 core areas in this interim recovery unit, 38 are at high risk of extirpation, 35 are at risk, 20 are at potential risk, 2 are at low risk, and 2 are at unknown risk (USFWS 2005, pp. 2, Map A, pp. 73-83).

Coastal-Puget Sound Interim Recovery Unit

Bull trout in the Coastal-Puget Sound interim recovery unit exhibit anadromous[1], adfluvial, fluvial, and resident life history patterns. The anadromous life history form is unique to this interim recovery unit. This interim recovery unit currently contains 14 core areas and 67 local populations (USFWS 2004a). Bull trout are distributed throughout most of the large rivers and associated tributary systems within this interim recovery unit. Bull trout continue to be present in nearly all major watersheds where they likely occurred historically, although local extirpations have occurred throughout this interim recovery unit. Many remaining populations are isolated or fragmented and abundance has declined, especially in the southeastern portion of the interim recovery unit. The current condition of the bull trout in this interim recovery unit is attributed to the adverse effects of dams, forest management practices (e.g., timber harvest and associated road building activities), agricultural practices (e.g., diking, water control structures, draining of wetlands, channelization, and the removal of riparian vegetation), livestock grazing, roads, mining, urbanization, poaching, incidental mortality from other targeted fisheries, and the introduction of non-native species. The draft Coastal-Puget Sound bull trout recovery plan (USFWS 2004a) identifies the following conservation needs for this interim recovery unit: 1) maintain or expand the current distribution of bull trout within existing core areas, 2) increase bull trout abundance to about 16,500 adults across all core areas, and 3) maintain or increase connectivity between local populations within each core area.

St. Mary-Belly River Interim Recovery Unit

This interim recovery unit currently contains six core areas and nine local populations (USFWS 2002b). Currently, bull trout are widely distributed in the St. Mary-Belly River drainage and occur in nearly all of the waters that it inhabited historically. Bull trout are found only in a 1.2-mile reach of the North Fork Belly River within the United States. Redd count surveys of the North Fork Belly River documented an increase from 27 redds in 1995 to 119 redds in 1999.

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

This increase was attributed primarily to protection from angler harvest (USFWS 2002b). The current condition of the bull trout in this interim recovery unit is primarily attributed to the effects of dams, water diversions, roads, mining, and the introduction of non-native fishes (USFWS 2002b). The draft St. Mary-Belly River bull trout recovery plan (USFWS 2002b) identifies the following conservation needs for this interim recovery unit: 1) maintain the current distribution of the bull trout and restore distribution in previously occupied areas, 2) maintain stable or increasing trends in bull trout abundance, 3) restore and maintain suitable habitat conditions for all life history stages and forms, 4) conserve genetic diversity and provide the opportunity for genetic exchange, and 5) establish good working relations with Canadian interests because local bull trout populations in this interim recovery unit are comprised mostly of migratory fish, whose habitat is mostly in Canada.

Life History

Bull trout exhibit both resident and migratory life history strategies. Both resident and migratory forms may be found together, and either form may produce offspring exhibiting either resident or migratory behavior (Rieman and McIntyre 1993, pp. 1-18). Resident bull trout complete their entire life cycle in the tributary (or nearby) streams in which they spawn and rear. The resident form tends to be smaller than the migratory form at maturity and also produces fewer eggs (Fraley and Shepard 1989, p. 1; Goetz 1989, pp. 15-16). Migratory bull trout spawn in tributary streams where juvenile fish rear 1 to 4 years before migrating to either a lake (adfluvial form), river (fluvial form) (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25), or saltwater (anadromous form) to rear as subadults and to live as adults (Cavender 1978, pp. 139, 165-68; McPhail and Baxter 1996, p. 14; WDFW et al. 1997, pp. 17-18, 22-26). Bull trout normally reach sexual maturity in 4 to 7 years and may live longer than 12 years. They are iteroparous (they spawn more than once in a lifetime). Repeat- and alternate-year spawning has been reported, although repeat-spawning frequency and post-spawning mortality are not well documented (Fraley and Shepard 1989, pp. 135-137; Leathe and Graham 1982, p. 95; Pratt 1992, p. 6; Rieman and McIntyre 1996, p. 133).

The iteroparous reproductive strategy of bull trout has important repercussions for the management of this species. Bull trout require passage both upstream and downstream, not only for repeat spawning but also for foraging. Most fish ladders, however, were designed specifically for anadromous semelparous salmonids (fishes that spawn once and then die, and require only one-way passage upstream). Therefore, even dams or other barriers with fish passage facilities may be a factor in isolating bull trout populations if they do not provide a downstream passage route. Additionally, in some core areas, bull trout that migrate to marine waters must pass both upstream and downstream through areas with net fisheries at river mouths. This can increase the likelihood of mortality to bull trout during these spawning and foraging migrations.

Growth varies depending upon life-history strategy. Resident adults range from 6 to 12 inches total length, and migratory adults commonly reach 24 inches or more (Goetz 1989, pp. 29-32; Pratt 1984, p. 13) The largest verified bull trout is a 32-pound specimen caught in Lake Pend Oreille, Idaho, in 1949 (Simpson and Wallace 1982).

Habitat Characteristics

Bull trout have more specific habitat requirements than most other salmonids (Rieman and McIntyre 1993, p. 7). Habitat components that influence bull trout distribution and abundance include water temperature, cover, channel form and stability, valley form, spawning and rearing substrate, and migratory corridors (Fraley and Shepard 1989, pp. 137, 141; Goetz 1989, pp. 19-26; Bond in Hoelscher and Bjornn 1989, p. 57; Howell and Buchanan 1992, p. 1; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Rieman and McIntyre 1993, pp. 4-7; Rieman and McIntyre 1995, pp. 293-294; Sedell and Everest 1991, p. 1; Watson and Hillman 1997, pp. 246-250). Watson and Hillman (1997, pp. 247-249) concluded that watersheds must have specific physical characteristics to provide the habitat requirements necessary for bull trout to successfully spawn and rear and that these specific characteristics are not necessarily present throughout these watersheds. Because bull trout exhibit a patchy distribution, even in pristine habitats (Rieman and McIntyre 1993, p. 7), bull trout should not be expected to simultaneously occupy all available habitats (Rieman et al. 1997, p. 1560).

Migratory corridors link seasonal habitats for all bull trout life histories. The ability to migrate is important to the persistence of bull trout (Gilpin, in litt. 1997, pp. 4-5; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1114). Migrations facilitate gene flow among local populations when individuals from different local populations interbreed or stray to nonnatal streams. Local populations that are extirpated by catastrophic events may also become reestablished by bull trout migrants. However, it is important to note that the genetic structuring of bull trout indicates there is limited gene flow among bull trout populations, which may encourage local adaptation within individual populations, and that reestablishment of extirpated populations may take a long time (Rieman and McIntyre 1993, p. 7; Spruell et al. 1999, pp. 118-120). Migration also allows bull trout to access more abundant or larger prey, which facilitates growth and reproduction. Additional benefits of migration and its relationship to foraging are discussed below under “Diet.”

Cold water temperatures play an important role in determining bull trout habitat quality, as these fish are primarily found in colder streams (below 15°C or 59°F), and spawning habitats are generally characterized by temperatures that drop below 9°C (48°F) in the fall (Fraley and Shepard 1989, p. 133; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7).

Thermal requirements for bull trout appear to differ at different life stages. Spawning areas are often associated with cold-water springs, groundwater infiltration, and the coldest streams in a given watershed (Baxter et al. 1997, pp. 426-427; Pratt 1992, p. 6; Rieman and McIntyre 1993, p. 7; Rieman et al. 1997, p. 1117). Optimum incubation temperatures for bull trout eggs range from 2°C to 6°C (35°F to 39°F) whereas optimum water temperatures for rearing range from about 6°C to 10°C (46°F to 50°F) (Buchanan and Gregory 1997, pp. 121-122; Goetz 1989, pp. 22-24; McPhail and Murray 1979, pp. 41, 50, 53, 55). In Granite Creek, Idaho, Bonneau and Scarnecchia (1996) observed that juvenile bull trout selected the coldest water available in a plunge pool, 8°C to 9°C (46°F to 48°F), within a temperature gradient of 8°C to 15°C (4°F to 60°F). In a landscape study relating bull trout distribution to maximum water temperatures,

Dunham et al. (2003) found that the probability of juvenile bull trout occurrence does not become high (i.e., greater than 0.75) until maximum temperatures decline to 11°C to 12°C (52°F to 54°F).

Although bull trout are found primarily in cold streams, occasionally these fish are found in larger, warmer river systems throughout the Columbia River basin (Buchanan and Gregory 1997, pp. 121-122; Fraley and Shepard 1989, pp. 135-137; Rieman and McIntyre 1993, p. 2; Rieman and McIntyre 1995, p. 288; Rieman et al. 1997, p. 1114). Availability and proximity of cold water patches and food productivity can influence bull trout ability to survive in warmer rivers (Myrick et al. 2002). For example, in a study in the Little Lost River of Idaho where bull trout were found at temperatures ranging from 8°C to 20°C (46°F to 68°F), most sites that had high densities of bull trout were in areas where primary productivity in streams had increased following a fire (Gamett, pers. comm. 2002).

All life history stages of bull trout are associated with complex forms of cover, including large woody debris, undercut banks, boulders, and pools (Fraley and Shepard 1989, pp. 135-137; Goetz 1989, pp. 22-25; Hoelscher and Bjornn 1989, p. 54; Pratt 1992, p. 6; Rich 1996, pp. 35-38; Sedell and Everest 1991, p. 1; Sexauer and James 1997, pp. 367-369; Thomas 1992, pp. 4-5; Watson and Hillman 1997, pp. 247-249). Maintaining bull trout habitat requires stability of stream channels and maintenance of natural flow patterns (Rieman and McIntyre 1993, p. 7). Juvenile and adult bull trout frequently inhabit side channels, stream margins, and pools with suitable cover (Sexauer and James 1997, pp. 367-369). These areas are sensitive to activities that directly or indirectly affect stream channel stability and alter natural flow patterns. For example, altered stream flow in the fall may disrupt bull trout during the spawning period, and channel instability may decrease survival of eggs and young juveniles in the gravel from winter through spring (Fraley and Shepard 1989, pp. 135-137; Pratt 1992, p. 6; Pratt and Huston 1993, pp. 70-72). Pratt (1992, p. 6) indicated that increases in fine sediment reduce egg survival and emergence.

Bull trout typically spawn from August through November during periods of increasing flows and decreasing water temperatures. Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley and Shepard 1989, p. 135). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz 1989, p. 15; Pratt 1992, p. 8; Rieman and McIntyre 1996, p. 133). Depending on water temperature, incubation is normally 100 to 145 days (Pratt 1992, p. 8). After hatching, fry remain in the substrate, and time from egg deposition to emergence may surpass 200 days. Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Ratliff and Howell 1992 in Howell and Buchanan 1992, pp. 10, 15; Pratt 1992, pp. 5-6).

Early life stages of fish, specifically the developing embryo, require the highest inter-gravel dissolved oxygen (IGDO) levels, and are the most sensitive life stage to reduced oxygen levels. The oxygen demand of embryos depends on temperature and on stage of development, with the greatest IGDO required just prior to hatching.

A literature review conducted by the Washington Department of Ecology (WDOE 2002) indicates that adverse effects of lower oxygen concentrations on embryo survival are magnified as temperatures increase above optimal (for incubation). In a laboratory study conducted in Canada, researchers found that low oxygen levels retarded embryonic development in bull trout (Giles and Van der Zweep 1996, pp. 54-55). Normal oxygen levels seen in rivers used by bull trout during spawning ranged from 8 to 12 mg/L (in the gravel), with corresponding instream levels of 10 to 11.5 mg/L (Stewart et al. 2007). In addition, IGDO concentrations, water velocities in the water column, and especially the intergravel flow rate, are interrelated variables that affect the survival of incubating embryos (ODEQ 1995). Due to a long incubation period of 220+ days, bull trout are particularly sensitive to adequate IGDO levels. An IGDO level below 8 mg/L is likely to result in mortality of eggs, embryos, and fry.

Migratory forms of bull trout may develop when habitat conditions allow movement between spawning and rearing streams and larger rivers, lakes or nearshore marine habitat where foraging opportunities may be enhanced (Brenkman and Corbett 2005, pp. 1073, 1079-1080; Frissell 1993, p. 350; Goetz et al. 2004, pp. 45, 55, 60, 68, 77, 113-114, 123, 125-126). For example, multiple life history forms (e.g., resident and fluvial) and multiple migration patterns have been noted in the Grande Ronde River (Baxter 2002). Parts of this river system have retained habitat conditions that allow free movement between spawning and rearing areas and the mainstem Snake River. Such multiple life history strategies help to maintain the stability and persistence of bull trout populations to environmental changes. Benefits to migratory bull trout include greater growth in the more productive waters of larger streams, lakes, and marine waters; greater fecundity resulting in increased reproductive potential; and dispersing the population across space and time so that spawning streams may be recolonized should local populations suffer a catastrophic loss (Frissell 1999, pp. 15-16; MBTSG 1998, pp. iv, 48-50; Rieman and McIntyre 1993, pp. 18-19; USFWS 2004a, Vol. 2, p. 63). In the absence of the migratory bull trout life form, isolated populations cannot be replenished when disturbances make local habitats temporarily unsuitable. Therefore, the range of the species is diminished, and the potential for a greater reproductive contribution from larger fish with higher fecundity is lost (Rieman and McIntyre 1993, pp. 1-18).

Diet

Bull trout are opportunistic feeders, with food habits primarily a function of size and life-history strategy. A single optimal foraging strategy is not necessarily a consistent feature in the life of a fish, because this strategy can change as the fish progresses from one life stage to another (i.e., juvenile to subadult). Fish growth depends on the quantity and quality of food that is eaten (Gerking 1994), and as fish grow, their foraging strategy changes as their food changes, in quantity, size, or other characteristics. Resident and juvenile migratory bull trout prey on terrestrial and aquatic insects, macrozooplankton, and small fish (Boag 1987, p. 58; Donald and Alger 1993, pp. 239-243; Goetz 1989, pp. 33-34). Subadult and adult migratory bull trout feed on various fish species (Brown 1994, p. 21; Donald and Alger 1993, p. 242; Fraley and Shepard 1989, p. 135; Leathe and Graham 1982, p. 95). Bull trout of all sizes other than fry have been found to eat fish up to half their length (Beauchamp and VanTassell 2001). In nearshore marine

areas of western Washington, bull trout feed on Pacific herring (*Clupea pallasi*), Pacific sand lance (*Ammodytes hexapterus*), and surf smelt (*Hypomesus pretiosus*) (Goetz et al. 2004, p. 114; WDFW et al. 1997, p. 23).

Bull trout migration and life history strategies are closely related to their feeding and foraging strategies. Migration allows bull trout to access optimal foraging areas and exploit a wider variety of prey resources. Optimal foraging theory can be used to describe strategies fish use to choose between alternative sources of food by weighing the benefits and costs of capturing one source of food over another. For example, prey often occur in concentrated patches of abundance ("patch model") (Gerking 1994). As the predator feeds in one patch, the prey population is reduced, and it becomes more profitable for the predator to seek a new patch rather than continue feeding on the original one. This can be explained in terms of balancing energy acquired versus energy expended. For example, in the Skagit River system, anadromous bull trout make migrations as long as 121 miles between marine foraging areas in Puget Sound and headwater spawning grounds, foraging on salmon eggs and juvenile salmon along their migration route (WDFW et al. 1997). Anadromous bull trout also use marine waters as migration corridors to reach seasonal habitats in non-natal watersheds to forage and possibly overwinter (Brenkman and Corbett 2005, p. 1079; Goetz et al. 2004, pp. 36, 60).

Changes in Status of the Coastal-Puget Sound Interim Recovery Unit

Although the status of bull trout in Coastal-Puget Sound interim recovery unit has been improved by certain actions, it continues to be degraded by other actions, and it is likely that the overall status of the bull trout in this population segment has not improved since its listing on November 1, 1999. Improvement has occurred largely through changes in fishing regulations and habitat-restoration projects. Fishing regulations enacted in 1994 either eliminated harvest of bull trout or restricted the amount of harvest allowed, and this likely has had a positive influence on the abundance of bull trout. Improvement in habitat has occurred following restoration projects intended to benefit either bull trout or salmon, although monitoring the effectiveness of these projects seldom occurs. On the other hand, the status of this population segment has been adversely affected by a number of Federal and non-Federal actions, some of which were addressed under section 7 of the Act. Most of these actions degraded the environmental baseline; all of those addressed through formal consultation under section 7 of the Act permitted the incidental take of bull trout.

Section 10(a)(1)(B) permits have been issued for Habitat Conservation Plans (HCP) completed in the Coastal-Puget Sound population segment. These include: 1) the City of Seattle's Cedar River Watershed HCP, 2) Simpson Timber HCP (now Green Diamond Resources), 3) Tacoma Public Utilities Green River HCP, 4) Plum Creek Cascades HCP, 5) Washington State Department of Natural Resources (WSDNR) State Trust Lands HCP, 6) West Fork Timber HCP, and 7) WSDNR Forest Practices HCP. These HCPs provide landscape-scale conservation for fish, including bull trout. Many of the covered activities associated with these HCPs will contribute to conserving bull trout over the long-term; however, some covered activities will result in short-term degradation of the baseline. All HCPs permit the incidental take of bull trout.

Changes in Status of the Columbia River Interim Recovery Unit

The overall status of the Columbia River interim recovery unit has not changed appreciably since its listing on June 10, 1998. Populations of bull trout and their habitat in this area have been affected by a number of actions addressed under section 7 of the Act. Most of these actions resulted in degradation of the environmental baseline of bull trout habitat, and all permitted or analyzed the potential for incidental take of bull trout. The Plum Creek Cascades HCP, Plum Creek Native Fish HCP, Storedahl Daybreak Mine HCP, and WSDNR Forest Practices HCP addressed portions of the Columbia River population segment of bull trout.

Changes in Status of the Klamath River Interim Recovery Unit

Improvements in the Threemile, Sun, and Long Creek local populations have occurred through efforts to remove or reduce competition and hybridization with non-native salmonids, changes in fishing regulations, and habitat-restoration projects. Population status in the remaining local populations (Boulder-Dixon, Deming, Brownsworth, and Leonard Creeks) remains relatively unchanged. Grazing within bull trout watersheds throughout the recovery unit has been curtailed. Efforts at removal of non-native species of salmonids appear to have stabilized the Threemile and positively influenced the Sun Creek local populations. The results of similar efforts in Long Creek are inconclusive. Mark and recapture studies of bull trout in Long Creek indicate a larger migratory component than previously expected.

Although the status of specific local populations has been slightly improved by recovery actions, the overall status of Klamath River bull trout continues to be depressed. Factors considered threats to bull trout in the Klamath Basin at the time of listing – habitat loss and degradation caused by reduced water quality, past and present land use management practices, water diversions, roads, and non-native fishes – continue to be threats today.

Changes in Status of the Saint Mary-Belly River Interim Recovery Unit

The overall status of bull trout in the Saint Mary-Belly River interim recovery unit has not changed appreciably since its listing on November 1, 1999. Extensive research efforts have been conducted since listing, to better quantify populations of bull trout and their movement patterns. Limited efforts in the way of active recovery actions have occurred. Habitat occurs mostly on Federal and Tribal lands (Glacier National Park and the Blackfeet Nation). Known problems due to instream flow depletion, entrainment, and fish passage barriers resulting from operations of the U.S. Bureau of Reclamation's Milk River Irrigation Project (which transfers Saint Mary-Belly River water to the Missouri River Basin) and similar projects downstream in Canada constitute the primary threats to bull trout and to date they have not been adequately addressed under section 7 of the Act. Plans to upgrade the aging irrigation delivery system are being pursued, which has potential to mitigate some of these concerns but also the potential to intensify dewatering. A major fire in August 2006 severely burned the forested habitat in Red Eagle and Divide Creeks, potentially affecting three of nine local populations and degrading the baseline.

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APPENDIX C: STATUS OF THE BULL TROUT CRITICAL HABITAT

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Appendix C: Status of the Bull Trout Critical Habitat (Rangewide)

Legal Status

Current Designation

The U.S. Fish and Wildlife Service (Service) published a final critical habitat designation for the coterminous United States population of the bull trout on October 18, 2010 (70 FR 63898); the rule became effective on November 17, 2010. A justification document was also developed to support the rule and is available on our website (http://www.fws.gov/pacific/bulltrout). The scope of the designation involved the species' coterminous range, including six draft recovery units [Mid-Columbia, Saint Mary, Columbia Headwaters, Coastal, Klamath, and Upper Snake (75 FR 63927)]. The Service's 1999 coterminous listing rule identified five interim recovery units (50 CFR Part 17, pg. 58910), which includes the Jarbidge River, Klamath River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments (also considered as interim recovery units). Our five year review recommended re-evaluation of these units based on new information (USFWS 2008, p. 9). However, until the bull trout draft recovery plan is finalized, the current five interim recovery units will be used for purposes of section 7 jeopardy analyses and recovery planning. The adverse modification analysis in this biological opinion does not rely on recovery units, relying instead on the listed critical habitat units and subunits.

Rangewide, the Service designated reservoirs/lakes and stream/shoreline miles as bull trout critical habitat (Table 1). Designated bull trout critical habitat is of two primary use types: 1) spawning and rearing, and 2) foraging, migration, and overwintering (FMO).

Table 1. Stream/shoreline distance and reservoir/lake area designated as bull trout critical habitat by state.

State	Stream/Shoreline Miles	Stream/Shoreline Kilometers	Reservoir /Lake Acres	Reservoir /Lake Hectares
Idaho	8,771.6	14,116.5	170,217.5	68,884.9
Montana	3,056.5	4,918.9	221,470.7	89,626.4
Nevada	71.8	115.6	-	-
Oregon	2,835.9	4,563.9	30,255.5	12,244.0
Oregon/Idaho	107.7	173.3	-	-
Washington	3,793.3	6,104.8	66,308.1	26,834.0
Washington (marine)	753.8	1,213.2	-	-
Washington/Idaho	37.2	59.9	-	-
Washington/Oregon	301.3	484.8	-	-
Total	19,729.0	31,750.8	488,251.7	197,589.2

The 2010 revision increases the amount of designated bull trout critical habitat by approximately 76 percent for miles of stream/shoreline and by approximately 71 percent for acres of lakes and reservoirs compared to the 2005 designation.

This rule also identifies and designates as critical habitat approximately 1,323.7 km (822.5 miles) of streams/shorelines and 6,758.8 ha (16,701.3 acres) of lakes/reservoirs of unoccupied habitat to address bull trout conservation needs in specific geographic areas in several areas not occupied at the time of listing. No unoccupied habitat was included in the 2005 designation. These unoccupied areas were determined by the Service to be essential for restoring functioning migratory bull trout populations based on currently available scientific information. These unoccupied areas often include lower main stem river environments that can provide seasonally important migration habitat for bull trout. This type of habitat is essential in areas where bull trout habitat and population loss over time necessitates reestablishing bull trout in currently unoccupied habitat areas to achieve recovery.

The final rule continues to exclude some critical habitat segments based on a careful balancing of the benefits of inclusion versus the benefits of exclusion. Critical habitat does not include: 1) waters adjacent to non-Federal lands covered by legally operative incidental take permits for habitat conservation plans (HCPs) issued under section 10(a)(1)(B) of the Endangered Species Act of 1973, as amended (Act), in which bull trout is a covered species on or before the publication of this final rule; 2) waters within or adjacent to Tribal lands subject to certain commitments to conserve bull trout or a conservation program that provides aquatic resource protection and restoration through collaborative efforts, and where the Tribes indicated that inclusion would impair their relationship with the Service; or 3) waters where impacts to national security have been identified (75 FR 63898). Excluded areas are approximately 10 percent of the stream/shoreline miles and 4 percent of the lakes and reservoir acreage of designated critical habitat. Each excluded area is identified in the relevant Critical Habitat Unit (CHU) text, as identified in paragraphs (e)(8) through (e)(41) of the final rule. See Tables 2 and 3 for the list of excluded areas. It is important to note that the exclusion of waterbodies from designated critical habitat does not negate or diminish their importance for bull trout conservation. Because exclusions reflect the often complex pattern of land ownership, designated critical habitat is often fragmented and interspersed with excluded stream segments.

Table 2. Stream/shoreline distance excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Kilometers	Miles
Lewis River Hydro Conservation Easements	7.0	4.3
DOD – Dabob Bay Naval	23.9	14.8
HCP – Cedar River (City of Seattle)	25.8	16.0
HCP – Washington Forest Practices Lands	1,608.30	999.4
HCP – Green Diamond (Simpson)	104.2	64.7
HCP – Plum Creek Central Cascades (WA)	15.8	9.8
HCP – Plum Creek Native Fish (MT)	181.6	112.8
HCP–Stimson	7.7	4.8
HCP – WDNR Lands	230.9	149.5
Tribal – Blackfeet	82.1	51.0
Tribal – Hoh	4.0	2.5
Tribal – Jamestown S’Klallam	2.0	1.2

Ownership and/or Plan	Kilometers	Miles
Tribal – Lower Elwha	4.6	2.8
Tribal – Lummi	56.7	35.3
Tribal – Muckleshoot	9.3	5.8
Tribal – Nooksack	8.3	5.1
Tribal – Puyallup	33.0	20.5
Tribal – Quileute	4.0	2.5
Tribal – Quinault	153.7	95.5
Tribal – Skokomish	26.2	16.3
Tribal – Stillaguamish	1.8	1.1
Tribal – Swinomish	45.2	28.1
Tribal – Tulalip	27.8	17.3
Tribal – Umatilla	62.6	38.9
Tribal – Warm Springs	260.5	161.9
Tribal – Yakama	107.9	67.1
Total	3,094.9	1,923.1

Table 3. Lake/Reservoir area excluded from bull trout critical habitat based on Tribal ownership or other plan.

Ownership and/or Plan	Hectares	Acres
HCP – Cedar River (City of Seattle)	796.5	1,968.2
HCP – Washington Forest Practices Lands	5,689.1	14,058.1
HCP – Plum Creek Native Fish	32.2	79.7
Tribal – Blackfeet	886.1	2,189.5
Tribal – Warm Springs	445.3	1,100.4
Total	7,849.3	19,395.8

Conservation Role and Description of Critical Habitat

The conservation role of bull trout critical habitat is to support viable core area populations (75 FR 63898:63943 [October 18, 2010]). The core areas reflect the metapopulation structure of bull trout and are the closest approximation of a biologically functioning unit for the purposes of recovery planning and risk analyses. CHUs generally encompass one or more core areas and may include FMO areas, outside of core areas, that are important to the survival and recovery of bull trout.

Thirty-two CHUs within the geographical area occupied by the species at the time of listing are designated under the final rule. Twenty-nine of the CHUs contain all of the physical or biological features identified in this final rule and support multiple life-history requirements. Three of the mainstem river units in the Columbia and Snake River basins contain most of the physical or biological features necessary to support the bull trout's particular use of that habitat, other than those physical biological features associated with Primary Constituent Elements (PCEs) 5 and 6, which relate to breeding habitat.

The primary function of individual CHUs is to maintain and support core areas, which 1) contain bull trout populations with the demographic characteristics needed to ensure their persistence and contain the habitat needed to sustain those characteristics (Rieman and McIntyre 1993, p. 19); 2) provide for persistence of strong local populations, in part, by providing habitat conditions that encourage movement of migratory fish (Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); 3) are large enough to incorporate genetic and phenotypic diversity, but small enough to ensure connectivity between populations (Hard 1995, pp. 314-315; Healey and Prince 1995, p. 182; Rieman and McIntyre 1993, pp. 22-23; MBTSG 1998, pp. 48-49); and 4) are distributed throughout the historic range of the species to preserve both genetic and phenotypic adaptations (Hard 1995, pp. 321-322; Rieman and McIntyre 1993, p. 23; Rieman and Allendorf 2001, p. 763; MBTSG 1998, pp. 13-16).

The Olympic Peninsula and Puget Sound CHUs are essential to the conservation of anadromous[1] bull trout, which are unique to the Coastal-Puget Sound population segment. These CHUs contain marine nearshore and freshwater habitats, outside of core areas, that are used by bull trout from one or more core areas. These habitats, outside of core areas, contain PCEs that are critical to adult and subadult foraging, overwintering, and migration.

Primary Constituent Elements for Bull Trout

Within the designated critical habitat areas, the PCEs for bull trout are those habitat components that are essential for the primary biological needs of foraging, reproducing, rearing of young, dispersal, genetic exchange, or sheltering. Based on our current knowledge of the life history, biology, and ecology of this species and the characteristics of the habitat necessary to sustain its essential life-history functions, we have determined that the following PCEs are essential for the conservation of bull trout.

1. Springs, seeps, groundwater sources, and subsurface water connectivity (hyporheic flows) to contribute to water quality and quantity and provide thermal refugia.

2. Migration habitats with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and freshwater and marine foraging habitats, including but not limited to permanent, partial, intermittent, or seasonal barriers.

3. An abundant food base, including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

[1] Bull trout migrate from saltwater to freshwater to reproduce are commonly referred to as anadromous. However, bull trout and some other species that enter the marine environment are more properly termed amphidromous. Unlike strictly anadromous species, such as Pacific salmon, amphidromous species often return seasonally to fresh water as subadults, sometimes for several years, before returning to spawn (Brenkman and Corbett 2005, p. 1075; Wilson 1997, p. 5). Due to its more common usage, we will refer to bull trout has exhibiting anadromous rather than amphidromous life history patterns in this document.

4. Complex river, stream, lake, reservoir, and marine shoreline aquatic environments, and processes that establish and maintain these aquatic environments, with features such as large wood, side channels, pools, undercut banks and unembedded substrates, to provide a variety of depths, gradients, velocities, and structure.

5. Water temperatures ranging from 2°C to 15°C (36°F to 59°F), with adequate thermal refugia available for temperatures that exceed the upper end of this range. Specific temperatures within this range will depend on bull trout life-history stage and form; geography; elevation; diurnal and seasonal variation; shading, such as that provided by riparian habitat; streamflow; and local groundwater influence.

6. In spawning and rearing areas, substrate of sufficient amount, size, and composition to ensure success of egg and embryo overwinter survival, fry emergence, and young-of-the-year and juvenile survival. A minimal amount of fine sediment, generally ranging in size from silt to coarse sand, embedded in larger substrates, is characteristic of these conditions. The size and amounts of fine sediment suitable to bull trout will likely vary from system to system.

7. A natural hydrograph, including peak, high, low, and base flows within historic and seasonal ranges or, if flows are controlled, minimal flow departure from a natural hydrograph.

8. Sufficient water quality and quantity such that normal reproduction, growth, and survival are not inhibited.

9. Sufficiently low levels of occurrence of non-native predatory (e.g., lake trout, walleye, northern pike, smallmouth bass); interbreeding (e.g., brook trout); or competing (e.g., brown trout) species that, if present, are adequately temporally and spatially isolated from bull trout.

The revised PCE's are similar to those previously in effect under the 2005 designation. The most significant modification is the addition of a ninth PCE to address the presence of nonnative predatory or competitive fish species. Although this PCE applies to both the freshwater and marine environments, currently no non-native fish species are of concern in the marine environment, though this could change in the future.

Note that only PCEs 2, 3, 4, 5, and 8 apply to marine nearshore waters identified as critical habitat. Also, lakes and reservoirs within the CHUs also contain most of the physical or biological features necessary to support bull trout, with the exception of those associated with PCEs 1 and 6. Additionally, all except PCE 6 apply to FMO habitat designated as critical habitat.

Critical habitat includes the stream channels within the designated stream reaches and has a lateral extent as defined by the bankfull elevation on one bank to the bankfull elevation on the opposite bank. Bankfull elevation is the level at which water begins to leave the channel and

move into the floodplain and is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series. If bankfull elevation is not evident on either bank, the ordinary high-water line must be used to determine the lateral extent of critical habitat. The lateral extent of designated lakes is defined by the perimeter of the waterbody as mapped on standard 1:24,000 scale topographic maps. The Service assumes in many cases this is the full-pool level of the waterbody. In areas where only one side of the waterbody is designated (where only one side is excluded), the mid-line of the waterbody represents the lateral extent of critical habitat.

In marine nearshore areas, the inshore extent of critical habitat is the mean higher high-water (MHHW) line, including the uppermost reach of the saltwater wedge within tidally influenced freshwater heads of estuaries. The MHHW line refers to the average of all the higher high-water heights of the two daily tidal levels. Marine critical habitat extends offshore to the depth of 10 meters (m) (33 ft) relative to the mean lower low-water (MLLW) line (zero tidal level or average of all the lower low-water heights of the two daily tidal levels). This area between the MHHW line and minus 10 m MLLW line (the average extent of the photic zone) is considered the habitat most consistently used by bull trout in marine waters based on known use, forage fish availability, and ongoing migration studies and captures geological and ecological processes important to maintaining these habitats. This area contains essential foraging habitat and migration corridors such as estuaries, bays, inlets, shallow subtidal areas, and intertidal flats.

Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, it should be recognized that the quality of marine and freshwater habitat along streams, lakes, and shorelines is intrinsically related to the character of these adjacent features, and that human activities that occur outside of the designated critical habitat can have major effects on physical and biological features of the aquatic environment.

Activities that cause adverse effects to critical habitat are evaluated to determine if they are likely to “destroy or adversely modify” critical habitat by no longer serving the intended conservation role for the species or retaining those PCEs that relate to the ability of the area to at least periodically support the species. Activities that may destroy or adversely modify critical habitat are those that alter the PCEs to such an extent that the conservation value of critical habitat is appreciably reduced (75 FR 63898:63943; USFWS 2004, Vol. 1. pp. 140-193, Vol. 2, pp. 69-114). The Service’s evaluation must be conducted at the scale of the entire critical habitat area designated, unless otherwise stated in the final critical habitat rule (USFWS and NMFS 1998, pp. 4-39). Thus, adverse modification of bull trout critical habitat is evaluated at the scale of the final designation, which includes the critical habitat designated for the Klamath River, Jarbidge River, Columbia River, Coastal-Puget Sound, and Saint Mary-Belly River population segments. However, we consider all 32 CHUs to contain features or areas essential to the conservation of the bull trout (75 FR 63898:63901, 63944). Therefore, if a proposed action would alter the physical or biological features of critical habitat to an extent that appreciably reduces the conservation function of one or more critical habitat units for bull trout, a finding of adverse modification of the entire designated critical habitat area may be warranted (75 FR 63898:63943).

Current Critical Habitat Condition Rangewide

The condition of bull trout critical habitat varies across its range from poor to good. Although still relatively widely distributed across its historic range, the bull trout occurs in low numbers in many areas, and populations are considered depressed or declining across much of its range (67 FR 71240). This condition reflects the condition of bull trout habitat. The decline of bull trout is primarily due to habitat degradation and fragmentation, blockage of migratory corridors, poor water quality, past fisheries management practices, impoundments, dams, water diversions, and the introduction of nonnative species (63 FR 31647, June 10 1998; 64 FR 17112, April 8, 1999).

There is widespread agreement in the scientific literature that many factors related to human activities have impacted bull trout and their habitat, and continue to do so. Among the many factors that contribute to degraded PCEs, those which appear to be particularly significant and have resulted in a legacy of degraded habitat conditions are as follows: 1) fragmentation and isolation of local populations due to the proliferation of dams and water diversions that have eliminated habitat, altered water flow and temperature regimes, and impeded migratory movements (Dunham and Rieman 1999, p. 652; Rieman and McIntyre 1993, p. 7); 2) degradation of spawning and rearing habitat and upper watershed areas, particularly alterations in sedimentation rates and water temperature, resulting from forest and rangeland practices and intensive development of roads (Fraley and Shepard 1989, p. 141; MBTSG 1998, pp. ii - v, 20-45); 3) the introduction and spread of nonnative fish species, particularly brook trout and lake trout, as a result of fish stocking and degraded habitat conditions, which compete with bull trout for limited resources and, in the case of brook trout, hybridize with bull trout (Leary et al. 1993, p. 857; Rieman et al. 2006, pp. 73-76); 4) in the Coastal-Puget Sound region where amphidromous bull trout occur, degradation of mainstem river FMO habitat, and the degradation and loss of marine nearshore foraging and migration habitat due to urban and residential development; and 5) degradation of FMO habitat resulting from reduced prey base, roads, agriculture, development, and dams.

Effects of Climate Change on Bull Trout Critical Habitat

One objective of the final rule was to identify and protect those habitats that provide resiliency for bull trout use in the face of climate change. Over a period of decades, climate change may directly threaten the integrity of the essential physical or biological features described in PCEs 1, 2, 3, 5, 7, 8, and 9. Protecting bull trout strongholds and cold water refugia from disturbance and ensuring connectivity among populations were important considerations in addressing this potential impact. Additionally, climate change may exacerbate habitat degradation impacts both physically (e.g., decreased base flows, increased water temperatures) and biologically (e.g., increased competition with non-native fishes).

Consulted on Effects for Critical Habitat

The Service has formally consulted on the effects to bull trout critical habitat throughout its range. Section 7 consultations include actions that continue to degrade the environmental baseline in many cases. However, long-term restoration efforts have also been implemented that provide some improvement in the existing functions within some of the critical habitat units.

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Appendix C – Ecosystems Discipline Report

Washington State Ferries

Seattle Multimodal Terminal at Colman Dock Project Environmental Assessment

Ecosystems Discipline Report

Prepared for

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Federal Highway Administration
Federal Transit Administration

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November 2013

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Acronyms and Abbreviations

BA	Biological Assessment
BMP	Best management practice
CFS	Cubic feet per second
CSL	Cleanup screening levels
DR	Discipline report
EA	Environmental Assessment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
ESA	Endangered Species Act
HPU	Hydraulic processing unit
ILF	In-lieu fee
LPS	Light-penetrating structures
MHHW	Mean higher high water
MLLW	Mean lower low water
MMPA	Marine Mammal Protection Act
MSA	Magnuson Stevens Act
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NTU	Nephelometric turbidity units
OHL	Overhead loading
OWC	Overwater cover
OWS	Overwater structures
PAH	Polycyclic aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PAR	Photosynthetically active radiation

PFMC	Pacific Fishery Management Council
PHS	Priority habitats and species
PFMC	Pacific Fisheries Management Council
POF	Passenger-only ferry
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SMS	Sediment management standards
SQS	Sediment quality standards
TSS	Total suspended solids
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

Introduction

Why are Ecosystems considered in the EA?

An ecosystem is a biological community interacting with its physical and chemical environment as an integrated, dynamic unit. Ecosystems consist of living organisms, including humans, and the environment they inhabit. Understanding this relationship is integral to the environmental review process. Various federal, state and local regulations such as the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA) require that the effects of a proposed project on ecosystem structure, function, and process be evaluated as part of an Environmental Assessment (EA). The Ecosystems Discipline Report (DR) provides a description of existing biological conditions in the project area and how the project alternatives would affect those conditions.

Regulatory Context

Federal, state and local laws protect upland, wetland, and marine wildlife habitat. Habitat protection is necessary for the continued presence of wildlife species in urban environments. The project would need to meet the requirements of the following regulations:

Federal

- Bald and Golden Eagle Protection Act. 1940. 16 USC 668a-d, as amended.
- Clean Water Act. 1977. 33 USC 1251-1376, as amended.
- Clean Air Act. 1963. 42 USC 7401, as amended.
- Endangered Species Act (ESA). 1973. 16 Unites States Code (USC) 1531-1544, as amended.
- Magnuson-Stevens Fishery Conservation Management Act. 1976. Public Law 94-265, as amended.
- Marine Mammal Protection Act (MMPA). Title I. 1972. 16 USC 1361 1389, 16 USC 1401-1407, 1411-1417, and 1421-1421h, as amended.
- Migratory Bird Treaty Act. 1936. 16 USC 703-712, as amended.
- National Environmental Policy Act. 1969. 42 USC 4321.

State

- Hydraulic Code. 1949. Chapter 77.55 Revised Code of Washington (RCW). Olympia, Washington.
- Shoreline Management Act of 1971. 1971. RCW 90.58, Washington Administrative Code (WAC) 173-18-100 and WAC 173-22. Olympia, Washington.
- Shoreline Substantial Development Permit. RCW 90.58.140(3) and WAC 173-27-150.
- State Environmental Policy Act. 1971. RCW 43.21C, and WAC 197-11 and WAC 468-12. Olympia, Washington.
- Water Quality Standards for Surface Waters of the State of Washington WAC 173-201a.
- Model Toxics Control Act WAC 173-340.
- Sediment Management Standards WAC 173-204.

Local

- Environmentally Critical Areas. 2010. City of Seattle – Seattle Municipal Code 25.09. Seattle, Washington.
- Shoreline Master Program. 2012. Seattle, Washington.

What are the key points of this report?

The study area for the Seattle Multimodal Terminal at Colman Dock Project contains a number of fish and aquatic resources**.** Construction and operation of the Build and No Build alternatives would have impacts to those resources. The Build Alternative would remove the northern timber portion of the trestle and a section of fill under the trestle, and replace it with a concrete trestle. The existing southern concrete trestle will be extended to the south. The terminal building and components of Slips 2 and 3 would be replaced. The No Build Alternative would only maintain and replace failing structures as necessary. Construction impacts would be greater under the Build Alternative.

Both alternatives would involve in-water work, which would generate elevated levels of noise and turbidity that could adversely affect aquatic organisms and their environment. Marine sediments at Colman Dock are contaminated and mobilization of contaminated sediments during construction could increase exposure of aquatic organisms to harmful chemicals. The duration and extent of in-water work would be much greater under the Build Alternative.

The Build Alternative would create a temporary increase in overwater cover during construction because a new section of trestle would be

built south of the existing trestle prior to removal of the northern portion of the dock. Overwater cover can increase shade, which reduces macroalgae cover and can disrupt salmonid migration patterns. The presence of work barges would also cause temporary increases in overwater cover and disturbance. The final project footprint would increase overwater cover slightly compared to pre-project conditions; however, a section of trestle would be constructed using light-penetrating surfaces to minimize shading. There would be no increase in overwater cover under the No Build Alternative.

Construction of the Build Alternative would have several beneficial effects. The project would increase benthic and shoreline habitat by removing over 2,500 piles as well as a section of fill under the north trestle. Many of the piles and decking that would be removed are treated with creosote; replacing the timber portion of the trestle would remove approximately 7,400 tons of creosote-treated wood that has the potential to leach contaminants into the environment.

Apart from oil-water separators underneath the southeast portion of the concrete trestle, there is currently no water quality treatment for stormwater that runs off the trestle. The Build Alternative would treat all stormwater runoff from the trestle, improving water quality in the vicinity of the terminal. The project would also cap contaminated sediments underneath the north trestle, minimizing the chance of contamination spreading into the environment. Contaminants under the south trestle have already been capped.

Most of these benefits would not be realized under the No Build Alternative, although creosote-treated structures would be replaced as necessary to maintain the safety of the terminal. The No Build Alternative would not remove fill from underneath the north trestle, cap sediments, or provide additional stormwater treatment.

What is the study area?

The study area encompasses both terrestrial and aquatic ecosystems. The terrestrial portion of the study area includes the downtown Seattle waterfront. The aquatic portion of the study area covers all of Elliott Bay (Exhibit 1).

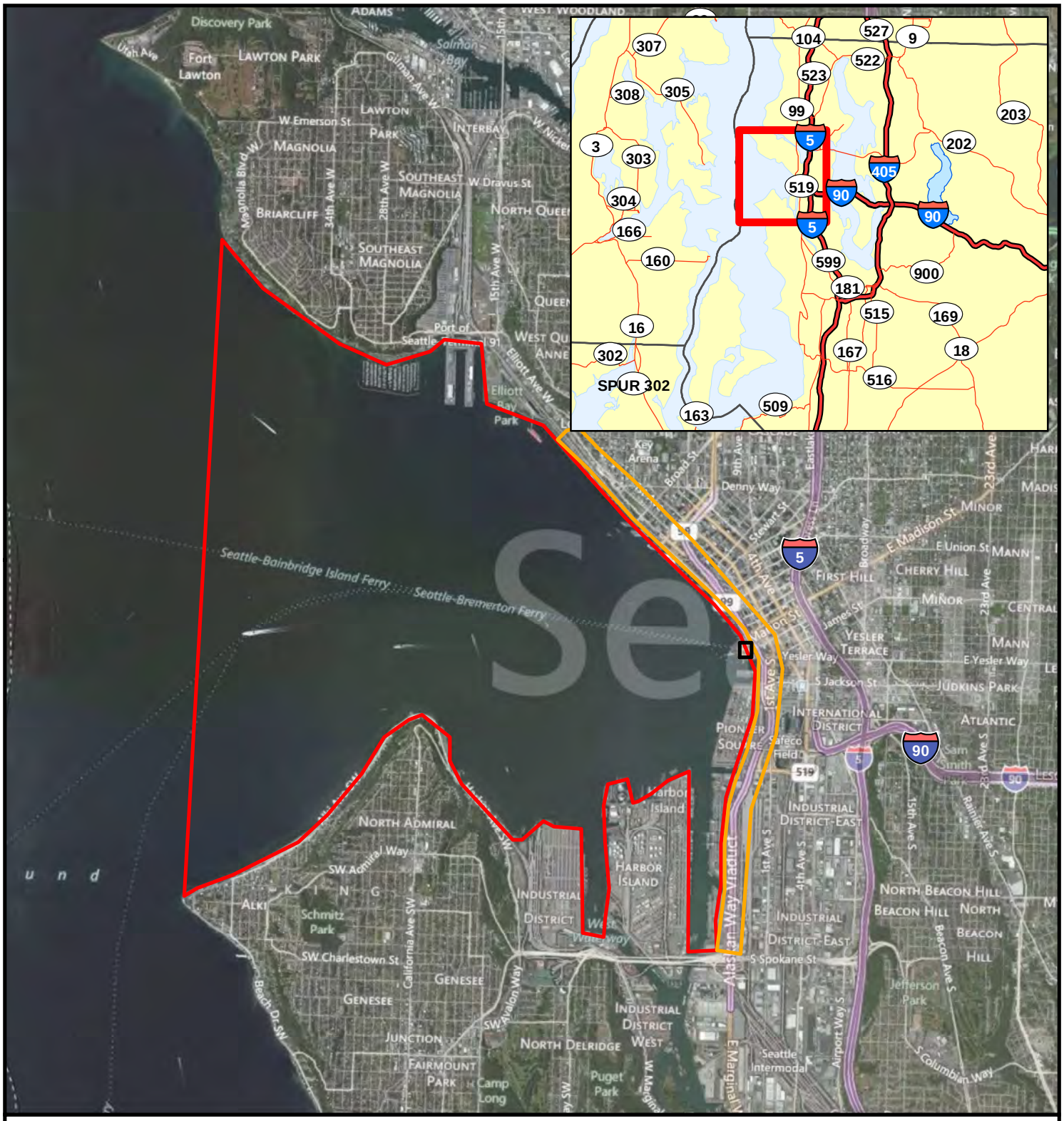

Exhibit 1. Study area

0 0.25 0.5 1 Miles

N

Legend

- Project footprint
- Aquatic portion of study area
- Terrestrial portion of study area

Washington State Department of Transportation

What are the project alternatives?

Two alternatives are being considered for this analysis, the Build and No Build Alternatives. The Build Alternative would construct the project as described below. The project would not be constructed under the No-Build Alternative but repair and replacement of failing structures would still take place as necessary for continued operation of the facility as required by state mandate.

What is the Build Alternative?

The Washington State Department of Transportation, Ferries Division (WSF) proposes to replace the aging and seismically vulnerable components of the Seattle Ferry Terminal at Colman Dock in order to maintain ferry service in the future. The Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) are the federal co-lead agencies responsible for reviewing the proposal for compliance with the National Environmental Policy Act (NEPA).Colman Dock is located on Pier 52, along the central waterfront of downtown Seattle, Washington. The northern portion of Colman Dock is a timber structure that has deteriorated over time and is both seismically vulnerable and at the end of its service life. Initially constructed in 1938, the timber dock was rebuilt in 1964 and expanded in the northwest corner in 1971; it is still supported in large part by many of the original 1938 timber piles and structural components. The terminal building and the vehicle and passenger loading bridges of Slips 2 and 3 were built in 1964 on independent foundations**.** Due to their degraded conditions, these components require regular maintenance, which can cause lane closures and disrupt operations.

Key elements of the Seattle Ferry Terminal Project include:

- Replacing and re-configuring the timber trestle portion of the dock;
- Replacing the main terminal building;
- Reconfiguring the dock layout to provide safer and more efficient operations;
- Replacing the vehicle transfer span and the overhead loading structures of Slip 3;

- Maintaining a connection to the Marion Street pedestrian overpass;
- Replacing the passenger-only ferry (POF) facility on the southern edge of Colman Dock.

Much of the northern trestle area would be left as open water after construction; the design replaces the northern holding lane capacity on the south side of the terminal. The reconfiguration increases near shore habitat and narrows the facility's frontage along Alaskan Way by 150 feet. The total overwater coverage for the reconfigured terminal, including the POF facility, would increase by about 5,200 square feet. Mitigation for the increased overwater coverage would include removal of an equivalent area of overwater coverage in Elliott Bay or elsewhere in Puget Sound.

When the south trestle of the Seattle Ferry Terminal was built in 1990, WSF placed a clean sediment cap over the contaminated sediments in the construction area. The current proposal would also place a clean sediment cap in the new construction areas, to contain contamination in the underlying sediment and prevent leaching into the marine environment. In addition, the Project would include basic stormwater treatment for all new and replaced areas of the terminal.

Construction would be phased to minimize disruption to ferry service. The phasing would maintain holding lane capacity on the dock to allow ferry loading during construction, and WSF anticipates that current ferry schedules would be maintained. The construction would last for six years, from 2015 through 2021.

This abbreviated description of the project is for the convenience of the reader, and is intended to be consistent with the details included in the project description included in the project's NEPA Environmental Assessment (EA). See Chapter 3 of the EA for a full description of the No build and Build Alternatives analyzed.

Exhibit 2 shows the terminal in its existing condition. Exhibit 3 shows the completed project.

Project construction would occur in four phases over approximately six years (~72 months; Exhibit 4), with four seasons of in-water work. In-water work would only occur during the in-water work window for Elliott Bay as determined during the ESA consultation and project permits and approvals.

Washington State Ferries

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N

NOT TO SCALE

SOURCE: WSDOT, 2011

Exhibit 2

Existing Project Site

Seattle Terminal Project

Seattle, Washington

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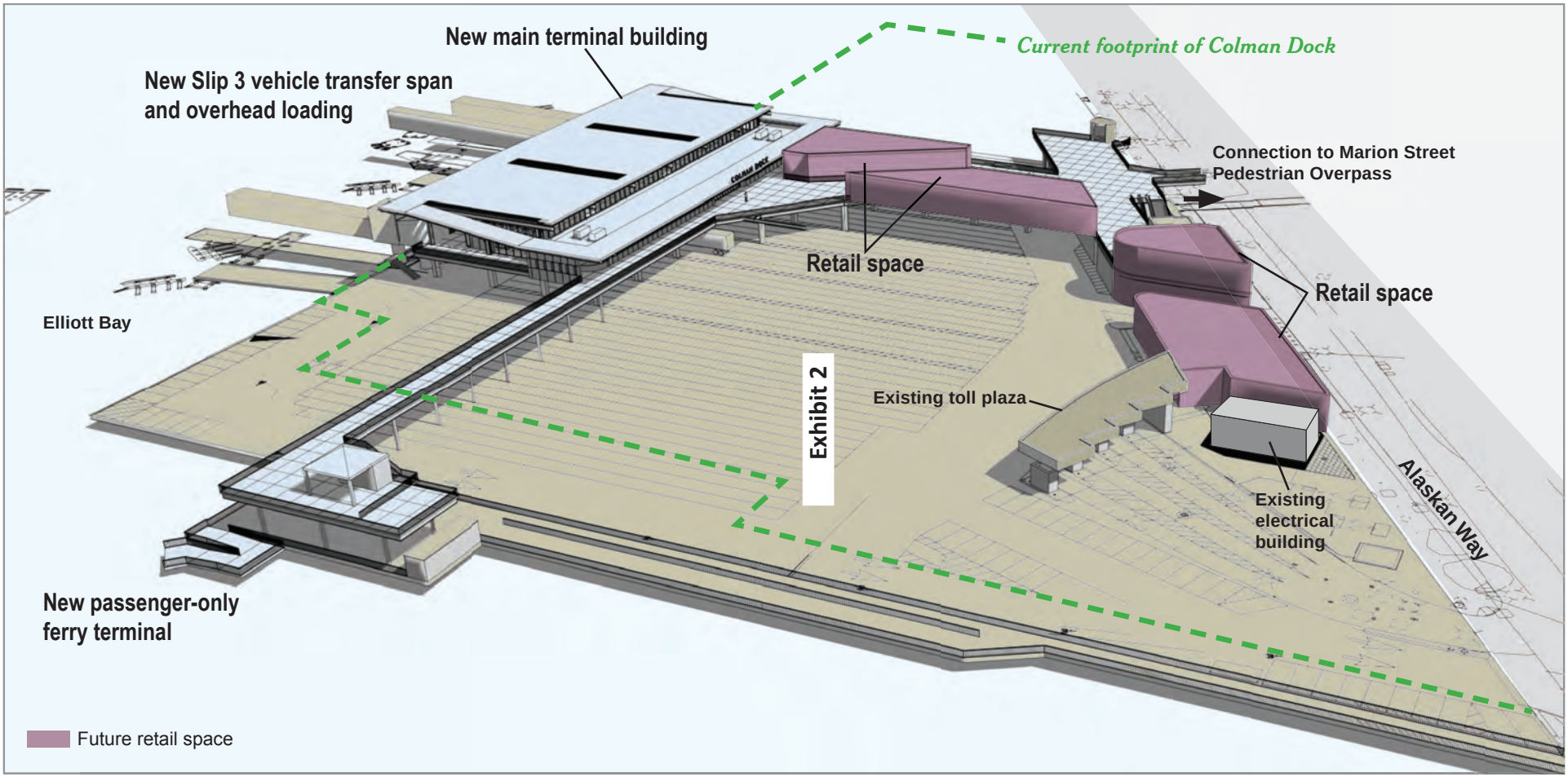
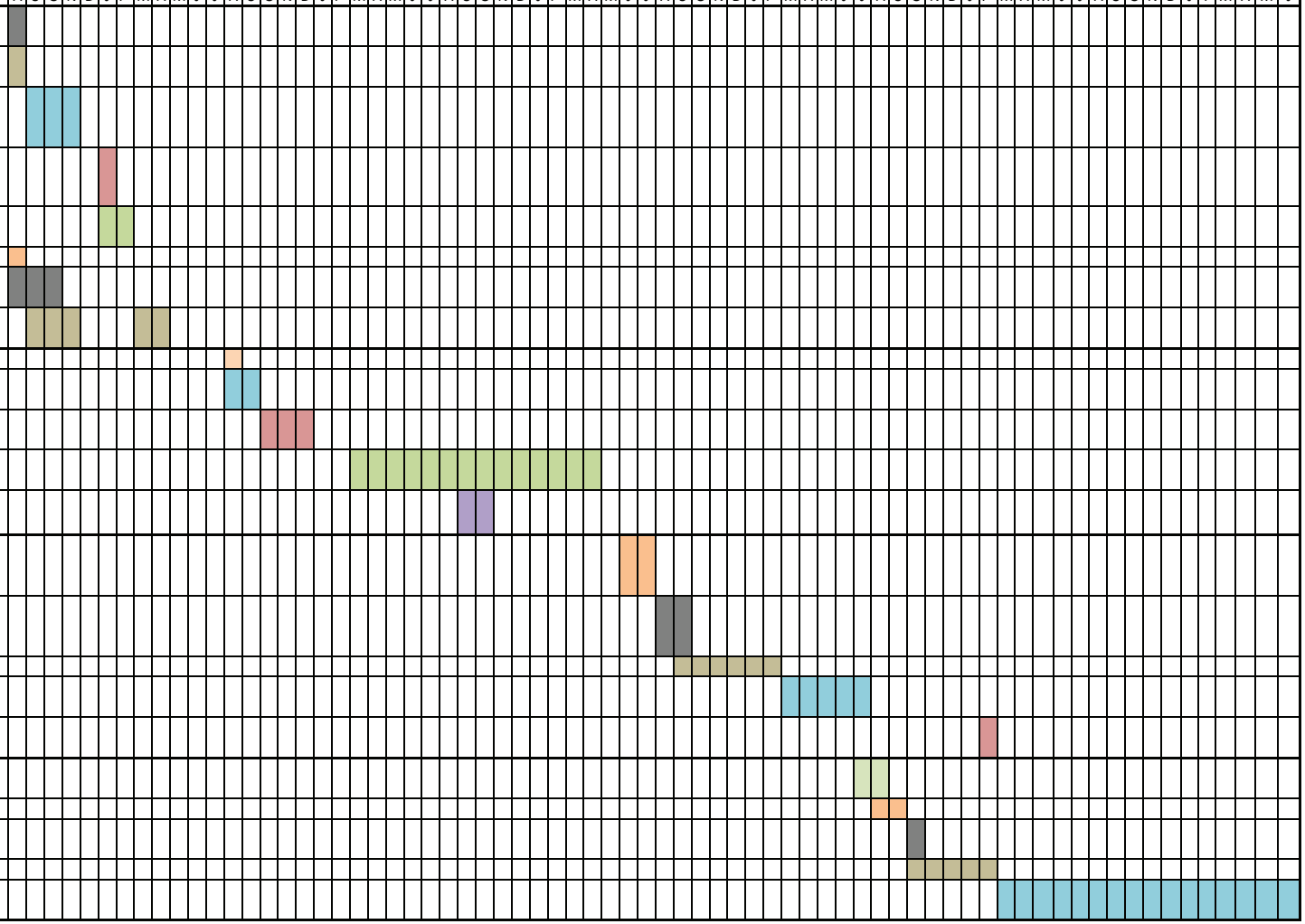


Exhibit 3
Build Alternative

Exhibit 4. Construction timeline.

Phase	Activity	Duration
I	Construct temporary POF slip	1 month
	Relocate POF float and gangway	2 weeks
	Build west section of south trestle, POF pier and part of POF walkway	3 mos
	Move POF float and gangway to permanent location	2 weeks
	Build SE Trestle and remaining POF walkway	1 month
	Remove Slip 3 structures	1 month
	Construct Slip 3 Dolphins & shafts	2-3 mos
	Construct Slip 3 OHL & Transfer Span	3-6 mos
II	Remove Slip I walkway	
	Demolish trestle under south third of new terminal bldg	2 mos
	Install pile foundation for terminal building	3 mos
	Construct southern third of terminal building	
	Complete elevated walkway	2 mos
III	Remove Slip 2 transfer span & OHL, demolish crew building	2 mos
	Demolish terminal building and 100- ft wide section of trestle	2 mos
	Reconstruct Trestle	5 mos
	Construct center third of terminal building	9 mos
	Reinstall Slip 2 transfer span & OHL	1 month
IV	Demolish remaining north timber trestle decking	6 weeks
	Demolish timber pilings	9 weeks
	Dredge fill under north trestle	2-3 weeks
	Reconstruct Trestle	4.5 mos
	Construct final third of terminal building	9-12 mos



Trestle and Ferry Slips

The existing timber trestle is an overwater structure approximately 140,000 square feet in size. The trestle includes the timber piles, the deck and the deck's structural supports. It extends from the south edge of the terminal building to the north edge of the facility, adjacent to the fire station. The trestle was originally constructed in 1936 and rebuilt in 1964 using many of the original timber piles. As part of the 1964 pier reconstruction, Washington State Ferries (WSF) also constructed the main terminal building. WSF added the southern, concrete half of the dock in 1990 (approximately 150,000 square feet).

The proposed project would remove the timber portion of the trestle and replace the area up to Marion Street with a concrete trestle. The area north of Marion would not be reconstructed. An approximately equivalent area of concrete trestle would be constructed on the south edge of the facility. This reconfiguration of the dock would enhance safety by reducing pedestrian/vehicle conflicts and provide increased operational efficiency, while opening approximately 150 linear feet of waterfront and near shore habitat.

Phase I Activities

During Phase I the POF slip would be temporarily relocated to the east prior to constructing a permanent replacement slip west of its current location. The slip consists of a float (barge where vessels tie up and passengers embark and disembark), a gangway (floating walkway that connects the float to the pier), pier (fixed overwater structure connecting the gangway to the walkway), and a walkway extending from the shore to the pier. Once the permanent slip has been constructed, the temporary slip would be removed.

The temporary platform for the POF slip would be constructed on the south side of the trestle. The existing POF pier and walkway, including supporting piles, would be removed and the float and gangway temporarily relocated east of their current location (Exhibit 5). Concrete piles would be used to support the platform and walkway and steel piles would support the float and gangway (Exhibit 6).

Nearly 45,000 ft^2 of new trestle with concrete and steel piles and decking would be built to the south. Once the southern portion of the trestle is complete, the new POF slip would be constructed using concrete and steel piles (Exhibit 6). A light-penetrating surface, such as glass blocks, would be used for the 5,300 ft^2 POF walkway. An elevated walkway over the concrete trestle would be constructed to connect the POF slip to the new terminal building. The walkway would be

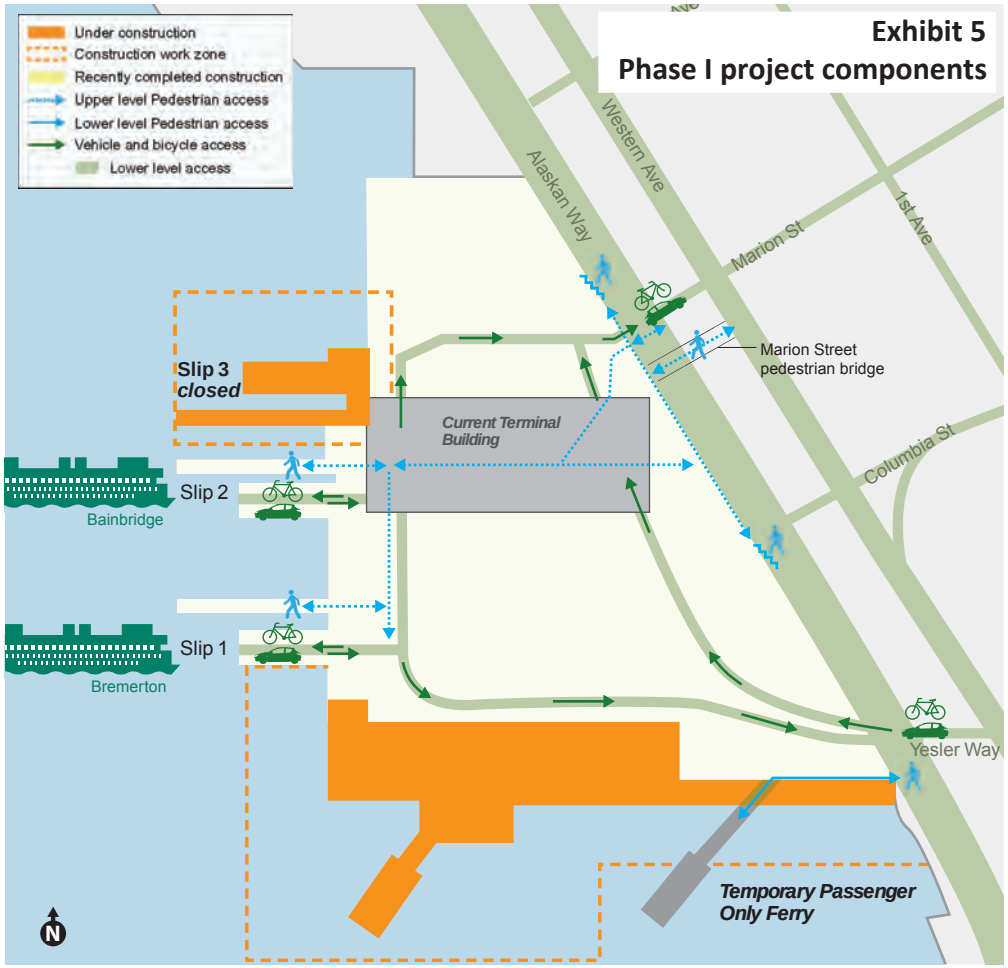


Exhibit 5
Phase I project components
Under construction
Construction work zone
Recently completed construction
Upper level Pedestrian access
Lower level Pedestrian access
Vehicle and bicycle access
Lower level access
Alaskan Way
Western Ave
Marion St
1st Ave
Columbia St
Yesler Way
Marion Street pedestrian bridge
Slip 3 closed
Current Terminal Building
Slip 2
Bainbridge
Slip 1
Bremerton
Temporary Passenger Only Ferry
N

Exhibit 6. Approximate number of piles during different construction phases.

Phase	Activity		Pile Type	# of Piles	Pile diam. (in)	Total area (SF)	Activity		Pile Type	# of Piles	Pile diam. (in)	Total area (SF)
I	Demolition	Demolish POF slip Remove portion of south trestle and concrete piling	Concrete	14	14	16	Construction	Slip 3 transfer span	Drilled shaft	2	80	70
			Concrete	2	16.5	3			Steel	10	30	49
			Concrete	18	18	34		Slip 3 OHL	Drilled shaft	1	108	64
			Steel pipe	5	36	35			Drilled shaft	1	84	38
			Steel pipe	2	30	10		Slip 3 HPU platform	Steel/concrete	4	30	20
		Remove Slip 3 structures	Vehicle-Ramp Tower	16	H-pile	16		Inner dolphins	Steel	12	30	59
			Passenger-Ramp Tower	6	H-pile	6			Steel	6	36	42
			Vehicle-Ramp Bridge Seat: Steel pipe pile	9	14	10		Temp. dolphin	Steel	7	24	22
			Concrete-encased timber	16	30	79		South trestle	Concrete	253	18	471
			Timber	49	12	38			Drilled shaft	4	72	113
		Remove Slip 2 right dogleg wingwall	Timber	97	13	89		POF slip platform and walkway	Concrete	132	18	246
		Remove Slip 3 left dogleg wingwall	Timber	97	13	89		POF slip float and gangway	Steel	5	36	35
									Steel	2	30	10
II		Remove concrete trestle and piling	Concrete	45	18	84		Install pile foundation for terminal building	Steel/concrete	69	30	339
			Concrete	84	16.5	132						
III		Remove existing trestle (100 ft strip)	Timber	748	12	587		Construct new trestle	Steel/concrete	236	30	1158
		Remove foundation for existing building	Concrete filled steel pile	76	12	60		Reinstall slip 2 transfer span bridge seat	Steel	10	30	49
								Storm water concrete vault	Steel/concrete	24	30	118
IV		Demolish north timber trestle	Timber	1187	12	932		Construct new trestle	Steel/concrete	225	30	1104
		Remove foundation for existing building	Concrete filled steel pile	80	12	63		Storm water concrete vault	Steel/concrete	12	30	59
		Remove fill under north trestle	NA	NA	NA	14,500						
			Demolition total	**2,551**	**---**	**16,783**			**Construction total**	**1,015**	**----**	**4,066**
											Total increase in benthic habitat post-project	**12,717**

supported by four 72-inch drilled shafts (walkway construction would be completed in Phase II).

Slip 3 would be reconstructed during this phase of the project. The Slip 3 transfer span would be replaced with a new standard hydraulic transfer span, hydraulic processing unit (HPU) platform, and bridge seat, and the overhead structures would be replaced. Two drilled shafts would be used to support the new overhead loading structures. The Slip 3 transfer span and overhead loading structure would be supported by four drilled shafts: two 80-inch diameter drilled shafts for the transfer span, and one 108-inch and one 84-inch diameter drilled shaft for the overhead loading. Steel casings for the drilled shafts would be vibrated into place. Thirty-inch steel piles would be used for the bridge seat.

The two timber dogleg dolphins between Slips 2 and 3 would be replaced by two new steel pile dolphins (Exhibit 5). A temporary dolphin would be built to allow vessels to dock at Slip 2. Steel piles would be used to construct both the temporary dolphin and fixed dolphins (Exhibit 6).

Phase I is scheduled to begin in 2015 and would last approximately 12 months, with one season of in-water work (Exhibit 4).

Phase II

In Phase II the Slip 1 walkway would be removed, as well as a portion of the south (concrete) trestle and piles underneath what would be the new terminal building (Exhibit 7). The pile foundation would be installed for the new terminal, and the southern third of the new terminal building would be constructed. The existing concrete piles would be removed and replaced with a concrete trestle supported by 30-inch diameter concrete-reinforced steel piles[1] (Exhibit 6). These piles would be installed with an impact hammer to the necessary depth. The Slip 1 connector ramp would be reinstalled, and the elevated POF walkway would be completed. A barge would be anchored south of Slip 2 to support construction equipment necessary for the work. This portion of the project would take approximately 28 months, with one season of in-water work (Exhibit 4).

[1] Concrete-reinforced steel piles are hollow steel piles containing a plug at the bottom. Once they have been driven to the requisite depth a rebar frame would be inserted into the pile and concrete poured around the frame.

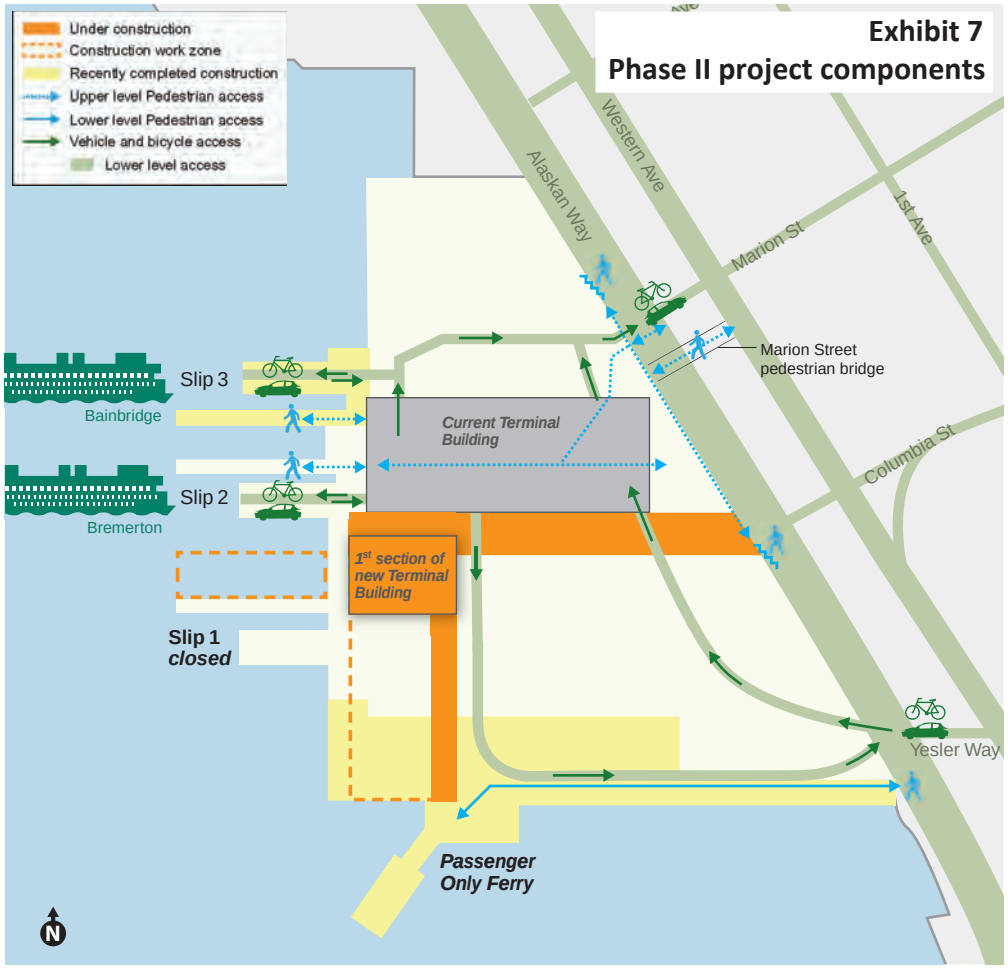


Exhibit 7
Phase II project components
Under construction
Construction work zone
Recently completed construction
Upper level Pedestrian access
Lower level Pedestrian access
Vehicle and bicycle access
Lower level access
Alaskan Way
Western Ave
Marion St
1st Ave
Columbia St
Yesler Way
Marion Street pedestrian bridge
Slip 3
Bainbridge
Slip 2
Bremerton
Slip 1 closed
Current Terminal Building
1st section of new Terminal Building
Passenger Only Ferry
N

Phase III

During this phase the Slip 2 transfer span and overhead loading would be temporarily removed and the vehicle attendant crew building under the Slip 2 overhead loading structure would be demolished (Exhibit 8). The entire terminal building would be demolished, and a strip of the north (timber) trestle approximately 100 feet wide immediately north of the existing concrete trestle would be demolished and replaced with a new concrete trestle supported by 30-inch diameter concrete-reinforced steel piles. The 12-inch diameter timber and concrete-reinforced steel piles would be removed (Exhibit 6). Piles would be vibrated out of the substrate to the extent possible to minimize disturbing contaminated sediments.

Using an average production rate of five to six piles per day, a total of approximately 47 days of driving would be needed.

Two temporary vehicle bridges would span the 100-foot strip during construction. The center third of the terminal building would be reconstructed and the Slip 2 vehicle and overhead loading spans reinstalled using 30-inch diameter steel piles (Exhibit 6). Temporary pedestrian bridges would link the Marion St overpass and Slip 3 to the new terminal building. Barges would be anchored with spuds south of the slip for this portion of the work, which would last about 24 months, with one season of in-water work (Exhibit 4).

Phase IV

In Phase IV the remaining portion of the north (timber) trestle would be demolished (Exhibit 8). Approximately 1,267 piles would be removed, consisting of 12-inch diameter timber and steel piles. Each pile would take about 15 minutes to remove. Approximately 10 piles would be removed per day (Exhibit 6).

Piles would be removed using vibratory methods to the extent possible to minimize suspending potentially contaminated sediments. Afterward, a section of fill measuring about 14,500 ft^2 (7,700 cubic yards) underneath the trestle contained behind a sheet pile bulkhead would be removed. The fill would be dredged while the bulkhead is still in place and either disposed of at an open water site (if it meets Dredged Material Management Plan [DMMP] provisions) or hauled offsite to an approved upland location. Once the fill has been removed and the area restored to match the bathymetry on either side, the bulkhead would be removed.

After removal of the bulkhead, the remainder of the new trestle and a stormwater vault would be constructed using 30-inch diameter

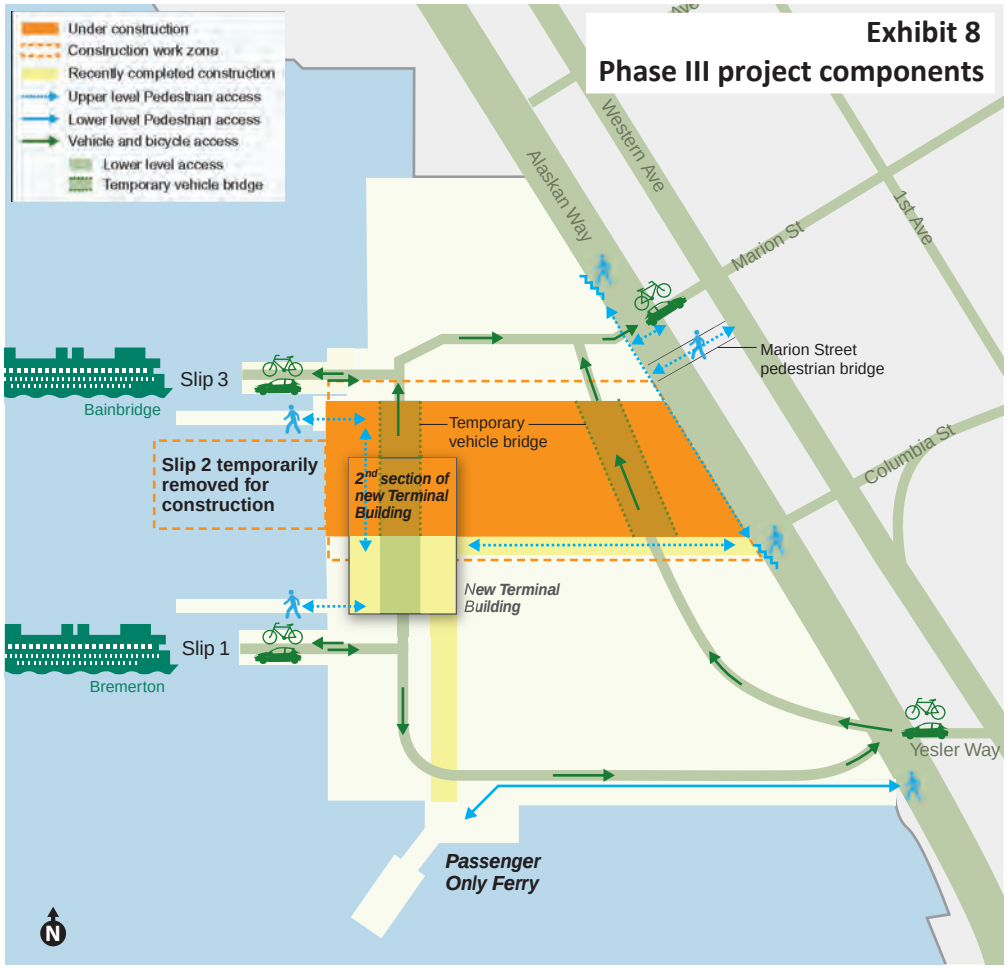


Exhibit 8
Phase III project components
Under construction
Construction work zone
Recently completed construction
Upper level Pedestrian access
Lower level Pedestrian access
Vehicle and bicycle access
Lower level access
Temporary vehicle bridge
Alaskan Way
Western Ave
Marion St
1st Ave
Columbia St
Yesler Way
Marion Street pedestrian bridge
Slip 3
Bainbridge
Slip 2 temporarily removed for construction
Temporary vehicle bridge
2nd section of new Terminal Building
New Terminal Building
Slip 1
Bremerton
Passenger Only Ferry
N

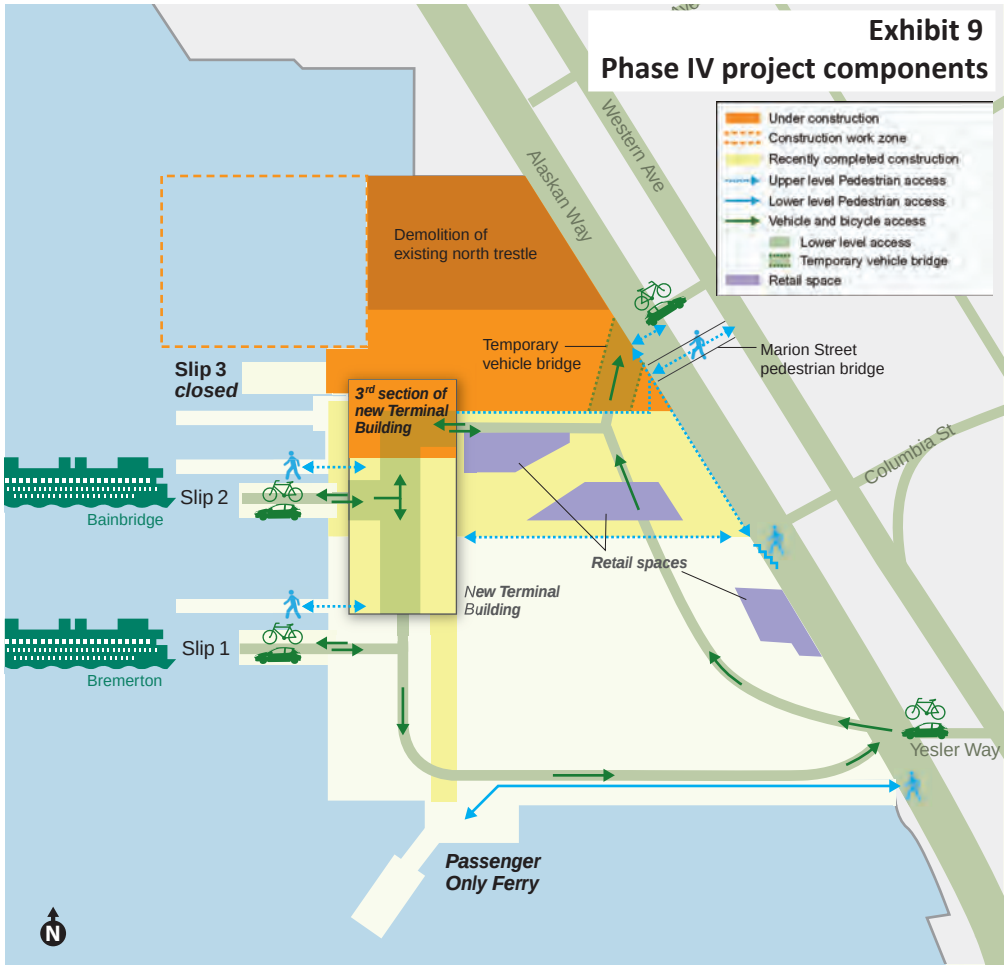


Exhibit 9
Phase IV project components
Under construction
Construction work zone
Recently completed construction
Upper level Pedestrian access
Lower level Pedestrian access
Vehicle and bicycle access
Lower level access
Temporary vehicle bridge
Retail space
Alaskan Way
Western Ave
Columbia St
Yesler Way
Demolition of existing north trestle
Temporary vehicle bridge
Marion Street pedestrian bridge
Slip 3 closed
3rd section of new Terminal Building
Slip 2
Bainbridge
Slip 1
Bremerton
Retail spaces
New Terminal Building
Passenger Only Ferry
N

concrete-reinforced steel piles filled (Exhibit 6). The final third of the new terminal building would be constructed, and temporary pedestrian bridges replaced with permanent structures (Exhibit 9). This portion of the project would last approximately 25 months, with one season of in-water work (Exhibit 4).

Stormwater Treatment

Terminal stormwater treatment now consists only of oil/water separators underneath the southeast portion of the trestle. The project would provide basic treatment for both new and existing impervious surfaces. Treatment would be provided by installing wet vaults with oil/water separators underneath the entire trestle. WSF also sweeps its terminals with a high efficiency sweeper on a quarterly basis.

Terminal Building

The existing terminal building would be demolished and a new building would be constructed as part of the project. The main level of the existing terminal building includes 36,000 square feet of enclosed space. The main level now accommodates passenger waiting and processing areas, as well as staff and vendor spaces. The new terminal building would provide 22,000 square feet of passenger, staff and vendor spaces. The design of the new building would provide the flexibility to add additional vendor spaces in a future phase of the project. A portion of the south (concrete) trestle would need to be reconstructed to support the new building.

Access and Egress

Access and egress points to the facility would remain unchanged for vehicle, bicycle, and pedestrian traffic. Access and egress to the facility at Marion Street and Yesler Way would also remain the same.

Multimodal Connections

Existing connections to transit service along Alaskan Way would be maintained. WSF would integrate its efforts with the City of Seattle and King County Metro to assure that ferry passenger connections to local transit service are maintained or enhanced as local transit routes or service are revised.

What is the No Build Alternative?

WSF uses a Life Cycle Cost Model (LCCM) as a management tool to determine when a system or structure is due for replacement. The balance of the cost to maintain versus to operate a structure is an indication of life cycle, and informs the prioritization of capital

investments. The model calculates when systems and structures are due for replacement and projects the annual capital investment necessary to sustain all inventory items within their useful life.

The LCCM would be applied to the No Build Alternative, which would maintain existing facilities at the terminal until structural systems reach a point in their lifespan when annual maintenance costs exceed annual operating costs. When that point is reached, the structure would be at or past its viable life span and would operate at reduced service or close; emergency repair and replacement would occur as necessary.

The footprint of the existing terminal would remain the same under the No Build Alternative. The creosote-treated timber piles and deck of the north trestle would not be removed, except to replace failing structures as part of ongoing maintenance, and the fill underneath the north trestle would remain in place. No additional stormwater treatment would be provided by the project.

Affected Environment

How was the information collected?

The project biologist reviewed the project footprint and construction methods provided by the design team to determine the extent of the study area. The biologist then reviewed existing data on wildlife and habitats in the study area from published and unpublished reports, maps, surveys, and federal, state and local agency data, as well as information summarized in other discipline reports (DRs) prepared for the project. The biologist also performed numerous on-site investigations of the project site and vicinity between December 2011 and May 2012 to document wildlife and habitats in the study area. The information collected for this project and the data sources include:

- Geographic information system base maps of the existing natural environment depicting the locations of aquatic resources, sensitive areas, species of interest, and existing infrastructure.
- Records of listed species, designated critical habitat, Essential Fish Habitat and marine mammals from the National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS).
- Records of Southern Resident killer whales and other marine mammals from The Whale Museum and the Orca Network.
- Record of Priority Habitats and Species and Species of Interest from WDFW.
- Washington Natural Heritage Program species and habitat database.
- Information on migratory birds and their habitat requirements from USFWS, Seattle Audubon, and internet resources, as well as bird surveys conducted during field visits.
- Dive surveys conducted by Anchor QEA in 2011, which provide detailed, site-specific information on habitat conditions and presence of aquatic species in the project vicinity.
- Water quality information from the Washington Department of Ecology.
- Information on contaminated sediments from studies conducted by Herrera Environmental Consultants.
- Information summarized in other DRs, such as the Hazardous Materials and Water Resources DRs.

- Published and unpublished literature regarding construction methods and operational impacts.
- Data on recreational and commercial fishing in the project vicinity from WDFW.
- Information on tribal fisheries.
- Information on aquatic resources including salmonids and other fish, shellfish, crustaceans, invertebrates, and plants and their habitat requirements from WDFW.
- Recent and historical aerial photography.

What are the existing ecosystem characteristics of the study area?

Regional Setting

The project area is in the Seattle Basin of central Puget Sound, an inlet of the Pacific Ocean formed by repeated glaciation over the past several thousand years. Volcanic activity and seismic events have also helped shape the landscape. Mudflows from Mount Rainier have filled the Duwamish Valley south of Seattle, moving the Duwamish River mouth to its current location. Earthquakes have also redirected the flow of the Duwamish by raising and lowering landforms along the waterfront. (Burke Museum 2013).

Terrestrial habitat

Prior to European settlement, the Seattle waterfront was located approximately where First Avenue now runs through downtown Seattle. The shoreline consisted of intertidal mud and sand flats interspersed with gravel beaches and vegetated wetlands, bordered by upland bluffs. Over the past 150 years filling, dredging and grading along the shoreline have dramatically altered the waterfront. The upland area along the waterfront has a layer of fill up to 30 feet thick containing substantial amounts of wood debris such as sawdust and creosote-treated timber piles (Burke Museum 2013).

The waterfront is nearly 100 percent developed. Vegetation is limited to landscaped strips and isolated patches of unmaintained scrub dominated by non-native plants (Attachment 1). This habitat contains no natural structural elements such as snags, downed logs, or rock piles. Human-made structures, such as buildings and piers, provide nesting and foraging opportunities for some species of birds and mammals. No wetlands occur in the project area.

Animals that use these habitats are adapted to human activity and disturbance. The only terrestrial species observed during site visits were birds typically found in urban environments, such as rock pigeon (*Columbia livia*), American crow (*Corvus corax*), European starling (*Sturmus vulgaris*) and house sparrow (*Passer domesticus*). Other species likely to be found in this environment include raccoon (*Procyon lotor)*, opossum (*Didelphis virginiana)*, Norway and black rats (*Rattus norvegicus* and *R. rattus*) and mice (*Mus* spp.; Exhibit 10).

Exhibit 10. Terrestrial species observed or likely to occur in the project area.

Species	Scientific name
Rock pigeon	***Sebastes auriculatus***
American crow	***Sebastes melanops***
European starling	***Sturmus vulgaris***
House sparrow	***Passer domesticus***
Black rat	***Rattus rattus***
Eastern gray squirrel	***Sciurus carolinensis***
House mouse	***Mus musculus***
Muskrat	***Ondatra zibethica***
Norway rat	***Rattus norvegicus***
Raccoon	***Procyon lotor***
Virginia opossum	***Didelphis virginiana***

Nearshore and Aquatic habitat

Existing Physical and Chemical Conditions

Physical Characteristics

Substrate and Slope

The Elliott Bay Seawall forms the shoreline in the project area. The base of the seawall is lined with riprap. Common shoreline features within the area include constructed bulkheads with manmade structures such as piers, wharves, and buildings extending over the water, and steeply sloped banks armored with riprap or other fill materials (e.g., concrete slabs and miscellaneous debris). There are very few intertidal habitats within the project area and these are less than 0.5 acre in size (Anchor QEA 2011; Exhibits 11a and 11b). A habitat mapping survey in 2010 documented sand, shell hash and silt as the primary substrate in the project area, with some gravel and cobble (Anchor QEA 2001). In the ferry slips, propeller wash has washed away fine particles, leaving coarser sand (WSDOT 1980).

Exhibit 11a. Substrates and macroalgae north of the Seattle Terminal.

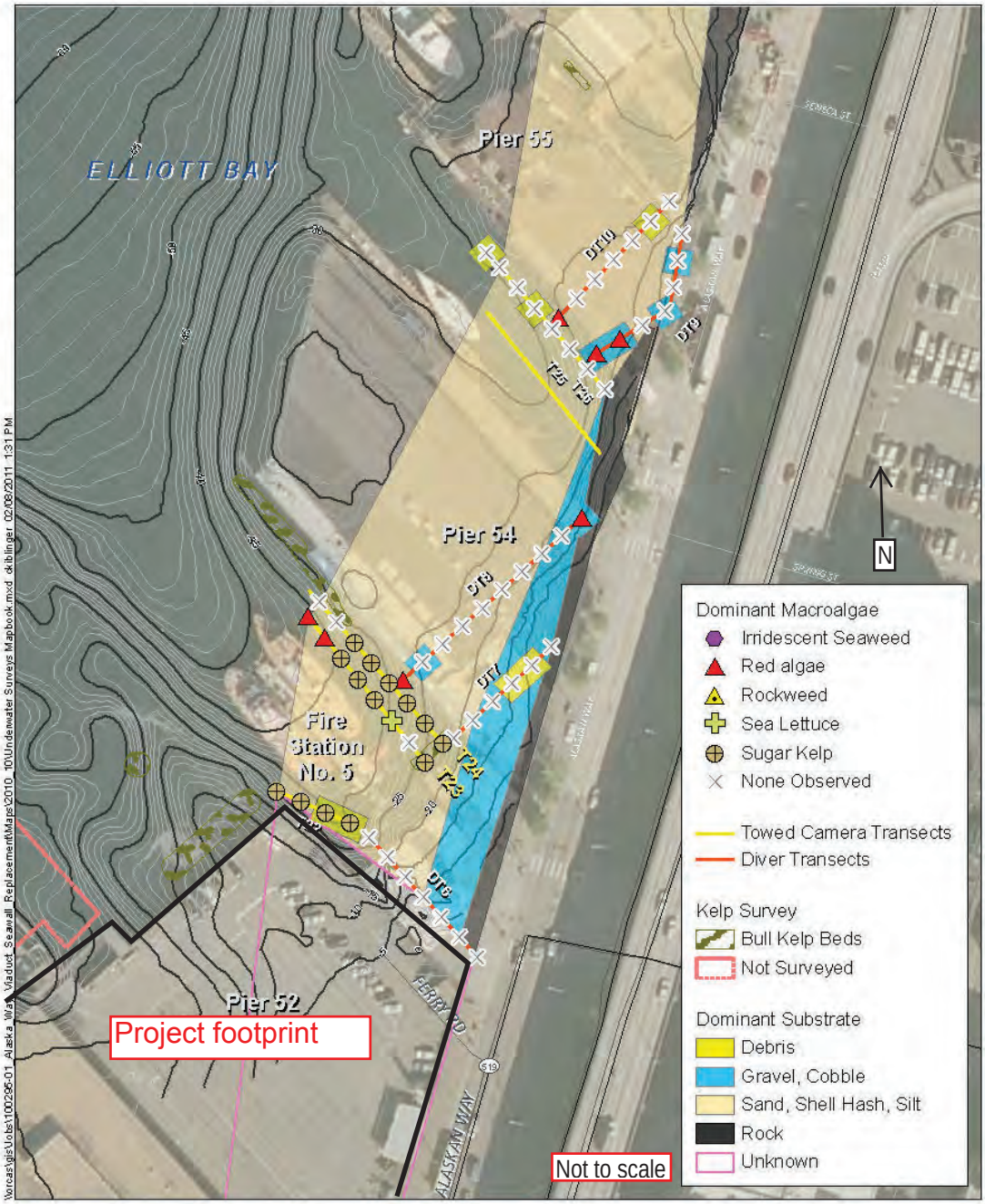
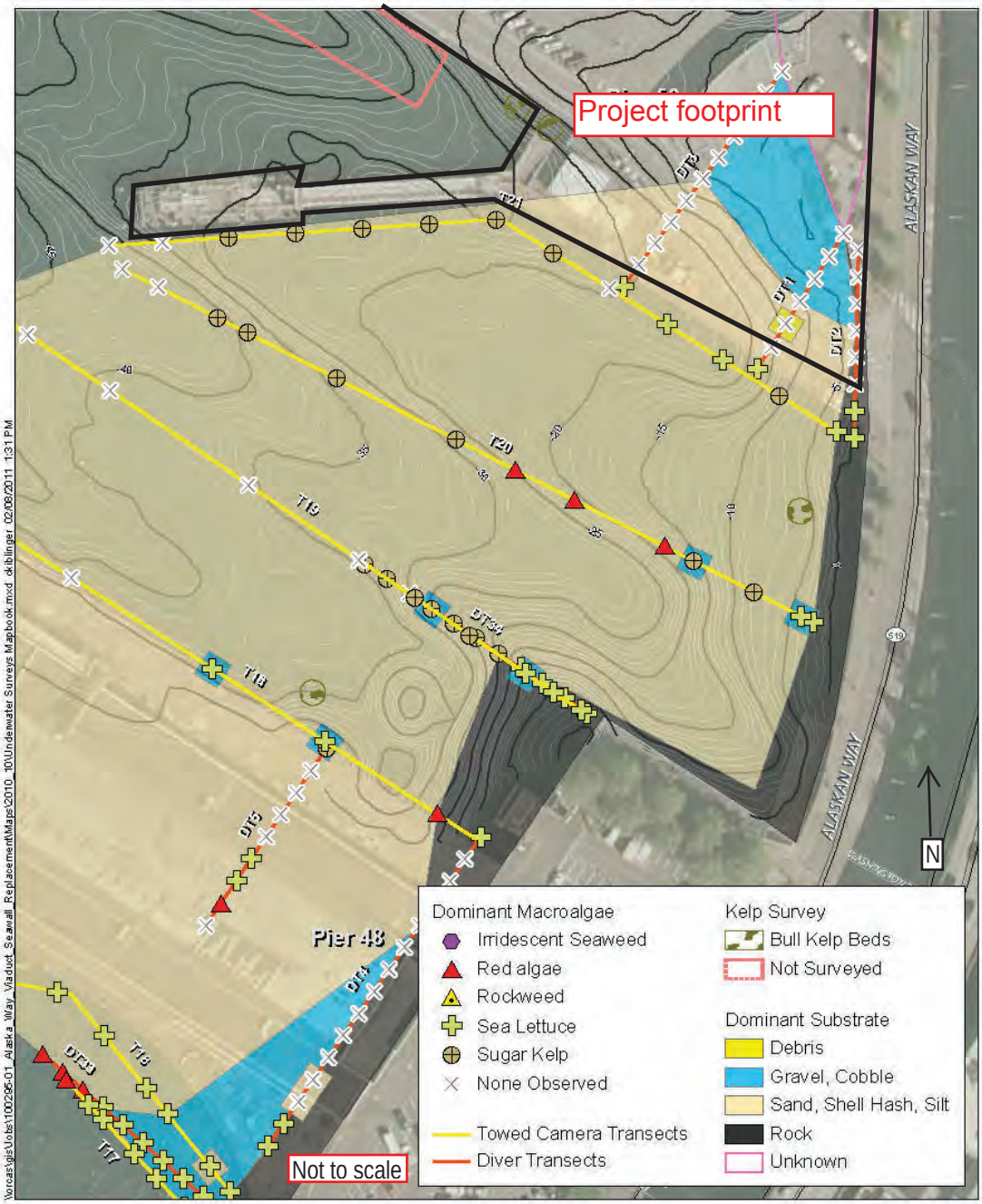


Exhibit 11a. Substrates and macroalgae north of the Seattle Terminal.



At the Seattle Terminal, the nearshore intertidal habitat extends gradually from mean higher high water (MHHW) to about -10 feet mean lower low water (MLLW). The habitat transitions quickly to deeper subtidal habitat beyond about 14 feet MLLW. The slope is approximately 13 percent along the east and west sides of the site. Steep slopes (greater than 25 percent) exist upland of the site. The subtidal slope is approximately 8 percent. Offshore depths of terminal structures vary from about -41 to -66 feet MLLW (Exhibit 12).

Exhibit 12. Depth of terminal structures at Colman Dock.

Structure	Depth (ft below MLLW)
Slip 1	44.3
Slip 2	41.2
Slip 3	47.5
POF landing	40
Floating dolphins	66

Flows and Currents

Water currents are influenced primarily by tides, with some influence from the Duwamish River, the primary source of freshwater to the bay. The mouth of the Duwamish is approximately one mile south of the ferry terminal. Discharges from the Duwamish River range from 250 cubic feet per second (cfs) in summer to 6,000 cfs in winter. In Elliott Bay, river water flows north along the Seattle waterfront, splitting at Smith Cove (north of downtown), with some flow turning south, and some following the Magnolia bluff north. Ebb tides tend to enhance this flow, while flood tides stall or reverse the flow pattern.

Tidal flow circulation velocities at Colman dock are very low, ranging from about 0.02 to 0.08 feet per second (Shepsis, pers. comm.). Tidal flow is not a significant factor in sediment transport or bottom scouring processes.

Chemical Characteristics

Water Quality

Elliott Bay water quality is considered excellent for aquatic life use per WAC 173-201A-612. Ecology's 2012 303(d) Category 5 list of parameters of concern for the bay includes bacteria in water samples. Tissue samples taken from fish in the bay showed 16 exceedances including PCBs, organics, and mercury (Ecology 2013).

Sediment Quality

Three separate studies have analyzed surface and near-surface sediments within the project area for polycyclic aromatic hydrocarbons (PAHs), metals, and other contaminants (Exhibit 13). The north (timber) trestle area was sampled in 1999 and 2011. Samples from 1999 showed concentrations of PAHs and metals were below Washington State Sediment Management Standards (SMS) Cleanup Screening Criteria, but PAHs did exceed Sediment Quality Standards (SQS) criteria (Herrera 1999). A boring from 2011 exceeded SMS criteria for dibenzofuran (Landau 2011).

Sediment samples were collected at five locations in the southern portion of the timber trestle area in 1999. All five samples exceeded SMS criteria for PAHs, four locations exceeded SMS criteria for hexachlorobutadiene, one location for 2,4-dimethylphenol, and one location for mercury and zinc. Bioassay testing at three of those locations was found to exceed Cleanup Screening Levels (CSL) for biological effects criteria. Two samples were also taken from the south timber trestle area in 2011. Exceedances of mercury, 2,4-diphenylmethol, and PAHs were found at one or both locations (Landau 2011). Sampling results for polychlorinated biphenyls (PCBs) indicate the possible presence of PCBs across the project site, although none of the samples exceeded SMS criteria.

A sediment cap of approximately 1.5 feet of clean commercially obtained sand was placed underneath the existing south (concrete) trestle in 1989. A study of the cap in 2004 indicated that the cap was largely intact, and a layer of new sediment four to eight inches thick had accumulated on top of the cap. Six out of seven samples of cap material met SMS criteria. At one location on the eastern portion of the cap, mercury, lead, silver and zinc exceeded SMS criteria. Reports indicated the cap was thin in this area and the sample may have captured some contaminated material from below the cap. The study also noted the presence of marine organisms across the cap surface (CH2M Hill 2005).

Two surface sediment samples were collected in 2011 from the area just south of the existing trestle where the new concrete trestle would be constructed. Mercury, phenol, and 2,4-dimethylphenol exceeding SQS or CSL criteria were detected at one or both locations. Sampling at Pier 48 south of the Colman Dock indicates sediment quality exceedances for metals, PAHs, organics, and PCBs.

Legend

Colman Dock

- Existing Structures Removed
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Terminal Structures
- New Slip 2 and 3 Structures
- Property boundary
- Managed by DNR under lease agreement
- Approximate Sea Wall
- 1999 Herrera surface sediment sample location (0-0.3' bgs)
- 2005 CH2M Hill Sediment Cap Monitoring Location
- 2011 Landau Associates Surface Sample Location (0-0.3' bgs)
- 2011 Landau Associates near-surface fill material sample location (0-10' bgs)

Exhibit 13. Sediment sampling locations at Colman Dock.

N

0 100 200 400 Feet

HERRERA

Aerial: King County 2007

K:\Projects\09-04410-004\Project\SedimentSamplingLocationsatColmanDock.mxd (3/6/2012)

Existing Biological Characteristics

The shoreline of Elliott Bay is almost entirely developed, and the area is subject to high levels of disturbance due to the presence of recreational and commercial boat traffic. Despite this high level of human activity, the bay still contains a number of biological resources. Aquatic plants, invertebrates, fish, and other vertebrate species are common in the bay, and numerous rare species have been observed in the bay or nearby in Puget Sound. Recreational, commercial, and tribal harvest of fish and shellfish occurs at several locations in the bay throughout the year.

Aquatic Plants

A detailed survey of aquatic habitats along the Seattle shoreline was conducted by the City of Seattle in 2010 for the Elliott Bay Seawall Project. In the vicinity of the terminal sea lettuce (*Ulva fenstrata*), sugar kelp (*Laminaria saccharina*) and red algae (Phylum Rhodophyta) were most commonly observed. Bull kelp beds were documented at several locations around the terminal, particularly west of the north timber trestle (Anchor QEA 2011; Exhibits 11a and 11b). No eelgrass was observed during this survey or during a previous survey in 2003 (Anchor QEA 2011; Norris and Fraser 2005).

Invertebrates

Epibenthic productivity is likely very low due to the condition and type of substrates, intense vessel traffic along the waterfront and at the ferry terminal, and dominance of an altered shoreline. However, over 30 species of invertebrates were observed during seawall surveys including annelids (tubeworms), arthropods (crustaceans), cnidarians (jellyfish and anemones), echinoderms (starfish), poriferans (sponges), mollusks (cephalopods, gastropods, bivalves), and tunicates (Anchor QEA 2011; Exhibit 14).

Fish

Elliott Bay is in the migratory path of several anadromous salmonid species and supports many resident fish species. The closest salmon-bearing river system is the Duwamish River, which is located approximately one mile south of the ferry terminal. Puget Sound Chinook, coho, chum and pink salmon, steelhead, and sea-run cutthroat trout have all been documented in the bay. Dive and video surveys for the Elliott Bay Seawall Project identified 24 fish species in the project area. The most abundant fish species observed during surveys were perch species (Anchor QEA 2011; Exhibit 15).

Seine net and snorkel surveys conducted in May and August of 2003 at sites along the Seattle waterfront (but outside the study area) identified

Exhibit 14. Invertebrates observed along the Elliott Bay Seawall during 2010 dive and video transect surveys.

Species	Scientific name
Terebellid (buried) tubeworm	
Sabellid tubeworms	
Acorn barnacle	***Balanus glandula***
Dungeness crab	***Cancer magister***
Red rock crab	***Cancer productus***
Kelp crab	***Pugettia*** sp***.***
Graceful crab	***Cancer gracilis***
Hairy crab	***Telmessus cheiragonus***
Decorator crab	***Oregonia gracilis***
Coon-stripe shrimp	***Pandalus danae***
Sea anemone	***Metridium*** sp***.***
Plumose anemone	***Metridium senile***
Painted anemone	***Urticina crassicornis***
Lions mane jelly	***Aurelia labiata***
Sunflower sea star	***Pycnopodia helianthoides***
Sea star	
Purple sun star	***Solaster endeca***
Mottled star	***Evasterias troschelii***
Blood star	***Henricia leviuscula***
Leather star	***Dermasterias imbricata***
Ochre star	***Pisaster ochraceus***
Rose star	***Crossaster papposus***
Jingleshell oyster	***Pododesmus cepio***
Pacific blue mussel	***Mytilus edulis***
Giant Pacific octopus	***Octopus dofleini***
Opal squid eggs	***Loligo opalescens*** eggs
Unspecified chiton	
Unspecified limpet	
Frosted nudibranch	***Dirona albolineata***
Unspecified tunicate	

Exhibit 15. Fish species observed along the Elliott Bay Seawall during 2010 dive and video transect surveys.

Species	Scientific name
Black rockfish	***Sebastes melanops***
Brown rockfish	***Sebastes auriculatus***
Chinook salmon	***Oncorhynchus tshawytscha***
Chum salmon	***Oncorhynchus keta***
Coho salmon	***Oncorhynchus kisutch***
Cutthroat trout	***Oncorhynchus clarkii***
Kelp perch	***Brachyistius frenatus***
Lingcod	***Ophiodon elongatus***
Painted greenling	***Oxyleius pictus***
Quillback rockfish	***Sebastes maliger***
Red Irish Lord	***Hemilepidotus hemilepidotus***
River lamprey	***Lampetra ayresi***
Lingcod	***Ophiodon elongatus***
Pile perch	***Rhacochilus vacca***
Pipe fish	***Syngnathus leptorhynchus***
Sailfin sculpin	***Nautichthys oculofasciatus***
Sand lance	***Ammodytes hexapterus***
Shiner perch	***Cymatogaster aggregata***
Speckled sanddab	***Citharichthys sordidus***
Spotted ratfish	***Hydrolagus colliei***
Starry flounder	***Platichthys stellatus***
Striped seaperch	***Embiotoca lateralis***
Surf smelt	***Hypomesus pretiosus pretiosus***
Tubesnout	***Aulorhynchus flavidus***

several other fish species that were not observed during the seawall survey (Toft et al 2004; Exhibit 16). Any of these species could be found in the project vicinity.

According to WDFW PHS data, there are no known forage fish spawning areas within Elliott Bay (PSWQA 1992). Shoreline development has reduced the availability of forage fish spawning habitat.

Exhibit 16. Fish species observed during 2003 surveys along the Seattle waterfront not documented during 2010 Elliott Bay Seawall surveys.

Species	Scientific name
Bay pipefish	***Syngnathus griseolineatus***
Buffalo sculpin	***Enophrys bison***
Crescent gunnel	***Pholis laeta***
English sole	***Pleuronectes (Parophrys) vetulus***
Fluffy sculpin	***Oligocottus snyderi***
Great sculpin	***Myoxocephalus polyacanthocephalus***
Pacific herring	***Clupea harengus pallasi***
Pacific staghorn sculpin	***Leptocottus armatus***
Padded sculpin	***Artedius fenestralus***
Penpoint gunnel	***Apodichthys flavidus***
Rock sole	***Pleuronectes (Lepidopsetta) bilineata***
Saddleback gunnel	***Pholis ornata***
Sand sole	***Psettichthys melanostictus***
Threespine stickleback	***Gasterosteus aculeatus***
White-spotted greenling	***Hexagrammos stelleri***

Seabirds

Several species of seabirds were observed during site visits. Glaucous-winged gulls (*Larus glaucescens*), double-crested cormorant (*Phalacrocorax auritus*), surf scoter (*Melanitta perspicillata*), and common goldeneye (*Bucephala clangula*) were all seen from the dock or nearby shoreline, and numerous other species have been documented in the bay (Exhibit 17). Seabirds tend to be more numerous during the winter months when birds from the outer coast move inland to calmer waters.

Special Status Species and Habitat

Special status species are rare species or species of interest that are protected or listed at the federal or state level. A number of special

Exhibit 17. Seabirds observed in Elliott Bay.

Species	Scientific name
Barrow's goldeneye[1]	***Bucephala islandica***
Brandt's cormorant[1]	***Phalacrocorax penicillatus***
Bufflehead[1]	***Bucephala albeola***
California gull[1]	***Larus californicus***
Canada goose	***Branta canadensis***
Common goldeneye[2]	***Bucephala clangula***
Double-crested cormorant[2]	***Phalacrocorax auritus***
Glaucous-winged gull[2]	***Larus glaucescens***
Herring gull[1]	***Larus argentatus***
Horned grebe[1]	***Podilymbus podiceps***
Mallard[1]	***Anas platyrhynchos***
Marbled murrelet[3]	***Brachyramphus marmoratus***
Mew gull[1]	***Laris canus***
Pelagic cormorant[1]	***Phalacrocorax pelagicus***
Pigeon guillemot[1]	***Cepphus columba***
Red-breasted merganser[1]	***Mergus serrator***
Red-necked grebe[1]	***Podiceps grisengena***
Rhinoceros auklet[1]	***Cerorhinca monocerata***
Surf scoter[2]	***Melanitta perspicillata***
Western grebe[1]	***Aechmophorus occidentalis***
Western gull[1]	***Larus occidentalis***

[1] Seattle Audubon 2013
[2] Observed during site visits
[3] Miller, pers. comm.

status species have been documented, or could occur, in the project area (Exhibit 17).

Federally Listed Species

The ESA of 1973, as amended, provides for the conservation of species that are endangered or threatened with extinction throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend. Twelve threatened or endangered species and five species of concern have been documented or could occur in the project area; proposed or designated critical habitat (areas containing the physical and biological habitat features essential to supporting one or more life stages of the species) for four of those species occurs in the project area (Exhibit 18).

Exhibit 18. Special status species in the project vicinity.

Common name	Scientific name	Status[1]	Occurrence in Project Area	Critical Habitat[2]
			Marine mammals	
Southern resident killer whale	***Orca orcinus***	FE, SE	Likely	Designated, occurs in project area
Humpback whale	***Megaptera novaeangliae***	FE, SE	Not likely	None in project area
Steller sea lion	***Eumetopias jubatus***	FT, ST	Likely	None in project area
Gray whale	***Eschrichtius robustus***	SS	Likely	
Dall's porpoise	***Phocoenoides dalli***	SM	Likely	
Pacific harbor porpoise	***Phocoena phocoena***	SC	Likely	
Harbor seal	***Phoca vitulina***	SM	Likely	
Minke whale	***Balaenoptera acutorostrata***	None	Likely	
California sea lion	***Zalophus californianus***	None	Documented[3]	
Elephant seal	***Mirounga angustirostris***	None	Not likely	
			Birds	
Marbled murrelet	***Brachyramphus marmoratus***	FT, ST	Documented[4]	Designated, none in project area
Bald eagle	***Haliaeetus leucocephalus***	FCo, SS	Documented[5]	None
Common loon	***Gavia immer***	SS	Likely	
Clark's grebe	***Aechmophorus clarkii***	SC	Likely	
Horned grebe	***Podiceps auritus***	SM	Documented[11]	
Red-necked grebe	***Podiceps grisegena***	SM	Documented[11]	
Western grebe	***Aechmophorus occidentalis***	SC	Likely	
Great blue heron	***Ardea herodias***	SM	Likely	
Green heron	***Butorides virescens***	SM	Likely	
Osprey	***Pandion haliaetus***	SM	Likely	
Caspian tern	***Sterna caspia***	SM	Likely	
Common murre	***Uria aalge***	SC	Likely	
			Fish	
Puget Sound Chinook salmon	***Oncorhynchus tshawytscha***	FT, SC	Documented[6]	Designated, occurs in project area
Puget Sound steelhead	***Oncorhynchus mykiss***	FT	Documented[6]	Proposed, occurs in project area
Coho salmon	***Oncorhynchus kisutch***	FCo	Documented[6]	None designated
Coastal-Puget Sound bull trout	***Salvelinus confluentus***	FT, SC	Documented[6, 7]	Designated, occurs in project area
Canary rockfish	***Sebastes pinniger***	FT, SC	Documented[8]	None designated
Yelloweye rockfish	***Sebastes ruberrimus***	FT, SC	Documented[8]	None designated
Bocaccio	***Sebastes paucispinus***	FE, SC	Likely[8]	None designated
Southern green sturgeon	***Acipenser medirostris***	FT	Not likely	Designated, none in project area
Pacific eulachon	***Thaleichthys pacificus***	FT, SC	Not likely	Designated, none in project area
Quillback rockfish	***Sebastes maliger***	FCo, SC	Documented[9]	None designated
River lamprey	***Lampetra ayresi***	FCo, SC	Documented[9]	None designated
Pacific herring	***Clupea harengus pallasi***	FCo, SC	Documented[10]	None designated

[1] FE = Federal Endangered; FT= Federal threatened; FCo = Federal Species of Concern; SE = State Endangered; ST = State Threatened; SC = State Candidate; SS = State Sensitive; SM = State Monitored

[2] Only applies to federally listed species; [3] WDFW 1992; [4] Miller, pers. comm.; [5] WDFW 2012; [6] Salmonscape 2013; [7] Toft, pers. comm.; [8] Miller and Borton 1980; [9] Anchor QEA 2011 dive surveys; [10] Toft et al. 2004; [11] Seattle Audubon 2013

The Marine Mammal Protection Act of 1972 prohibits take of all marine mammals in US waters. Eight species of marine mammals may be present in the project area, three of which are listed as threatened or endangered under the ESA (Exhibit 18)

State Listed Species

The State of Washington maintains a species of concern list for any species native to Washington State that is threatened with extinction (endangered), likely to become endangered within the foreseeable future (threatened), vulnerable or declining species (sensitive), or species under review for possible listing in any of those categories (candidate). WDFW also lists State Monitor species that are monitored for status and distribution, and managed as needed to prevent them from becoming endangered, threatened, or sensitive (WDFW 2012). Twenty-eight state listed species have been documented or could occur in the project vicinity, several of which are also federally listed (Exhibit 18).

Essential Fish Habitat

Public Law 104-267, the Sustainable Fisheries Act of 1996, amended the Magnuson-Stevens Fishery Conservation and Management Act (MSA) to establish new requirements for essential fish habitat (EFH) descriptions in federal fishery management plans and to require federal agencies to consult with NMFS on activities that may adversely affect EFH. EFH has been defined for the purposes of the MSA as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (DOC 2007). The Pacific Fishery Management Council (PFMC) has designated EFH for Pacific salmon, Pacific coast groundfish, and coastal pelagic species. EFH for all three groups is found in the project area.

The Pacific salmon fishery EFH includes all streams, lakes, ponds, wetlands, and other waterbodies currently or historically accessible to salmon in Washington, except above the impassable barriers identified by PFMC. In the estuarine and marine areas, salmon EFH extends from the nearshore and tidal submerged environments within state territorial waters out to the full extent of the exclusive economic zone (EEZ), 200 miles (370 kilometers) offshore of Washington. EFH for Pacific coast groundfish and coastal pelagic species includes all waters from the mean high water line along the coasts of Washington, upstream to the extent of saltwater intrusion and seaward to the boundary of the U.S. EEZ 200 miles (370 km). The Biological Assessment (BA) for the project includes a detailed discussion of EFH species that could occur in the project area and effects of the proposed project on EFH.

Commercial, Recreational, and Tribal Fisheries

Commercial, recreational, and tribal fishing occurs in Elliott Bay throughout the year. Commercial fishing within the bay is limited. Between 2005 and 2010 only clams, herring, rockfish, pile perch, sea cucumbers, skate, spiny dogfish, shrimp, and squid were commercially harvested (Singleton, pers. comm.; Exhibit 19).

Exhibit 19 Species commercially harvested in Elliott Bay, 2005-2010.

Species	Scientific name
Geoduck	***Panopea generosa***
Pacific herring	***Clupea harengus pallasi***
Horse clam	***Tresus capax***
Rockfish spp.	
Pile perch	***Racochilus vacca***
Sea cucumber	***Paristichopus californicus***
Skate spp.	
Spiny dogfish	***Squalus acanthias***
Spot shrimp	***Pandalus platyceros***
Pacific squid	***Loligo opalescens***

Recreational catch records in the project area are from fishing area 10, which includes central Puget Sound from Seattle to Bremerton and is not specific to Elliott Bay. Salmonids, marine fish, and shellfish were all harvested from the area (Kraig, pers. comm.; WDFW 2013; Exhibit 20).

The Suquamish and Muckleshoot Tribes harvest spot shrimp and several salmonid species in Elliott Bay. Spot shrimp season is in April. Chinook are fished in June and July, and pink salmon in August and September. Coho are harvested in September and October, chum in October and November, and steelhead in December and January. The length of the fishery and numbers harvested depends on how many fish return to the Duwamish (Narte, pers. comm.).

Exhibit 20. Recreational catch records for central Puget Sound, 2009-2010.

Species	Scientific name
	Salmonids
Chinook	***Oncorhynchus tshawytscha***
Coho	***O. kisutch***
Pink	***O. gorbuscha***
Chum	***O. keta***
Steelhead	***O. mykiss***
	Marine fish
Black rockfish	***Sebastes melanops***
Blue rockfish	***S. mystinus***
Yellowtail rockfish	***S. flavidus***
China rockfish	***S. nebulosus***
Quillback rockfish	***S. maliger***
Copper rockfish	***S. caurinus***
Canary rockfish	***S. pinniger***
Yelloweye rockfish	***S. ruberrimus***
Tiger rockfish	***S. nigrocintus***
Vermillion rockfish	***S. minatus***
Brown rockfish	***S. auriculatus***
Black rockfish	***S. melanops***
Bocaccio	***S. paucispinus***
Lingcod	***Ophiodon elongates***
Kelp greenling	***Hexagrammos decagrammus***
Pacific cod	***Gadus macrocephalus***
Cabezon	***Scorpaenichthys marmoratus***
Perch spp.	
Spiny dogfish	***Squalus acanthius***
Sharks and skates	
Starry flounder	***Platichthys stellatus***
Sanddabs	***Citharichthys sordidus***
Sablefish	***Anoplopoma fimbria***
	Shellfish
Spot shrimp	***Pandalus platyceros***
Dungeness crab	***Metacarcinus magister***

Potential Effects of the Project

What methods were used to evaluate the potential effects?

The project biologist characterized ecosystems in the study area as described in previous sections. The project design team provided plan sheets and information on construction methods. The biologist then reviewed the design information and proposed construction methods to identify potential effects to fish and wildlife and their associated habitats, and known or hypothesized effects of various construction methods on fish and wildlife.

How would construction of the project affect ecosystems?

No Build

Under the No Build Alternative, construction activities would be limited to replacing failing structures as necessary. The creosote-treated timber trestle and piles would be replaced when failure occurs. The timber berthing structures and the transfer span for Slip 2 would be replaced. Pile installation and removal could temporarily degrade water quality and create noise impacts as described in proceeding sections.

Fill at the north end of the terminal would not be removed. No shoreline habitat would be created, and there would be no increase in benthic habitat. No stormwater treatment would be provided under this alternative, and most stormwater runoff from the trestle would continue to discharge untreated to Elliott Bay. Contaminated sediments would not be capped. The No Build Alternative would not result in any temporary or permanent increase in overwater cover.

Build Alternative

Construction would result in temporary degradation of water quality due to mobilization of sediments during in-water work, particularly installation and removal of piles. Sediments underneath and adjacent to the trestle are known to be contaminated, and disturbing sediments

could spread contamination. Pile installation would also generate noise levels that could disturb or harm aquatic species. Construction of the southern portion of the trestle would result in a temporary increase in overwater cover until the north timber trestle is removed, approximately four years after construction of the new south trestle.

The project would also result in several beneficial effects to ecosystems. Construction would remove nearly 2,200 creosote-treated timbers and piles, reducing the potential for harmful chemical compounds found in creosote to leach into the environment. The project would also remove a section of fill underneath the northern portion of the trestle once the trestle is removed, increasing benthic and nearshore habitat and offsetting the extension of the trestle to the south. Contaminants in the fill material would be removed from the aquatic environment. Contamination would be further reduced by placing a sediment cap underneath the trestle after the trestle is demolished and prior to pile driving, reducing the potential for any contaminated sediments to spread into Elliott Bay. The project would provide water quality treatment for all stormwater that flows off the trestle, decreasing the amount of pollutants discharged to Elliott Bay.

The BA for this project contains detailed descriptions of the life histories of species listed under the ESA, their occurrence in the project area, and potential project impacts to those species.

Adverse Impacts

Water Quality

Turbidity

Pile driving, pile removal, placement of barge anchors, and removal of the sheet pile wall under the north trestle would all generate turbidity during in-water work. Factors affecting the amount of turbidity generated during pile removal include the type and number of piles removed, the removal technique used, and the characteristics of the bottom sediments.

Of the in-water work, pile removal has the greatest potential to create turbidity. There are several methods of pile removal, such as vibratory extraction, wrapping piles with a cable or chain and pulling the piles with a crane ("direct pull"), removing piles with a clamshell bucket, and cutting piles below the mudline. Vibratory extraction would be the preferred method of pile removal for timber and steel piles and the one that would likely generate the least turbidity. Concrete piles cannot be vibrated and would need to be removed by direct pull.

Turbidity during project construction is expected to be minimal. Washington State turbidity standards require that the turbidity does not exceed 5 NTU over background levels at a point 150 feet from the activity. Turbidity measurements during pile removal and installation using a vibratory hammer at the WSF Friday Harbor ferry terminal did not exceed water quality standards (WSF 2005). Another study during a pier replacement project in Manchester, WA, found that turbidity at the construction site was less than 1 NTU above background levels (Roni and Weitkamp 1996). One pile pulling study at Jimmycomelately Creek showed turbidity levels of 10-20 NTU above background extending much farther from the base of the pile (between 60-150 feet; Weston Solutions and Pascoe Environmental Consulting 2006). However, these results are not typical. Currents at the project site are very low energy and turbidity would probably not extend beyond 25 feet from the base of the pile. Approximately 10 piles will be removed per day during demolition, and about six piles will be installed per day during construction, so turbidity at any one time would be limited to a 25-ft radius around those piles.

The fill area underneath the north trestle would be dredged as part of the project. This area is contained behind a sheet pile wall, which would remain in place until dredging is complete, preventing sediments from spilling into the bay. Some turbidity would be generated when the sheet pile wall is removed, similar to that that caused by pile removal.

Impacts to aquatic resources due to elevated turbidity could include:

- Mortality, gill tissue damage, and physiological stress to fish, including juvenile salmonids
- Burial, abrasion of body parts, and clogging of filtration systems of crustaceans and other marine invertebrates
- Reduced light levels affecting behavior and feeding of aquatic animal species
- Reduced photosynthesis by burial of aquatic plants or reduced light levels

Based on the physical attributes of the sediments, and the turbidity measurements taken at Friday Harbor and Manchester discussed above, WSF expects that increases in turbidity resulting from pile removal and installation would be localized to the immediate vicinity of the base of the piles and would not exceed water quality standards; therefore direct mortality of fish is unlikely. However, fish may experience reduced foraging success. Fish and other mobile species are likely to avoid the project area during construction. Aquatic plants and sessile invertebrates within the project footprint could be buried and

weakened or killed by extended periods of reduced light. Although impacts will be highly localized (approximately 25 feet from the pile), they would occur for the duration of in-water work.

Contaminated Sediments

Sediments in the project vicinity are contaminated, and in-water work has the potential to spread contamination. The extent and duration of contaminant suspension would be similar to that of sediments disturbed by pile removal, as discussed above. Exceedances of compounds found in creosote, mercury, and zinc have all been detected in sediments in the project footprint.

Creosote is a mixture of compounds, primarily polycyclic aromatic hydrocarbons (PAHs) as well as dibenzofuran, hexachlorobutadiene, and dimethyl phenol, used to protect wood from degradation by aquatic organisms in aquatic environments (EPA 2008; NOAA 2009). Creosote compounds are harmful to fish, shellfish, and other marine organisms, particularly those species that use the creosote piles for spawning habitat or that eat the eggs of the species that have laid spawn on the timber (Stratus 2006). PAHs can cause cancer, reproductive and immune system problems, and impair growth and development in fish exposed to even low concentrations (NOAA 2009). Hexachlorobutadiene can be lethal to fish and crustaceans at concentrations as low as 32 ppb (CCOHS 2001).

Zinc exposure can adversely affect growth, reproduction and survival of aquatic organisms. Zinc can interfere with embryonic development of fish (Eisler 1993) and fish have demonstrated avoidance of zinc in laboratory studies (Sprague 1968).

Contaminated sediments would be disturbed during in-water work, particularly pile removal. As discussed in the section on turbidity, above, the sediment plume would be limited to about 25 feet from the base of the pile and is unlikely to extend beyond the project footprint due to the low current velocities in Elliott Bay. Turbidity is anticipated to settle out less than an hour after sediment disturbance. During a pile removal project at Jimmycomelately Creek, turbidity returned to background levels less than ten minutes after piles were pulled (Weston Solutions and Pascoe Environmental Consulting 2006).

Implementation of best management practices (BMPs) such as using vibratory removal methods to the extent possible and avoiding twisting or breaking piles will minimize the spread of contaminants. Water quality will be monitored during construction. If exceedances of turbidity standards are detected at the point of compliance, work will

stop immediately. BMPs will be updated or additional BMPs will be implemented to prevent a recurrence of the exceedance.

Noise and Disturbance

The project will install several types of piles which will be installed by both impact and vibratory methods. Steel piles and casings for drilled shafts will be vibrated into the sediment. Concrete piles and concrete-filled steel piles will be driven with an impact hammer.

During impact hammer pile installation, which is employed mainly for large piles, a detonation in a cylinder lifts a heavy hammer, which then drops several feet onto the pile, driving it into the ground. The use of a vibratory hammer is possible in places where sediments are comparatively soft. Vibratory hammers are quieter than most other types of hammers, produce sound at different frequencies, with lower impulse energy, and are less harmful to fish and wildlife. Drilled shafts are constructed by installing a hollow steel casing six to ten feet in diameter with a vibratory hammer. The material inside the casing is then excavated using an augur or a clamshell dredge and disposed of upland. Rebar is then placed in the shaft and concrete poured into the shaft.

Pile driving produces intense sound pressure waves in the water column that can adversely affect aquatic species. The level of sound produced during pile driving depends on several variables, including the type of hammer used and the type and size of piles being used. The distance that the sound travels underwater and in air also depends on several variables. High levels of underwater sound can injure or kill fish, and cause alterations in behavior (Turnpenny et al. 1994; Turnpenny and Nedwell 1994; Popper 2003; Hastings et al. 1996; Popper and Schilt 2007, Popper and Hastings 2009). Fish with swim bladders, such as salmonids, are more susceptible to barotraumas (injuries such as hemorrhage and rupture of internal organs caused by pressure waves) from impulsive sounds. Death from barotrauma can be instantaneous or delayed up to several days after exposure.

Elevated noise levels can also cause sublethal injuries, such as a reduced ability to detect predators and prey or damage to hearing (Turnpenny et al. 1994; Hastings et al. 1996, Popper and Schilt 2007). Exposure to high noise levels can cause a temporary shift in hearing sensitivity for periods lasting from hours to days, which can reduce the survival, growth, and reproduction of fish by increasing the risk of predation and reducing foraging or spawning success.

Noise can result in fish avoiding foraging or spawning grounds (Engas et al. 1996). The effect of these avoidance responses may range from

insignificant to permanent long-term effects if feeding or reproduction is impeded. Feist et al. (1992) found that impact pile driving of concrete piles affected juvenile pink and chum salmon distribution, school size, and schooling behavior.

Pile driving noise may affect diving birds that commonly use Elliott Bay in the vicinity of the site such as grebes, marbled murrelets, and scoters. Birds are harmed by sound pressure levels in the range of those levels that harm fish and mammals (Fitch and Young 1948; Yelverton et al. 1973; Yelverton and Richmond 1981). Noise in the marine environment could also reduce marbled murrelet foraging efficiency (USFWS 2009).

For marine mammals, whales in particular, sound is one of the most critical sensory pathways of information. Whales communicate with each other over short and long distances with a variety of clicks, chips, squeaks, and whistles. They also use echolocation to find prey and navigate. Underwater noise may reduce the audibility of signals, impairing foraging and communication, increasing energetic expenditures, reducing hearing sensitivity, and causing behavioral changes (Krahn et al. 2004; Southall et al. 2007). Changes in behavior can range from minor changes in orientation or breathing to interrupted feeding or avoidance of an area (Richardson et al. 1995; Moore and Clarke 2002). Noise can also cause non-auditory physiological changes such as alterations in cardiac rates and respiratory patterns (Krahn et al. 2004; Southall et al. 2007). Very loud noises at close range may cause hearing damage, other physical damage, or even death of marine mammals (Richardson et al. 1995). Although vibratory pile driving produces less energy and is generally the preferred method of pile installation, NMFS has established a lower underwater disturbance threshold for marine mammals for continuous noise, such as that produced by a vibratory hammer; therefore, noise impacts from vibratory pile installation may extend over a broader area than those generated by impact pile driving.

Noise attenuation devices, such as a bubble curtain, would be deployed during impact pile driving to reduce noise levels. The amount of noise attenuation achieved by bubble curtains averages about 12dB. Timing restrictions and monitoring for the presence of birds and marine mammals in the project area would help reduce impacts of pile driving noise on aquatic species.

Overwater cover

Reduced Light Availability

The project will cause a temporary increase of overwater cover of approximately 38,590 ft^2 for nearly four years because the southern

portion of the terminal will be constructed during the first phase of the project, but the northern timber trestle will not be removed until the final phase (Exhibit 21). Direct overwater cover will limit the amount of ambient light, which could reduce the amount of photosynthetically active radiation (PAR) available to macroalgae. A reduction in PAR could result in a dieback of macroalgae and fish species associated with aquatic vegetation such as lingcod and greenling (Haas et al. 2002). Several species of kelp and algae have been documented near the terminal (Exhibits 10a and 10b). Macroalgae at the southern edge of the terminal will likely be shaded out by extending the trestle to the south.

Although substrates at the project site are heavily altered, 30 species of invertebrates were documented in the project vicinity during surveys for the Elliott Bay Seawall Project (Exhibit 13). Species at the southern edge of the trestle could be reduced in number or diversity due to shading impacts and reduced primary productivity.

Effects to Salmonids

Juvenile salmonids depend on nearshore habitats for food and refuge. The movement of migrating juvenile salmonids may be affected by dark-edge and light-edge over-water structures (OWS), such as docks and piers (Southard et al. 2006). OWS, such as ferry terminals, bridges, and temporary work trestles, may directly affect juvenile salmon by disrupting migratory behavior along the shallow-water nearshore zone.

The response of fish to overwater structures is complex; individuals of some species readily pass under OWS, some pause and go around, schools may disband upon encountering OWS, and some schools pause and eventually go under OWS en masse (Nightingale and Simenstad 2001). Observations discussed by Southard et al. (2006) demonstrate that the shading caused by ferry terminals and other OWS characteristics can deter or delay juvenile salmonid movement, and this effect may be decreased at low tides when ambient light can better filter beneath the terminal structure. Delays in migration could lead to increased energy expenditure. The temporary increase in overwater cover for the Build Alternative could impede salmonid migration along the shoreline.

Beneficial Effects

Removal of Creosote-Treated Timbers

PAHs that leach from creosote-treated wood can accumulate in sediments, resulting in chronic and dietary exposure of marine organisms, primarily benthic species (NOAA 2009; Stratus 2006). Detectable leaching can occur for years and perhaps much longer

Exhibit 21. Change in overwater cover (OWC) by phase during project construction.

Phase	Project element			OWC (SF)	Difference in OWC per phase
Phase I (~Aug 2015 – Apr 2016)	***Demolition***	Demolish POF slip and portion of south trestle		-10,700	+44,890
		Remove Slip 3 structures	Transfer span, apron and tower	-3,400	
			Bridge seat	-350	
			OHL	-1,900	
			Building	-1,800	
		Remove Slip 2 right dogleg wingwall		-900	
		Remove Slip 3 left dogleg wingwall		-900	
	Construction	Slip 3	Transfer span	+3,600	
			OHL	+1,900	
			HPU platform	+300	
			Inner dolphin	+740	
			Temp dolphin	+200	
		South trestle		+37,000	
		POF slip	Platform and Walkway	+15,300	
			Float and gangway	+5,800	
Phase II (~July 2016 – May 2018)	***Demolition***	Remove concrete trestle and piling		-16,300	+44,890
	Construction	Install pile foundation for terminal building		+16,300	
Phase III (~June 2018 – Feb 2020)	***Demolition***	Remove existing trestle including transfer span bridge seat and OHL platform		-45,000	+46,164
	Construction	Construct new trestle		+45,830	
		Reinstall slip 2 transfer span bridge seat		+444	
Phase IV (~Apr 2019 – June 2021)	***Demolition***	Demolish north timber trestle		-76,000	+5,164
		Demolish retained fill area		-14,500	
	Construction	Construct new trestle		+49,500	

(Stratus 2006). A study conducted in British Columbia found elevated PAH concentrations within 24.6 feet of creosote-treated pilings the first year after installation. After 10 years, that distance declined to 8.2 feet. Both in-water structures, such as timber pilings, and overwater structures such as docks, can be a source of creosote in aquatic environments (NOAA 2009).

The project would remove approximately 7,400 tons of creosote-treated timber and decking, eliminating the potential for this material to leach creosote into the environment. Timber piles would be removed completely to the extent possible by vibrating the piles from the sediment. If piles break during vibratory extraction, broken piles would be removed by wrapping a chain around the pile and pulling it from the sediment. If piles cannot be removed using a chain they would be cut approximately two feet below the mudline and the holes filled with clean material. Piles would not be removed using a clamshell or a hydraulic jet, both of which can generate high levels of turbidity and risk spreading contaminated sediment.

Benthic and Shoreline Habitat

The new concrete trestle will occupy about 30 feet of shoreline habitat. Shoreline habitat is the landward portion of the nearshore zone where variations in wave energy, sunlight, sediment movement, water depth and salinity provide a variety of environments that support a diverse array of species, and where biological processes such as photosynthesis and carbon cycling occur at greater rates (WDFW 2010). In addition, installation of piers will create about 1,850 ft^2 of impacts to benthic habitat (Exhibit 5). Impacts to shoreline and benthic habitat will be offset by removal of the fill prism underneath the north trestle. Approximately 14,500 ft^2 (7,700 cubic yards) of fill will be dredged. The area will be restored to match the bathymetry on either side of the fill prism. Removing the fill would open up approximately 180 feet of shoreline and increase benthic habitat in the project area by about 12,650 ft^2, allowing macroalgae and benthic organisms to recolonize the area, and providing a better migration corridor along the shoreline for juvenile salmonids.

Stormwater Treatment

Stormwater generated by roadways, parking lots, and other infrastructure used by vehicles contains pollutants detrimental to aquatic life. The primary constituents of concern, with respect to federally protected salmonids, are total suspended solids (TSS, which causes turbidity), copper, and zinc. Impacts to fish from turbidity are discussed in the Water Quality section, above. Dissolved copper has been demonstrated to reduce olfactory responsiveness in juvenile

salmonids in freshwater in laboratory studies (Baldwin et al. 2003), and fish have shown avoidance reactions to elevated levels of dissolved zinc (Sprague 1968).

Currently there is very little stormwater treatment at Colman Dock. Except for oil/water separators under the southeast portion of the trestle, runoff from the trestle discharges untreated from the holding area into Elliott Bay. The project would provide stormwater treatment for the entire trestle, reducing pollutant loads discharged to Elliott Bay (Exhibit 22).

Exhibit 22. Pre- and post-project pollutant loads.

Scenario	Pollutant load (lb/yr)[1]				
	TSS	TCu	DCu	TZn	DZn
Existing	1608	0.407	0.095	2.48	0.712
Proposed	148	0.13	0.079	0.61	0.41
Percent reduction	***91%***	***68%***	***17%***	***75%***	***42%***

[1]TCu = total copper; DCu = dissolved copper; TZn = total zinc; DZn = dissolved zinc.

Capping of Contaminated Sediments

Sediments in the project footprint are contaminated, as described earlier. Once construction is complete, the project will implement a remediation technique, such as a sediment cap, to minimize the spread of contaminated sediments and to provide a clean surface for colonization by algae and other benthic organisms.

How would operation of the project affect ecosystems?

No Build

Under the No Build Alternative, the project would not provide any stormwater treatment, and pollutants from the trestle would continue to discharge mostly untreated to Elliott Bay. The north trestle and associated fill would not be removed, providing no opportunity for restoration of shoreline and benthic habitat, and contaminated sediments would not be capped.

Build Alternative

Operational impacts of the Build Alternative consist of stormwater runoff, permanent new overwater cover, and changes in the amount of shoreline habitat. Under the Build Alternative, the project would provide water quality treatment for all pollutant-generating impervious surfaces as described in the Beneficial Effects section above, reducing pollutants in the vicinity of the terminal. Contaminants would also be minimized by capping sediments in the project area.

The project has been designed to minimize new overwater cover to the extent possible. However, post-project the final footprint will create a slight permanent increase of overwater cover by approximately 5,164 ft^2. Impacts of overwater cover and associated shading on primary productivity and salmonid migration are discussed previously in this document. To offset the impacts of shading, 5,300 ft^2 of light-penetrating structures (LPS) such as glass blocks would be incorporated into the design of the POF walkway. LPS will allow more light to reach the seabed, increasing PAR and primary productivity, and will minimize shading impacts that could interfere with juvenile salmonid migration along the waterfront.

Extending the terminal to the south will reduce shoreline habitat by approximately 30 feet. Removal of the fill prism under the north trestle will open up about 180 feet of shoreline, for a net gain of about 150 feet of shoreline. Removing the fill would also increase benthic habitat by approximately 12,650 ft^2.

The project will not affect operation of the ferries. The project is a maintenance and preservation project, and would not expand service, the number of vehicles using the dock, or frequency or number of boat trips.

How do the alternatives differ in their effects on ecosystems?

The Build Alternative would affect ecosystems during construction by generating turbidity, increasing noise impacts, and creating a temporary increase of overwater cover of about 38,600 ft^2 and a permanent increase of about 5,200 ft^2. Beneficial effects would result from removing creosote-treated structures, removing contaminated fill, increasing benthic and shoreline habitat, installing stormwater treatment vaults, and capping contaminated sediments.

The No Build Alternative would have minimal in-water work, resulting in far less noise and turbidity than the Build Alternative, and for a much shorter time span. There would be no increase in overwater cover, and no beneficial effects.

How would operation of the project affect ecosystems in the current or reasonably foreseeable future?

Operation of the project would have minimal impacts to aquatic resources in the project vicinity. As described above, operational impacts of the project would be offset by minimization measures that have been incorporated into the project design, such as stormwater treatment, use of light-penetrating surfaces, and increasing shoreline habitat. Overall, operation of the project would reduce impacts to ecosystems in the project area compared to existing conditions.

Cumulative Effects

Several other projects within the project area are being constructed or would be constructed by the time the Seattle Multimodal Terminal at Colman Dock Project begins, but very few of those would affect ecosystems. The City of Seattle's Elliott Bay Seawall Project would be constructed concurrently with the Colman Dock Project. The Seawall Project would rebuild the seawall approximately 15 feet landward of its current location. A cantilevered sidewalk made of LPS would be constructed over the water. The purpose of moving the seawall back is to provide a migratory corridor along the seawall for juvenile salmonids that migrate along the shoreline. Installing LPS would reduce shading, thereby increasing primary productivity and benthic

invertebrate density. The Elliott Bay Seawall Project would also construct a habitat beach just south of the Seattle Terminal. The Colman Dock Project has been designed to accommodate construction of that habitat feature.

The City of Seattle also plans to upgrade the combined sewer system that runs underneath Alaskan Way that transports sewage and stormwater to the wastewater treatment facility in Discovery Park, north of the project area. Currently the pipe that carries wastewater is undersized and capacity is exceeded during large rainstorms, resulting in overflows of combined sewage and stormwater to Elliott Bay that degrade water quality. As part of the upgrade, the City would install a larger pipe that would reduce the frequency of overflow events, improving water quality in the bay.

In conjunction with other planned projects, the Seattle Terminal at Colman Dock project would provide additional benthic and shoreline habitat that would benefit salmonids and other aquatic species, as well as improve water quality in Elliott Bay.

Mitigation

What has been done to avoid or minimize negative effects?

Several features have been incorporated into the project design to minimize impacts to ecosystems in the project area. To reduce impacts of overwater cover, the size of the new terminal has been reduced to the extent possible. Because it would not be possible to maintain the necessary holding capacity without slightly increasing overwater cover, LPS has been incorporated into the design of the POF walkway to minimize impacts of shading.

Extending the trestle to the south and installing new piers would result in impacts to shoreline and benthic habitat. Removing the north trestle and fill underneath the trestle would increase both benthic and shoreline habitat. In addition, stormwater treatment would be provided by the project to reduce pollutant loading and improve water quality near the trestle.

In-water work, particularly pile removal, could degrade water quality. Implementation of BMPs would minimize those impacts. BMPs include, but are not limited to:

- Piles will be removed by vibratory extraction to the extent possible. Broken or damaged piles that cannot be removed with a vibratory hammer may be removed by wrapping the piles with a cable or chain and pulling them directly from the sediment.
- Piles will not be removed using a clamshell bucket or hydraulic jets.
- The crane operator will be trained to remove piles slowly to minimize turbidity.
- Before removal, piles will be vibrated slightly to break the bond with the surrounding sediment. This technique avoids pulling out large blocks of sediment that could cause the pile to break apart during removal.
- Piles will not be broken off intentionally by twisting, bending, or other deformation, to minimize any potential release of creosote into the water column.
- During removal of creosote-treated piles, containment booms and absorbent booms (or other oil-absorbent fabric) will be placed around the perimeter of the work area to capture wood debris, oil, and other materials if released into marine waters.

- All accumulated debris will be collected daily and disposed of at an approved upland site.

Water quality will be monitored during construction. In the event of a water quality exceedance, work will stop and existing BMPs will be upgraded or new BMPs implemented to ensure compliance with Washington State water quality standards. During dredging of the fill prism under the north trestle, the sheet pile wall containing the fill will be left in place until dredging is complete to prevent sediments in the dredge prism from drifting in to the bay.

To minimize the spread of contaminated sediments, a sediment cap or similar containment measure would be installed post-construction. A sediment cap would likely consist of a layer of clean sand similar to what was previously installed underneath the concrete trestle.

Pile driving during construction could cause elevated noise levels that would disturb or injure aquatic species. To minimize pile driving noise, the project will install piles using vibratory methods to the extent possible. A noise attenuation device such as a bubble curtain would be deployed during impact pile driving of steel piles. The amount of noise reduction gained by bubble curtains varies widely but averages approximately 12dB. Underwater noise levels would be monitored during impact pile driving to make sure the project does not exceed noise levels described in the BA (WSDOT 2013). If noise levels exceed those used for the effects analysis in the BA, WSF will stop work and consult with the NMFS and USFWS to improve existing BMPs or implement additional BMPs to minimize noise impacts.

WSF will monitor the presence of marine mammals and marbled murrelets during construction per the requirements of the BA and MMPA. If those species enter the harassment or injury zones during pile driving, work will stop until the animals have left the area.

How could the project compensate for unavoidable adverse effects?

Based on early coordination with the City of Seattle and WDFW regarding potential permit conditions, WSF will be required to mitigate for any increase in OWC created by the project by removing an equivalent amount of OWC within Elliott Bay or as close to Elliott Bay as possible within Puget Sound. To achieve the necessary mitigation WSF is searching for appropriate mitigation to offset the additional OWC. One likely option to achieve the necessary mitigation is by contributing

money to the King County in-lieu fee program.

In-lieu fee (ILF) mitigation is used to compensate for unavoidable impacts to aquatic areas when other approaches to compensation are not available, practicable, or when the use of an ILF is in the best interest of the environment. In this approach to mitigation, WSF pays a fee to a third party instead (in-lieu) of conducting project-specific mitigation. King County operates an ILF program as a government agency with demonstrated competence in natural resource management. The fee charged by an ILF represents the expected cost of replacing the habitat functions lost or degraded as a result of the permittee's project. An ILF program typically combines fees collected from one permittee's project with fees collected from other permittees' projects to finance a larger mitigation project. The ILF mitigation is an accepted program by the City of Seattle, USACE, Ecology, and WDFW to compensate for project impacts.

Impacts from implementation of the ILF mitigation would likely be similar to impacts of constructing the build alternative described on p. 37: increased turbidity, possible mobilization of contaminated sediments, and elevated noise. Appropriate minimization measures would be taken to control those impacts during construction. If the ILF program were chosen as the most appropriate mitigation, the ILF mitigation project would be fully defined during the permitting process for the Seattle Terminal Project.

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Attachment 1

Project area photos.

Photo 1. Tollbooths at terminal entrance.

Photo 2. Alaskan Way and Alaskan Way Viaduct east of terminal viewed from the northeast corner of the terminal.

Photo 3. Terminal holding lanes facing west.

Photo 4. Shoreline South of the Seattle Terminal.

Photo 5. Shoreline north of the Seattle Terminal.

Appendix D – Transportation Discipline Report

Washington State Ferries

Seattle Multimodal Terminal at Colman Dock Project Environmental Assessment

Transportation Discipline Report

Prepared for

Washington State Department of Transportation

Federal Highway Administration

Federal Transit Administration

Lead Author

Parsons Brinckerhoff

November 2013

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Acronyms and Abbreviations

ACTT	Advisory Committee on Tolling and Traffic Management
ADA	Americans with Disabilities Act
AWVRP	Alaskan Way Viaduct Replacement Program
EA	environmental assessment
FEIS	final environmental impact statement
FHWA	Federal Highway Administration
LOS	level of service
NB	northbound
PSRC	Puget Sound Regional Council
ROD	Record of Decision
SB	southbound
SDOT	Seattle Department of Transportation
SR	State Route
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

Introduction

Why is transportation considered in the Environmental Assessment?

The Washington State Department of Transportation Ferries Division (WSF) plays a vital transportation role in the Puget Sound area. As a transportation service provider, the system carried nearly 23 million riders in 2009 and was the second largest transit system in Washington. As a marine highway, ferry routes are extensions of the state highway system and are essential to the transportation network in the State of Washington.

The Seattle Ferry Terminal, located at Colman Dock at Pier 52 on Elliott Bay, is one of 20 terminals in the WSF system. This terminal supports transportation across Puget Sound between downtown Seattle and the communities of Bremerton and Bainbridge Island. Several portions of the Seattle Ferry Terminal are at the end of their useful life, including the creosote-treated timber trestle dock structures and their associated buildings, and the Slip 3 vehicle and pedestrian bridges and their supporting structures.

WSF is proposing to replace the aging and seismically vulnerable components of the Seattle Ferry Terminal to maintain ferry service in the future and provide safe, reliable, and effective service for transit, general purpose and commercial vehicles, high-occupancy vehicles, pedestrians, and bicycles.

Therefore, as part of the environmental assessment (EA), the transportation effects of the proposed project and its alternatives, as well as reasonable alternatives to those actions, were considered.

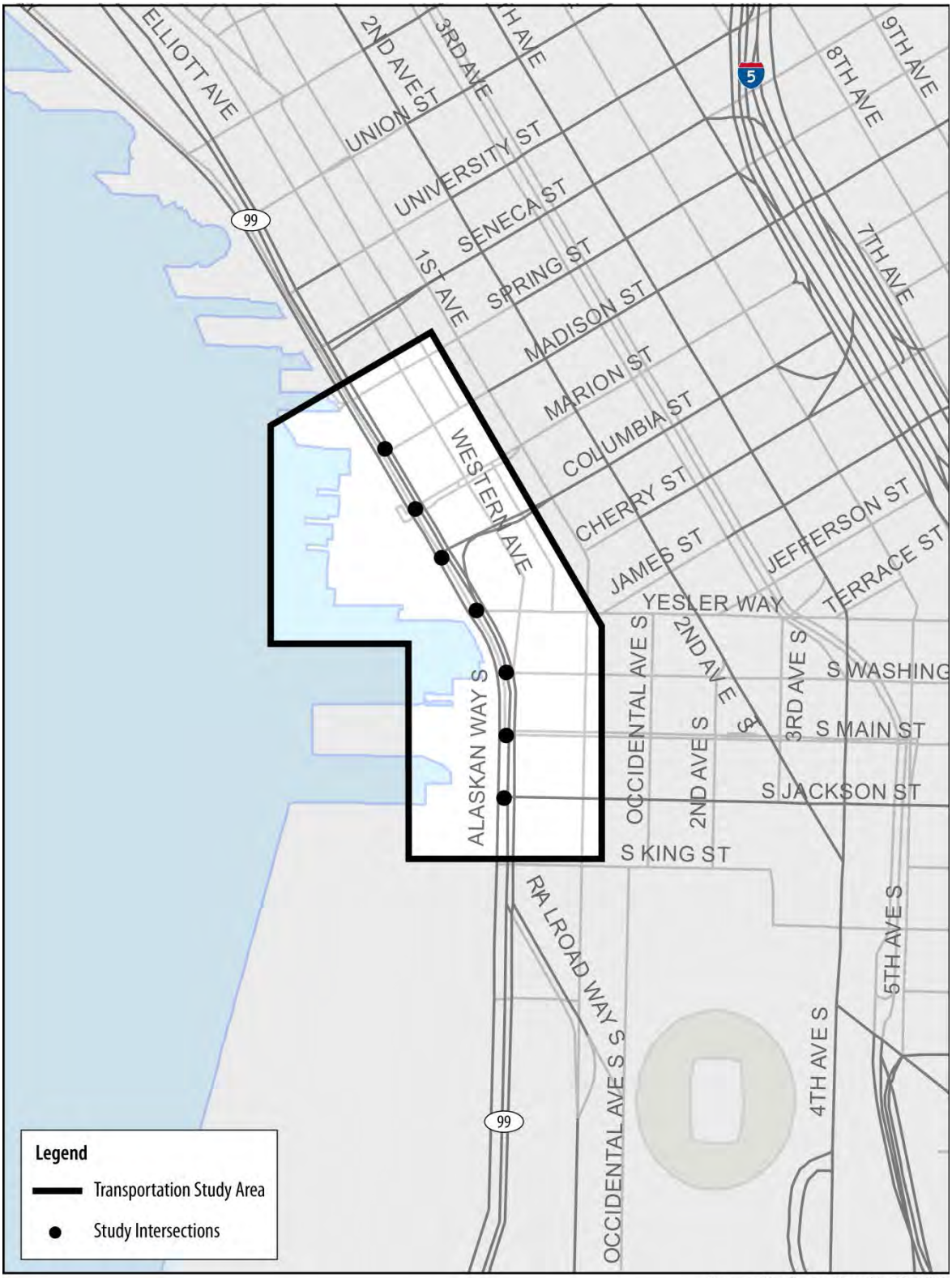
What are the key points of this report?

- The Build Alternative is not expected to have any major impacts to overall transportation operations on Colman Dock or the surrounding streets. The project is being designed to preserve the level of vehicle holding on Colman Dock available today. Access and egress points to the facility would remain unchanged.
- The Build Alternative is expected to provide safer and more efficient operations. This would be accomplished through reconfiguration of on-dock circulation patterns that would remove vehicular and pedestrian conflict points, improve the movement of pedestrians and vehicles throughout the facility, and improve pedestrian connections to transit services adjacent to the facility.

- Under the No Build Alternative, portions of the terminal may, over time, face weight restrictions and possible closures for safety reasons because of structural deficiencies. Operations may be affected if on-dock storage is reduced because of safety concerns.
- Analysis of traffic operations during construction phases 1-3 of the Build Alternative showed that effects to the surrounding transportation system would be minimal. However, as is typical for an EA, the analysis represents typical weekday PM peak hour volumes. It is recognized that there are days throughout the year during which higher volumes may occur and construction mitigation may be needed during these very busy times.
- Phase 4 construction is expected to have some impacts to congestion and queuing along Alaskan Way. However, implementation of proposed active lane management mitigation strategies on Colman Dock are expected to result in conditions that are similar to the No Build Alternative.

What is the project area?

The Seattle Ferry Terminal Project is located at Colman Dock along the central waterfront of downtown Seattle, Washington. The site is owned by WSDOT, and is part of the State Highway System. The terminal is the western terminus of SR 519 and the eastern terminus of SR 305. The Elliott Bay Seawall and Alaskan Way border the site on the east. Immediately north of the site is the Seattle Fire Station # 5 at Pier 53, while just south of the site are the Washington Street Boat Landing and Pier 48, owned by WSDOT. The project site includes Piers 50 and 52 in the numbering system used along the Seattle waterfront. The study area is shown in Exhibit 1.



Basemap Data Source: City of Seattle, 2009

0 0.25 Miles

North

Exhibit 1
Study Area

1

What are the project alternatives?

What is the Build Alternative?

One Build Alternative is being proposed for the project. The purpose of the Build Alternative is to preserve the role of the Seattle Ferry Terminal as a regional multimodal transportation hub, providing safe, reliable and effective service for transit, general purpose and commercial vehicles, high occupancy vehicles (vanpools/carpools), pedestrians and bicycles.

The northern portion of Colman Dock is a timber structure that has deteriorated over time and is both seismically vulnerable and at the end of its service life. Initially constructed in 1938, the timber dock was rebuilt in 1964 and expanded in the northwest corner in 1971; it is still supported in large part by many of the original 1938 timber piles and structural components. The terminal building and the vehicle and passenger loading bridges of Slips 2 and 3 were built in 1964 on independent foundations. Due to their degraded conditions, these components require regular maintenance, which can cause lane closures and disrupt operations.

Safety is WSDOT's top priority. WSDOT's preservation program for ferry terminals aims to identify the needs for operating at current service levels and to maintain, preserve, and replace existing capital takes into account the facilities' condition. Current LCCM reports (2009) rate many of the Seattle Ferry Terminal's assets as "poor" in condition, and a portion of the north timber trestle's foundation received a "substandard" rating. The existing structures proposed for replacement are at the end of their service life. They are deteriorating and seismically vulnerable, and the Slip 3 OHL does not meet the requirements of the Americans with Disabilities Act (ADA).

Key elements of the Seattle Ferry Terminal Project include:

- Replacing and re-configuring the timber trestle portion of the dock;
- Replacing the main terminal building;
- Reconfiguring the dock layout to provide safer and more efficient operations;
- Replacing the vehicle transfer span and the overhead loading structures of Slip 3;
- Maintaining a connection to the Marion Street pedestrian overpass;
- Replacing the passenger-only ferry (POF) facility on the southern edge of Colman Dock.

Much of the northern trestle area would be left as open water after construction; the design replaces the northern holding lane capacity on the south side of the terminal. The reconfiguration increases near shore habitat and narrows the facility's frontage along Alaskan Way by 150 feet. The total overwater coverage for the reconfigured terminal, including the POF facility, would increase by about 5,200 square feet. Mitigation for the increased overwater coverage would include removal of an equivalent area of overwater coverage in Elliott Bay or elsewhere in Puget Sound.

When the south trestle of the Seattle Ferry Terminal was built in 1990, WSF placed a clean sediment cap over the contaminated sediments in the construction area. The current proposal would also place a clean sediment cap in the new construction areas, to contain contamination in the underlying sediment and prevent leaching into the marine environment. In addition, the Project would include basic stormwater treatment for all new and replaced areas of the terminal.

Construction would be phased to minimize disruption to ferry service. The phasing would maintain holding lane capacity on the dock to allow ferry loading during construction, and WSF anticipates that current ferry schedules would be maintained. The construction would last for six years, from 2015 through 2021.

The WSF Long Range Plan concluded that expanded ferry service in the future could be accommodated without increasing the holding lanes on Colman Dock. Therefore, as a preservation project, the Build Alternative is being designed to preserve the level of vehicle holding on Colman Dock available today; however, the layout on Colman Dock would be reconfigured to provide safer and more efficient operations. Access and egress points to the facility would remain unchanged from existing conditions for vehicle traffic. The new facility will be connected to the future terminal building and the Marion Street pedestrian bridge by an overhead walkway in order to reduce the potential for vehicle and pedestrian conflict.

Existing connections to transit service along Alaskan Way would be maintained. Washington State Ferry service through the design year, 2020, is assumed to be similar to existing conditions. The Build Alternative would include the in-kind replacement of the existing two-slip passenger-only ferry facility located at Pier 50. The years to be covered in this transportation study include the year 2015 and 2020, the years that construction of the Build Alternative is expected to begin and the year the trestle portion of the project is expected to be complete.

What is the No Build Alternative?

Both federal and Washington State environmental regulations require agencies to evaluate a No Build Alternative to provide baseline information about existing conditions in the project area. This alternative assumes no improvements would be made to Colman Dock.

The No Build Alternative would include maintenance and repair of the existing facility until structural systems reach a point in their lifespan when annual maintenance costs surpass annual operating costs. At that point, WSF would either have to operate reduced service or close the facility.

Under the No Build Alternative, the Pier 50 passenger-only ferry service will continue in its current location. Timber berthing structures and transfer span for slip 2 would be replaced. Slip 3 vehicle transfer span and the overhead loading structure would be at risk of closure due to weight restrictions. Under the No Build Alternative, portions of the terminal may face

weight restrictions over time, and possible closure because of structural deficiencies. If either of these were to occur operations would be affected.

Although these structures and systems could be operated at reduced levels or close during their lifespans, since existing state law requires the state ferry system maintain existing facilities, the more likely predicted action of the Washington State Legislature would be that it would appropriate funds to replace those structures and systems as needed in order to maintain the current level of ferry service.

What topics are included in this Transportation Discipline Report?

This report describes transportation conditions on Colman Dock and the adjacent arterial, Alaskan Way, between the intersections of Madison Street and S. Jackson Street. This report presents transportation information as it exists today and estimates transportation operations for the No Build and Build Alternative options under evaluation for this project. The report also identifies the meaningful differences between the Build Alternative and the No Build Alternative in terms of local street performance, safety, and effects to transit and non-motorized facilities.

The Build and No Build Alternatives were described above in this Introduction chapter. The remaining chapters provide a discussion of the following topics:

- Methodology—This chapter describes the methods used to predict, assess, and describes transportation system performance and impacts.
- Affected Environment—This chapter discusses baseline transportation conditions for the year 2015, the year construction is expected to begin.
- Potential Effects of the Project—This chapter describes the expected effects the project would have on performance of transportation facilities in 2020 and assesses each alternative under predicted future conditions. It also covers Construction Effects and Mitigation as well as Cumulative Effects.
- References—This chapter includes the information sources used to prepare this report.

Methodology

What is in this chapter?

This chapter summarizes the overall study approach, as well as the techniques and tools used to develop transportation data, perform operational impact analysis of existing and future traffic conditions, and assess multimodal transportation system performance for the Seattle Multimodal Terminal Project.

What is the study area?

The primary study area for the transportation analysis encompasses the project area and nearby transportation facilities related to or affected by Colman Dock. The study area for the Transportation Discipline Report includes Colman Dock and Alaskan Way, bounded by the intersection of Alaskan Way /Madison Street in the north and the intersection of Alaskan Way S. /S. Jackson Street in the south, as shown in Exhibit 1.

Changes in travel patterns and transportation-related effects outside the study area were considered and found to be minimal. In addition, the potential for cumulative effects was evaluated for a broader area and is discussed in the Cumulative Effects section.

What is the Alaskan Way Viaduct Replacement Program?

The Alaskan Way Viaduct Replacement Program is located in downtown Seattle, Washington. The program includes a number of independent projects by WSDOT and the City of Seattle that improve safety and mobility along State Route (SR) 99 and the Seattle central waterfront from the area south of downtown to Seattle Center.

The projects include replacing SR 99 between S. Royal Brougham Way and Roy Street with a bored tunnel. The existing viaduct along the Seattle waterfront will be removed and the Battery Street Tunnel will be closed and decommissioned.

Other projects in the Program include the Elliott Bay Seawall Project, the Central Waterfront Project, the Elliott/Western Connector, and various transit improvements.

Extensive analyses of the transportation system along Seattle's waterfront, including the project area for the Seattle Multimodal Terminal at Colman Dock Project, were evaluated as part of the AWVRP environmental process.

How was transportation information collected?

Geometric Data and Traffic Control

Data were assembled that related to roadway geometry, channelization, and traffic control (including signal timing) from data collected as part of WSDOT's Alaskan Way Viaduct Replacement Project (AWVRP) Final Environmental Impact Statement (WSDOT et al. 2011). Channelization data along Alaskan Way, proposed under the Elliott Bay Seawall Project, was also collected.

Pedestrians and Bicycles

Pedestrian volumes at intersections and bicycle traffic volumes were assembled from data available as part of the AWVRP.

Transit

Transit information related to service coverage, frequency, and travel times for buses that currently use Alaskan Way and other nearby street segments were obtained from published schedules and maps provided by King County Metro, Community Transit, Pierce Transit, and Sound Transit.

Parking

As part of the AWVRP, an inventory of on-street parking in the Seattle Central Business District and along the waterfront was conducted in 2001, with additional counts completed in 2002, 2003, and 2006. Location and types of parking were rechecked in 2009 and 2010. This previously developed information was assessed and considered current and appropriate for use in the Seattle Multimodal Terminal EA.

Freight

Information on volumes of heavy trucks was collected during arterial turning movement counts conducted as part of the AWVRP and used in this EA.

Ferry Service

Washington State Ferries representatives provided data relating to current ferry vessel capacities, ferry operating schedules, Seattle Ferry Terminal vehicle holding capacity, and typical loading and offloading procedures.

How were traffic volume forecasts developed?

Assumptions

To estimate the year 2015 and 2020 PM peak hour traffic volumes, work conducted previously for the AWVRP was used. As part of the AWVRP environmental process, transportation analysts prepared forecasts of PM peak hour arterial intersections in the study area under 2015 and 2030 conditions.

The 2015 and 2030 estimates for the AWVRP were developed by the application of a regional travel demand model. The model was based on the (2008) Seattle Department of Transportation (SDOT) enhanced version of the Puget Sound Regional Council's (PSRC) regional planning model, which operates in the EMME software environment.

The AWVRP model reflects assumptions for regional population and employment growth as defined in PSRC's regional plan, *Destination 2030: Metropolitan Transportation Plan for the Central Puget Sound Region* (PSRC,

Why were the tolled conditions for the AWVRP project used for this analysis?

The AWVRP considered three build alternatives. Each of the three build alternatives was evaluated for its potential impacts to the natural and built environment with and without the application of tolling.

The Tolled Bored Tunnel Alternative was identified as the preferred alternative in the Final Environmental Impact Statement.

Extensive travel demand and traffic operations models were developed for the AWVRP, including the area surrounding Colman Dock, and are considered applicable to this project.

2001). These data were most recently updated in 2006. *Transportation 2040: Metropolitan Transporataion Plan for Central Puget Sound Region* Final Environmental Impact Statement (FEIS) was released on March 19, 2010. The PSRC's General Assembly adopted *Transportation 2040* on May 20, 2013.

The traffic models developed as part of the AWVRP FEIS process are still valid for the Seattle Terminal Project. The AWVRP EIS traffic model assumed that the bored tunnel would be tolled by 2020, thereby accounting for diversion impacts in both volume development and analysis.

As part of the AWVRP Record of Decision (ROD), WSDOT committed to seeking a long-term tolling solution to minimize traffic diversion in order to optimize operation of the transportation network for all users. Strategies for optimization are currently being developed by the Advisory Committee on Tolling and Traffic Management (ACTT). The committee is exploring ways to refine tolling of the SR 99 tunnel to minimize traffic diversion and meeting funding goals. The committee is currently halfway through its analysis of potential toll scenarios and anticipates providing recommendations in mid-2013. Final recommendations will be made in December 2015, when the tunnel is scheduled to open and tolling begins.

The toll rates assumed as part of the AWVRP FEIS analysis are higher than the tolling strategies currently being examined as part of the ACTT. The higher toll rates assumed in the AWVRP FEIS resulted in greater traffic diversion and volumes on Alaskan Way providing a conservative analysis to forecasted impacts on Alaskan Way. The lower toll rates being analyzed as part the ACTT have resulted in much lower diversion rates to arterial streets, including Alaskan Way.

The AWVRP FEIS assumed a level of future transit service and growth in the area, which was assumed to help reduce impacts from toll diversion. Due to current funding challenges faced by King County Metro, future transit service could be significantly less than the service growth assumptions in the AWVRP FEIS. However, transit service to Colman dock is expected to be maintained, and coupled with the reduced toll rates currently assumed by the ACTT, impacts that could result from traffic diversion and/or transit cuts are not expected to result in greater impacts to Alaskan Way than what is documented as part of the AWVRP FEIS.

Other projects in the area, in addition to the Seattle Terminal Project, have used the traffic models and assumptions from the AWVRP, as the basis for their traffic analysis, including the Elliott Bay Seawall project (construction planned to being in fall 2013) and the Central Waterfront project, currently in the planning process.

Intersection Traffic Volumes

Volumes forecasted for the 2015 Construction scenario for the AWVRP were used for the year 2015 analysis for the Seattle Multimodal Terminal EA. Under this scenario, the Alaskan Way Viaduct is still standing and the bored tunnel is under construction. To estimate the year 2020 traffic volumes, the traffic volumes developed for the 2015 and 2030 Project (tolled) conditions for the AWVRP were used as a starting point for the calculation. The annual growth rate estimated between the 2015 and 2030 Project (tolled) volumes was then used to estimate the 2020 traffic volumes for the Seattle Multimodal Terminal Project.

The AWVRP will be complete by 2020 and the bored tunnel is assumed to be tolled by this analysis year. The trestle construction for the Seattle Multimodal Terminal Project is expected to be completed by 2020 as well. Ferry service is expected to remain the same for both 2015 and 2020; therefore, peak hour traffic volumes forecasted to enter and exit the Seattle ferry terminal were assumed to be similar for both 2015 and 2020 as well, with a relatively small growth between the two years based on projections used for the AWVRP.

Time Periods

Traffic volumes were forecasted for the weekday PM peak hour. This peak hour corresponds to the hour-long period in the evening when overall traffic volumes and travel demand are at their highest levels. The PM peak hour assessed corresponds to the 5:00 to 6:00 p.m. time period. Generally, traffic volumes are at similar levels at other times during the evening commute period as well. Therefore, peak hour results are largely representative of travel conditions anytime between 4:00 and 6:00 p.m.

> **What is the peak hour?**
>
> The hour within the morning or afternoon peak period when the maximum demand occurs on a given transportation facility or corridor.

How were traffic operations analyzed?

Arterial intersection operations

To capture the transportation-related effects of the Seattle Multimodal Terminal Project, the following seven signalized intersections along Alaskan Way were analyzed with the VISSIM model to determine intersection level of service (LOS) and delay:

1. Madison Street and Alaskan Way
2. Marion Street and Alaskan Way
3. Columbia Street and Alaskan Way
4. Yesler Way and Alaskan Way
5. S. Washington Street and Alaskan Way (pedestrian signal)
6. S. Main Street and Alaskan Way
7. S. Jackson Street and Alaskan Way

The VISSIM model replicates traffic flow by simulating discrete vehicle movements to produce estimates of travel speeds, intersection delay, and queues, which can be used to assess intersection LOS consistent with industry-standard definitions as presented in the *Highway Capacity Manual* (Transportation Research Board, 2000). Intersection LOS is based on the average delay per vehicle and is categorized as shown in Exhibit 2.

Exhibit 2. Level of Service Designations for Signalized Intersections

Level of Service for Signalized Intersections	Average Vehicle Delay (seconds)	Description
A	0 to 10	Little or no delay
B	>10 to 20	Short delays
C	>20 to 35	Moderate delays
D	>35 to 55	Long delays
E	>55 to 80	Very long delays
F	>80	Failure—extreme congestion

Source: Transportation Research Board, 2000

Average vehicle delay and LOS are reported for the PM peak hour conditions for key study area intersections on Alaskan Way. Average vehicle delay is reported from the simulation runs in the VISSIM model.

Queuing

A queue spill-back occurs in an area where vehicles cannot proceed through an intersection because the vehicles ahead are backed up from the next intersection. Queue spillbacks along Alaskan Way can occur during times when demand on Colman Dock is high. Queue spillbacks are identified for this project through results of the VISSIM simulation analysis.

The vehicle holding on Colman Dock and the loading and offloading of vehicles to the ferry vessels were replicated in the VISSIM simulation analysis to determine whether an adequate amount of holding is available to accommodate the typical weekday ferry traffic.

Travel Conditions during Construction

Traffic management approaches (detours) associated with major construction stages of the Build Alternative are described in the following sections. Travel forecasts were prepared for one construction stage associated with the Build Alternative, corresponding to the stage that is expected to be most disruptive. Travel disruption during other construction stages is described qualitatively relative to this modeled stage. Transportation measures to help maintain mobility and access during construction are suggested based on the degree, location, and extent of the forecasted disruption.

Affected Environment

This chapter describes the affected environment for the transportation system within the study area. Information is presented regarding transportation facilities, their use, and their performance. The affected environment describes the context, or setting, of the project.

For this EA, the year 2015 was chosen to reflect the affected environment as this is the year construction is expected to begin on the project. Several projects near the study area are currently under construction but will be completed, or substantially completed, by the start of construction of the Seattle Multimodal Terminal at Colman Dock in the year 2015. The S. Holgate Street to S. King Street Viaduct Replacement Project affects access to the Alaskan Way Viaduct near the project study area. This project is currently under construction and will be complete before 2015.

The Alaskan Way Viaduct Replacement Project will be substantially complete by 2015, although the existing viaduct will still be standing, with detours in place, and the bored tunnel will not yet be open to traffic. These projects will result in modified traffic patterns in the study area at the time that Seattle Multimodal Terminal Project construction begins, and so need to be captured as part of the affected environment. Therefore, it was determined that 2015 would serve as a better description of the project setting in the EA than 2012 conditions.

Note that while 2015 is listed as the analysis year, in some cases, such as for the discussion of ferry and bus service, only existing 2012 data were available. However, as no expected changes in service for either bus or ferry are anticipated between 2012 and 2015, the volumes are expected to still be relevant. Such exceptions are indicated in the applicable sections.

What are the existing transportation characteristics of the study area?

Ferry Service

This section describes ferry service as it occurs in 2012. Ferry service to downtown Seattle is provided by WSF and King County. It is assumed that while ridership is forecasted to increase in the future, sailing frequency and vessel capacity on the assigned routes for 2015 will be the same as for 2012. Washington State Ferries provides direct ferry service between downtown Seattle and both Bainbridge Island and Bremerton. Alternative transportation connections between Seattle and these communities are by highway through Tacoma (via the Tacoma Narrows Bridge) or by ferry to Edmonds.

The King County Ferry District provides service to downtown Seattle from West Seattle and Vashon Island. Alternative transportation connections for the West Seattle route involve the West Seattle Bridge and either SR 99 or surface streets. Alternatives for the Vashon Island

service involve WSF service to Fauntleroy and surface streets to the West Seattle Bridge and either SR 99 or surface streets to downtown Seattle.

The King County Ferry District announced in October 2012 plans to build two new boats. The new vessels are expected to hold between 225 and 250 passengers each and will replace the 20-plus-year-old leased vessels currently in use. Delivery of the new vessels is anticipated in mid-2014.

Colman Dock, located on Pier 52 on Seattle's downtown waterfront, is the Seattle terminus for the Washington State Ferries service for Bainbridge Island and Bremerton routes, as well as for King County's passenger-only service from Vashon Island and from West Seattle. Access to Colman Dock is provided from Alaskan Way at Yesler Way, and exits are provided to Alaskan Way at Yesler Way and Marion Street.

Vehicle and Passenger Ferries

For the WSF service, two Jumbo Mark II boats, each with a capacity of 202 vehicles and 2,500 passengers, operate on the Bainbridge Island service between 4:45 a.m. and 1:35 a.m. on weekdays, with departures and arrivals approximately every 50 minutes.

Service to Bremerton generally operates with one Super Class vessel with a capacity of 144 vehicles and 2,000 passengers and one Issaquah Class vessel with a capacity of 124 vehicles and 1,200 passengers during fall, winter, and spring.

During summer, service to Bremerton operates with one vessel with a capacity of 144 vehicles and 2,000 passengers and one vessel with a capacity of 188 vehicles and 2,000 passengers. The Bremerton service generally operates on approximately 80-minute headways daily between 4:50 a.m. and 12:50 a.m.

Leased Passenger-Only Facility at Pier 50

Passenger-Only Ferries

The King County Ferry District and the Port of Kingston currently operate passenger-only ferry service from Pier 50 through a lease with WSF. King County operates passenger ferries between Pier 50 and West Seattle and Pier 50 and Vashon Island. The passenger-only boats for both routes can accommodate 150 passengers and currently operate year round.

During winter, weekday service to and from West Seattle is provided approximately every 30 minutes from 6:30 a.m. to 9:00 a.m. and again from 4:00 p.m. to 7:00 p.m., with no midday service or weekend service. During spring, summer, and fall, weekday service is provided every 30 minutes between 6:30 a.m. and 9:00 a.m. and again from 4:00 p.m. and 7:00 p.m. and each hour from 10:30 a.m. to 3:30 p.m. Special trips beginning at 7:30 p.m. operate hourly until 11:00 p.m. on Fridays and when the Mariners, Sounders, or Seahawks play weekday

evening games that start after 7:00 p.m. Saturday and Sunday service is offered every hour from 9:00 a.m. to 11:00 p.m.

The Vashon passenger-only ferry provides peak-only service, operating three morning trips to Seattle at 6:10, 7:10, and 8:15 a.m., and three afternoon trips from Seattle at 4:30, 5:30, and 6:30 p.m.

Characteristics of Ferry-related Traffic

Arterial intersection analysis estimates indicate that 435 vehicles exit Colman Dock and 550 vehicles arrive at Colman Dock during the PM peak hour under 2015 conditions. The analysis assumes that there is one Bremerton and two Bainbridge Island route arrivals and departures. The analysis of the PM peak hour demand at the Seattle Ferry Terminal represents the 30th busiest day of the year, which corresponds to a 92nd-percentile weekday. This magnitude is consistent with traffic counts taken near the Seattle Ferry Terminal. Because these volumes represent a typical traffic day, there are days throughout the year when higher volumes occur.

Vehicles enter Colman Dock from Alaskan Way northbound at Yesler Way using a signalized left turn. Right turns into the terminal from southbound Alaskan Way are prohibited during peak periods except for registered carpools. Vehicles pass through a toll area that has four booths and capacity for 35 queued vehicles. They then proceed to holding lanes that can accommodate approximately 596 passenger vehicles. Queued vehicles are directed from there onto the ferries. Approximately 80 parking spots (78 regular and 2 ADA spaces) are currently reserved on Colman Dock for employees.

There are two vehicle exits from Colman Dock. The first is to Alaskan Way at Yesler Way. This exit is two lanes and forces all traffic to turn right to southbound Alaskan Way. Traffic destined for downtown or other locations to the north must turn around on Alaskan Way or, more commonly, circle back into town on S. Royal Brougham Way to Fourth Avenue. The second exit is at the signalized intersection of Alaskan Way and Marion Street, which allows vehicles to travel north or south on Alaskan Way, as well as east on Marion Street.

The traffic signals for Colman Dock at either Marion Street or Yesler Way use queue detection to extend the green time for exiting traffic to the maximum green time allocated when there is substantial queuing on Colman Dock. Once the green phase is completed, the north–south movements are allocated their normal split timings. The resulting signal cycle length during a ferry off-load remains the same coordinated length that occurs when there is not an emptying vessel. The queue detection continues to trigger maximum green time for exiting ferry traffic until the vessel is empty. While vessels are offloading, approximately 50 percent of the green time is allocated to traffic exiting Colman Dock. During this time, delay for Alaskan Way traffic increases, but since the signals are coordinated, disruption to Alaskan Way traffic is limited. Following an offloading event, the north–south flow on Alaskan Way will be largely uninterrupted at the Marion Street and Yesler Way cross streets, except for pedestrian or occasional automobile crossings.

Foot Passenger Connections to Seattle Central Business District

The majority of foot passengers arriving at or departing from Colman Dock use the Bainbridge Island route. Loading and offloading occurs at the upper level of Colman Dock, from which a direct walkway is provided that crosses above Alaskan Way and below the existing Alaskan Way Viaduct and connects to the sidewalk on the south side of Marion Street at First Avenue. Passengers can also enter and exit at Alaskan Way, where they can catch a bus or cross Alaskan Way. Signalized crosswalks crossing Alaskan Way are located at Marion Street, Columbia Street, and Yesler Way.

Roadway Characteristics

Alaskan Way is designated by the City of Seattle as a principal arterial. During 2015 conditions, between the intersections of Madison Street and S. Jackson Street there are seven signalized intersections and no unsignalized intersections or driveways within the 1,800 foot section. In 2015 conditions, Alaskan Way will operate with two lanes in both the northbound and southbound directions. Madison Street is one-way westbound with two left-turn lanes and one right-turn lane to Alaskan Way. Marion Street is one-way eastbound at Alaskan Way and is aligned with one of the ferry exiting driveways. Columbia Street is one-way westbound and operates with two approach lanes to Alaskan Way.

At the intersection of Alaskan Way S. /Yesler Way there is a transit-only left-turn lane in the southbound direction and a northbound left-turn for general-purpose traffic turning onto Colman Dock. The signal at Alaskan Way S. /S. Washington Street is a pedestrian signal. There are no vehicle connections between S. Washington Street and Alaskan Way S. S. Main Street is one lane in each direction east of Alaskan Way S. At S. Jackson Street, there is one eastbound lane east of S. Jackson and an eastbound signalized driveway west of Alaskan Way S.

Traffic Operations

Volumes

For the 2015 conditions, traffic volumes from the AWVRP Final Environmental Impact Statement analysis for the 2015 Bored Tunnel Construction scenario were used. This scenario modeled traffic conditions just prior to the bored tunnel being opened to traffic, with the Alaskan Way Viaduct still standing and in operation and detours in place in the south end of the study area.

Traffic volumes are fairly balanced in the northbound and southbound directions along Alaskan Way during the 2015 condition PM peak hour. Volumes on the east/west side streets that intersect with Alaskan Way are considerably lower than the volumes traveling along Alaskan Way Exhibit 3 illustrates the 2015 conditions traffic volumes.

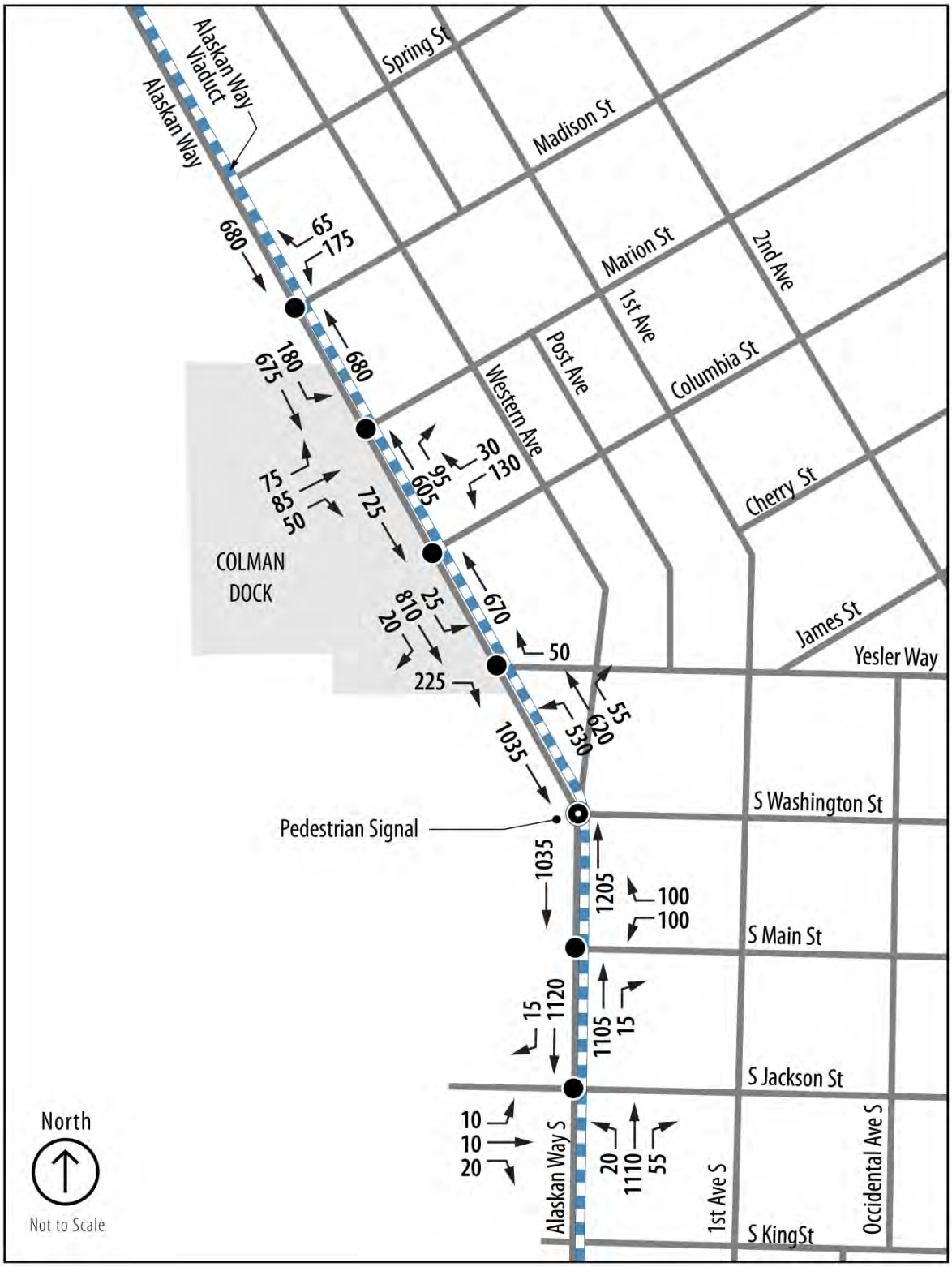


Exhibit 3
2015 Conditions PM Peak Hour Volumes

Level of Service

Traffic operations at signalized intersections in the study area were assessed using VISSIM traffic simulation software to determine intersection LOS and average vehicle delay. Exhibit 4 presents traffic operations for study area intersections in the 2015 PM peak hour condition. Intersections in the study area are expected to operate at LOS C or better during the 2015 PM peak hour.

Exhibit 4. PM Peak Hour Level of Service—2015 Conditions

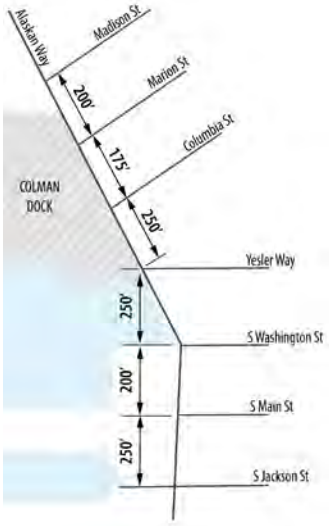
Street	Cross Street	2015 Conditions	
		LOS	Avg. Delay
Alaskan Way S.	S. Jackson Street	C	30
Alaskan Way S.	S. Main Street	B	12
Alaskan Way S.	S. Washington Street	A	10
Alaskan Way S.	Yesler Way	C	23
Alaskan Way	Columbia Street	A	5
Alaskan Way	Marion Street	B	15
Alaskan Way	Madison Street	B	13

LOS = level of service; Avg Delay = average delay per vehicle in seconds

Queues

In 2015, there will continue to be no off-site ferry holding. Therefore, any vehicles that cannot queue directly on Colman Dock will have to queue along Alaskan Way S. Exhibit 5 illustrates the predicted average queue lengths, in feet, along Alaskan Way. The available queue length between intersections is shown in the figure to the right. To capture queues that may be related to Colman Dock, northbound queues are reported for intersections from Yesler Way south, and southbound queues are reported for intersections north of Yesler Way.

What is the distance available for queuing between intersections?



Average peak hour queue lengths are not expected to cause spill-back to adjacent intersections. However, at times during the peak hour, modeling showed that queues along both northbound and southbound Alaskan Way will spill back to adjacent intersections. At the intersection of Alaskan Way at Yesler Way, the high PM peak hour volumes in the single northbound left turn used by vehicles entering Colman Dock spills back into the adjacent intersection. This spill-back is caused by left turning delay, not queue spill-back from the ferry terminal. Analysis shows that the on-dock ferry holding lanes will accommodate the typical weekday peak hour volume of traffic.

Exhibit 5. Average PM Peak Hour Queues—2015 Conditions

Street	Cross Street	2015 Conditions	
		Direction	Average Queue (ft)
Alaskan Way S.	S. Jackson St	NB through	405
Alaskan Way S.	S. Main St	NB through	125
Alaskan Way S.	S. Washington St	NB through	125
Alaskan Way S.	Yesler Way	NB through NB left SB through	40 185 40
Alaskan Way	Columbia St	SB through	10
Alaskan Way	Marion St	SB through	45
Alaskan Way	Madison St	SB through	20

Transit Service

While the ferry terminal at Colman Dock is an extension of the highway system, it is also a type of transit. In addition to the transit service provided at Colman Dock by WSF and the King County Ferry District, other transit service in the study area includes bus service and vanpools.

Transit Stop at Colman Dock

King County Metro operates two routes along Alaskan Way in the study area, Route 16 and Route 66, both of which serve Colman Dock. Construction of the Olympic Sculpture Park and the resulting displacement of the vehicle storage and maintenance facility led to the indefinite suspension of the George Benson Line Waterfront Streetcar service in 2009. King County Metro provides replacement service with bus service on the Route 99 Waterfront Streetcar Line. Route 99 does not directly serve Colman Dock. The closest stop to Colman Dock is at Alaskan Way/Spring Street.

Transit agencies in the region all operate vanpool programs. The programs provide the vans, maintain the vehicles, and offer ride-matching service and support. In turn, fees are collected from vanpool users to cover expenses. A substantial volume of vanpools access downtown Seattle via WSF routes serving Bainbridge Island and Bremerton.

Freight

Alaskan Way is designated as a Major Truck Street by the City of Seattle. In case of congestion, incidents, or lack of access to the Alaskan Way Viaduct, oversized or overweight trucks are limited to Alaskan Way and Broad Street, or I-5, the City of Seattle's designated over-legal routes.

Alaskan Way is the City of Seattle's designated route for over-legal trucks through the downtown area. Alaskan Way is also outside the City of Seattle's downtown traffic control zone, which precludes trucks 30 feet or taller from using city streets in the downtown area north of S. King Street from 7:00 a.m. to 7:00p.m. daily.

Pedestrian

Pedestrian Facilities

Primary pedestrian traffic generators along the waterfront include tourist activities, businesses, recreational uses, and ferry service. The majority of streets in the study area have sidewalks. A widened sidewalk on the west side of Alaskan Way fronts waterfront businesses and attractions, acting as a pedestrian promenade. The promenade varies from 16 to 20 feet wide in the central waterfront area. The east side of Alaskan Way is only periodically fronted by sidewalks between S. King Street and Pike Street, primarily at stops for the old waterfront streetcar. There is also a pedestrian bridge at Marion Street, which extends from First Avenue S., over Alaskan Way , and connects to the Seattle Ferry Terminal at Colman Dock and the west side of Alaskan Way, allowing commuters and other ferry users to access downtown without having to cross Alaskan Way at-grade . The pedestrian bridge at Marion Street provides access to Western Avenue via a staircase that is non-ADA compliant.

Marion Street Pedestrian Bridge

The Elliott Bay Trail is a multipurpose asphalt pathway along the east side of Alaskan Way (east of the streetcar tracks) that is used by both pedestrians and cyclists. This facility extends from the stadium area to Myrtle Edwards Park.

Surface crossings of Alaskan Way are provided at fairly regular intervals along the roadway. Signalized intersection crossings along Alaskan Way S. are located at S. Jackson Street, S. Main Street, S. Washington Street, Yesler Way, and Columbia, Marion, and Madison Streets.

Pedestrian Volumes

Pedestrian traffic along the waterfront varies substantially—both day-to-day and seasonally—as a result of ferry, tourist, and cruise ship activities. Data from WSF show that overall foot passenger volumes are typically higher during summer than during fall and winter

(Exhibit 6). Unlike overall pedestrian volumes in the downtown area, which are generally associated with typical workday activities and tend to peak during the weekday PM peak hour, pedestrian volumes along the downtown waterfront tend to peak during the weekend PM peak hour in summer.

Pedestrian volumes along Alaskan Way were collected by video in August 2006 during the PM peak hour for both weekday and weekend conditions (Exhibit 7). These volumes also confirm the variability of pedestrian traffic in the area. Pedestrian volumes along Alaskan Way saw fairly substantial increases during the weekend PM peak hour over the weekday PM peak hour. The Marion Street pedestrian bridge was the only location to see a decrease in pedestrian volumes during the weekend PM peak hour.

Exhibit 6. Washington State Ferries Seasonal Foot Passenger Traffic at Colman Dock

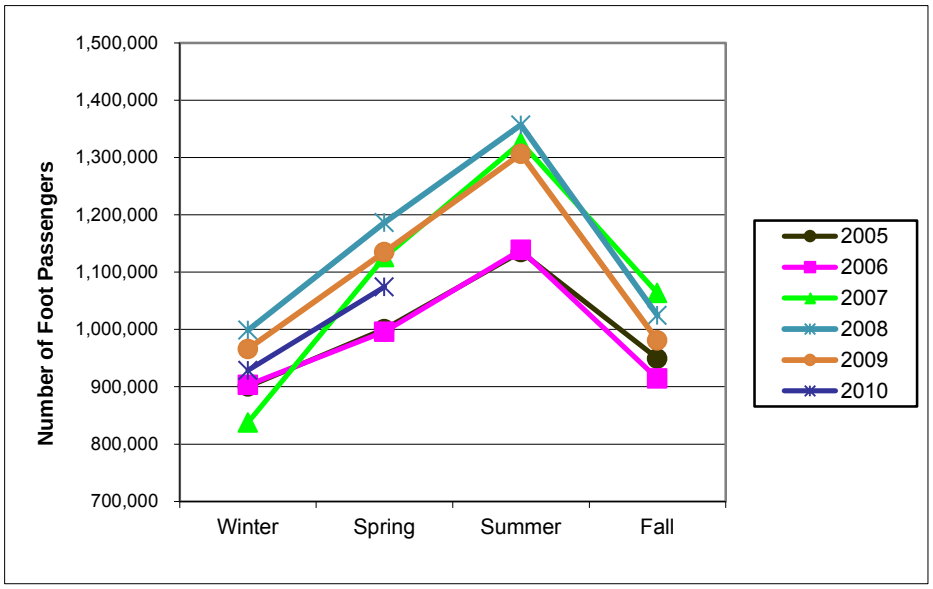
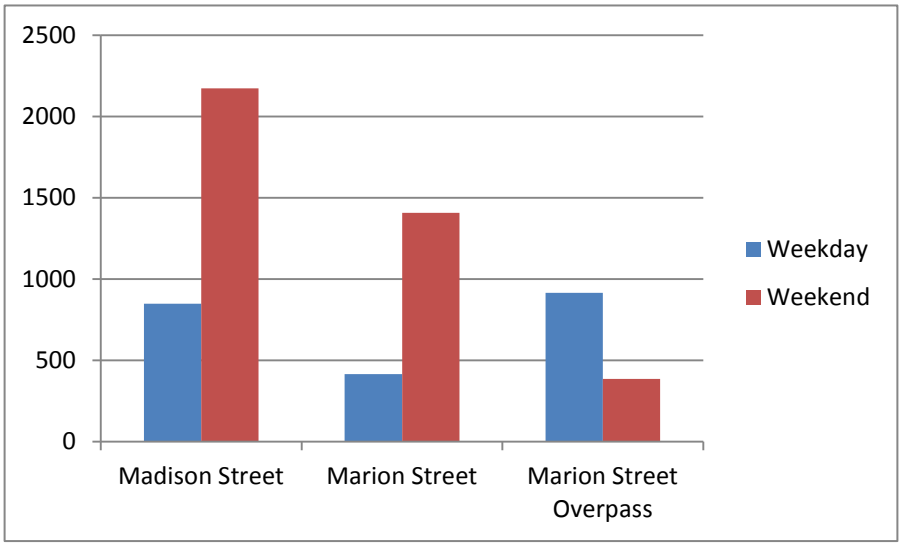


_Exhibit 7. 2006 PM Peak Hour Pedestrian Volumes Crossing Alaskan Way



Pedestrian Connections

Several inadequacies at the current terminal complicate connections for pedestrians. The existing stairs from Alaskan Way up to the existing terminal, just north of Marion Street, are too narrow for current pedestrian demand. North of the Marion Street exit lanes, there is no pedestrian access at the terminal building level that is compliant with the Americans with Disabilities Act (ADA). The existing ramp from the second level of the main terminal building to Alaskan Way does not meet ADA standards. However, WSF does provide elevators to the terminal from the street level.

As a result of these inadequacies, all passengers with disabilities, luggage, or baby strollers who wish to travel north along Alaskan Way must first use the existing elevators or interior building ramp to reach Alaskan Way They are then required to queue at the Marion Street crosswalks during offloading until the traffic signal indicates they are able to cross, increasing the potential for pedestrian-vehicular conflicts compared to those passengers that are able to use the existing stairs to cross over the Marion Street egress. During times when there is no offloading at Marion, pedestrians can usually cross with no conflicts.

What is a "sharrow"?

Shared lane pavement markings (or "sharrows") are bicycle symbols carefully places to guide bicyclists to the best place to ride on the road, avoid car doors, and remind drivers to share the road with cyclists.

Unlike bicycle lanes, sharrows do not designate a particular part of the street for the exclusive use of bicyclists. They are simply a marking to guide bicyclists to the best place to ride and help motorists expect to see and share the lane with bicyclists.

Source: City of Seattle Department of Transportation, *Bicycle Program: Sharrows, web*

Bicycle

Major bicycle facilities along the waterfront include the Elliott Bay Trail, which extends from the stadium area to Myrtle Edwards Park. On-street bicycle facilities are not presently provided on Alaskan Way, although cyclists ride either in the street or on the Elliott Bay Trail. Bicycles are welcome on the Washington State Ferries and the ferries operated by King County.

Bicycle enter Colman Dock via the main entrance at at Yesler Way. There are sharrows on the lane leading to the northern tollbooth at the Yesler Way entrance. A marked bicycle lane exists under the current terminal but there is no marked bicycle lane between the toll booth and this holding lane. A bicycle lane for bicycles exiting ferries is located on the south side of Colman Dock with access to Yesler Way.

Parking

Changes to public parking from ongoing construction of the AWVRP have been incorporated into the 2015 conditions. Public parking available during the 2015 condition coincides with the parking available during Stage 6 of the AWVRP construction schedule, from approximately July 2014 to April 2015. In 2015 there will be no on-street parking available along Alaskan Way within the project area. Short-term metered on-street parking is available underneath the existing Alaskan Way Viaduct, north of S. King Street.

Event Traffic

Similar to conditions today, traffic levels near the stadiums are expected to intensify before and after events at Safeco Field, Century Link Field for 2015 conditions. Typical travel patterns would change as patrons search for parking, and pedestrian activity increases. As a result, local traffic conditions would be much more congested before and after events compared to typical, non-event conditions. Current estimates that indicate that between 15,000 and 20,000 additional vehicles, beyond background traffic levels, enter and exit the stadium area for a typical Seahawks game. This increase would carry over to the 2015 conditions.

Explicit detour routing and comprehensive traffic control measures would likely continue to be used on First Avenue S. and critical east-west arterials (e.g., S. Royal Brougham Way and S. Atlantic Street) for large events at Safeco Field and Century Link Field such as Seahawks and Mariners games and Sounders matches. These measures commonly include police-based traffic management commissioned and funded by the stadiums and required by the City for approval of the stadiums' traffic management plan.

Potential Effects of the Project

To gauge potential effects to the transportation system and evaluate transportation performance, Colman Dock, Alaskan Way, and related transportation systems were analyzed with and without the proposed project under year 2020 conditions.

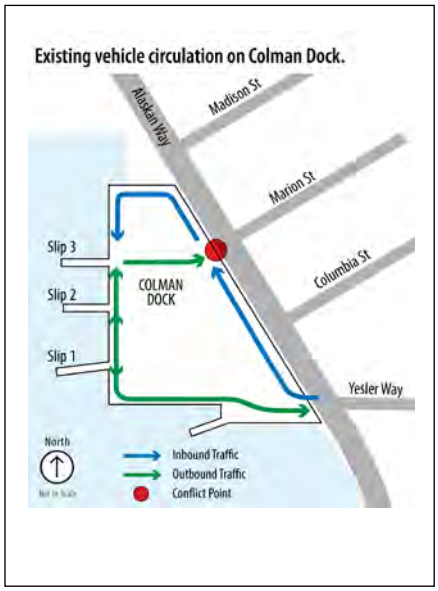
How would operation of the project affect transportation?

Ferry service and operation following construction

Ferry service provided by WSF is expected to remain unchanged from existing conditions. The number of routes, type of vessel, and frequency of service are all expected to be the same between the Build Alternative and the No Build Alternative.

Under the No Build Alternative and existing conditions, terminal crews often cannot off-load the vessels fast enough to meet the sailing schedule because of conflicts between vehicular traffic bound for the holding area north of Marion Street and vehicular traffic exiting the dock via Marion Street. To improve the safety and operational efficiency of Colman Dock, the Build Alternative would relocate the vehicle holding area north of the Marion Street exit to the new south portion of the terminal, thereby eliminating the existing vehicle conflict point near the Marion Street exit. This change on dock requires the passenger-only ferry service located at Pier 50 to be relocated from its current location in the southeast corner of the trestle to a new location in the southwest corner of the trestle.

In WSF's 2030 long-range plan, a vehicle reservation system is identified as a primary demand management strategy. One of the benefits of the reservation system is to reduce or eliminate traffic congestion on roads leading to the terminal. The WSF plans to expand its reservation-based system to include central Puget Sound routes during the 2015-2017 biennium. However, for the sake of this analysis,



a conservative approach was used and no reduction in traffic or congestion was assumed.

How would traffic operations change?

Traffic volumes between the No Build and Build Alternatives are expected to be the same, as no changes in ferry service is proposed as part of the project. However, if the project is not constructed, it is likely that storage capacity under the No Build Alternative would be reduced on the existing dock over time because of safety concerns. Therefore, the queues shown in the resulting analysis would be longer under the No Build Alternative, compared to the Build Alternative.

Exhibit 9 illustrates the forecasted 2020 PM peak-hour turning movements at study-area intersections. Intersection operation analyses were performed for the PM peak-hour conditions for 2020. As there are no changes in traffic volumes or channelization along Alaskan Way proposed as part of the project, traffic operation results for 2020 are expected to be the same for the No Build and Build Alternatives.

Level of Service

Exhibit 8 presents traffic operations for study area intersections in the 2020 PM peak hour for the No Build and Build Alternatives. Level of service for both the No Build and Build Alternative is expected to be the same. All intersections in the study area except for Alaskan Way at Madison Street are expected to operate at LOS D or better during the 2020 PM peak hour.

Exhibit 8. PM Peak Hour Level of Service—2020 Conditions

Street	Cross Street	2020 No Build and Build Alternatives	
		LOS	Avg. Delay
Alaskan Way S.	S. Jackson St	D	50
Alaskan Way S.	S. Main St	A	10
Alaskan Way S.	S. Washington St	A	8
Alaskan Way S.	Yesler Way	C	21
Alaskan Way	Columbia St	B	15
Alaskan Way	Marion St	B	19
Alaskan Way	Madison St	F	149

LOS = level of service; Avg Delay = average delay per vehicle in seconds

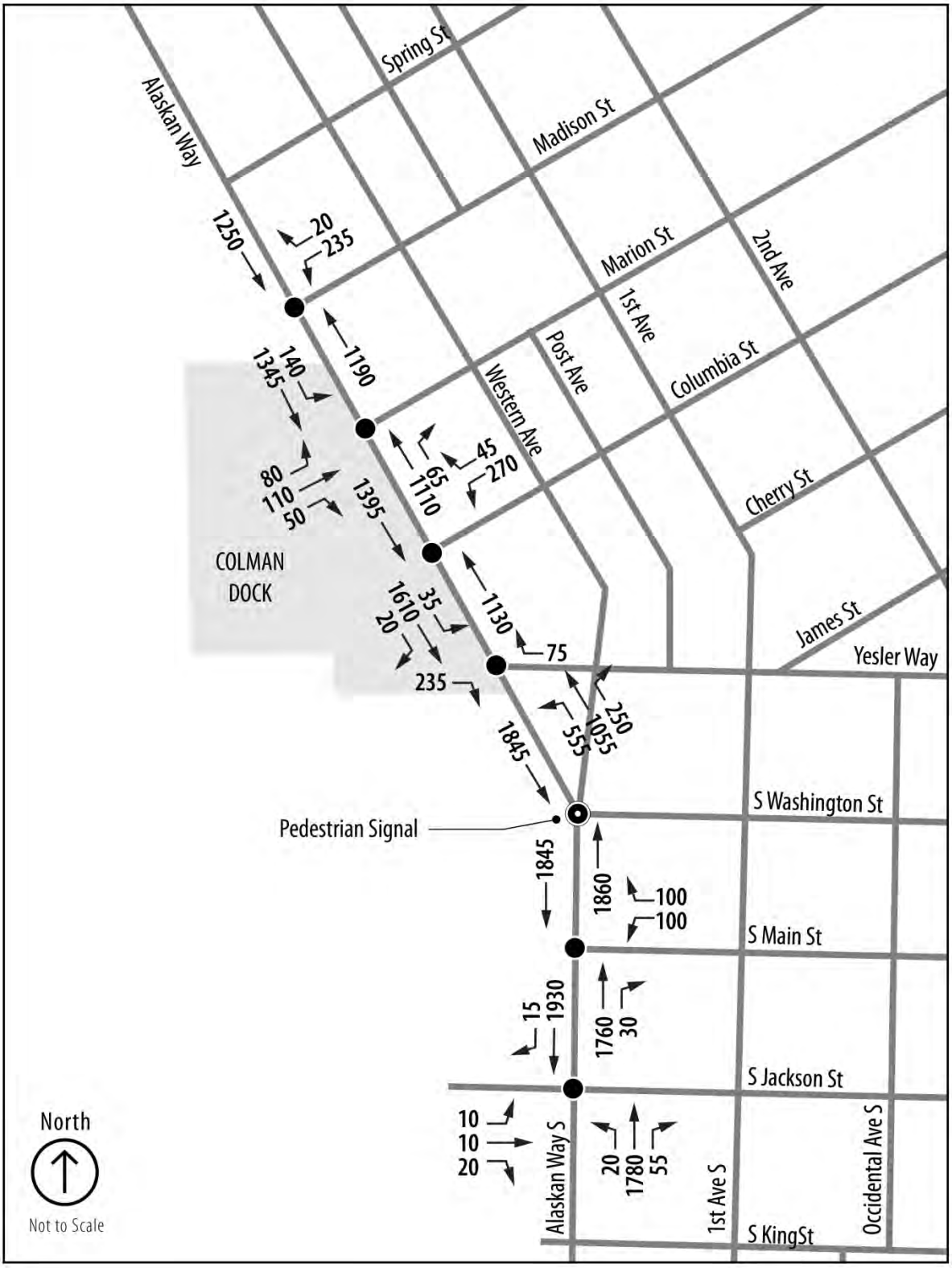


Exhibit 9
2020 Future Conditions PM Peak Hour Volumes

The intersection of Alaskan Way at Madison Street is anticipated to operate at a LOS F with high delay. The delay is caused by spill-back from the intersection of Alaskan Way at Marion Street in the southbound direction. Vehicles traveling southbound along Alaskan Way that turn left onto Marion Street will not have a separate turn-pocket and will block the heavy through volume while waiting for a gap to turn left. This spill-back extends to Madison Street and prohibits both the southbound and westbound left-turn movements at Madison Street from proceeding south, resulting in high delay at Alaskan Way at Madison Street.

Exhibit 10. Average PM Peak Hour Queues—2020 Conditions

Street	Cross Street	Direction	Distance to Next Intersection[1]	2020 No Build & Build Average Queue (ft)[2]
Alaskan Way S.	S. Jackson St	NB through	~ 330 feet	930
Alaskan Way S.	S. Main St	NB through	~ 250 feet	90
Alaskan Way S.	S. Washington St	NB through	~ 200 feet	115
Alaskan Way S.	Yesler Way	NB through NB left SB through	~ 250 feet	90 120 75
Alaskan Way	Columbia St	SB through	~175 feet	70
Alaskan Way	Marion St	SB through	~200 feet	180
Alaskan Way	Madison St	SB through	~225 feet	1310

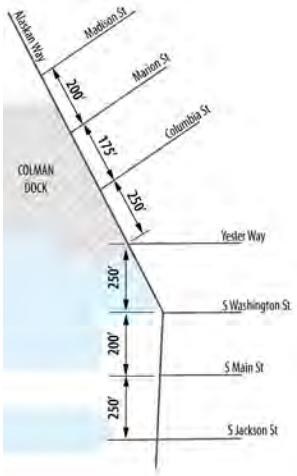
1. Distance measured from the stop bar back to the upstream intersection

Queues

Exhibit 10 illustrates the average queue length expected at study area intersections in the 2020 PM peak hour for the No Build and Build Alternatives. The average vehicle queue is measured from the stop bar back to the next intersection upstream. As shown in Exhibit 10, queues at most of the study area intersections during the PM peak hour are not expected to extend through upstream intersections and therefore possibly impact upstream intersection operations.

However, the average PM peak hour queue lengths at both S. Jackson Street in the northbound direction and Madison Street in the southbound direction are expected to spill back through the adjacent intersections of S. King Street and Spring Street, respectively. Queues under the No Build and Build alternatives are expected to be the same. VISSIM simulation reports queue lengths back to the nearest intersection, however queues may extend beyond. The analysis shows

What is the distance available for queuing between intersections?



that these queues result from delays at adjacent intersections, because the on-dock ferry holding lanes should accommodate the typical weekday peak-hour vehicle volume. Vehicles entering Colman Dock from northbound Alaskan Way must wait for a signal to turn left. This, not queuing in the Colman Dock loading area, creates a queue at S. Jackson St.

Similarly, in the southbound direction, the queues along southbound Alaskan Way at Madison Street are caused by delay from Marion Street, as described under the level of service discussion above. Average queues at all other intersections in the study area are not expected to extend to adjacent intersections.

Under the No Build Alternative, portions of the terminal may over time face weight restrictions for safety reasons, and possible closure, because of structural deficiencies. This would reduce vehicle holding capacity on Colman Dock, resulting in longer queues along Alaskan Way during the No Build Alternative.

Changes to transit facilities and connections

What surface transit services are assumed in the future?

The WSF Long Range Plan identified surface transit enhancements as an environmentally and fiscally responsible way to accommodate growth in vehicle ridership, optimize vehicle capacity, and reduce environmental effects. The Long Range Plan suggests that WSF would have the ability to accommodate a significant growth in ridership with existing facilities if more customers chose to travel as walk-on passengers. However, inadequate bus loading and layover facilities currently limit connections and likely discourage some passengers from relying on transit. Providing sufficient transit-supportive facilities and services would encourage a shift in travel modes from vehicles to walk-ons. To address this issue, WSF requested funding for a number of surface transit enhancements at terminals in the system. However, the 2009 Legislature deferred capital investments in transit-supportive facilities outside of the 16-year financial period, or until it is clear that local transit service is available and that walk-on ridership is increasing.

King County Metro has no current plans to increase bus service to Colman Dock in the future. Therefore, bus service to Colman Dock is expected to remain the same as existing conditions for both the No Build and Build Alternatives.

How would the project affect surface transit operations?

The Build Alternative would improve access and connections between the ferry terminal and buses, improve pedestrian and ADA access, add a new elevator, and provide for coordination with King County Metro on any future changes in Metro's bus service.

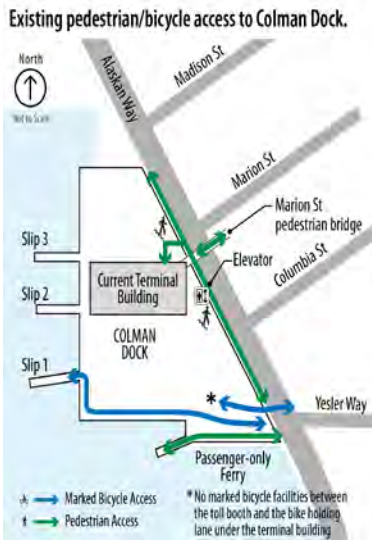
How would freight connections change?

Freight connections are expected to be the same for the No Build and Build Alternatives. The Build Alternative would continue to accommodate freight vehicles at the ingress/egress points at Marion Street and Yesler Way, as well as on the dock in the ferry holding lanes.

How would pedestrian facilities and connections change?

The Seattle Multimodal Terminal serves 68 percent of the entire WSF system's foot passengers (4.2 million passengers at Colman Dock in 2010). The WSF Long-Range Plan forecasts walk-on ridership to grow by 31 percent on the Bainbridge Island route and 20 percent on the Bremerton route by 2030.

The existing pedestrian inefficiencies would become even more apparent, and potentially unsafe, under the No Build Alternative. It is expected that some pedestrians (such as disabled passengers, those with luggage or with strollers) would continue to cross at-grade at the Marion Street exit because of inefficiencies in pedestrian access.



What are the new, proposed pedestrian facilities and their expected impacts?

As part of the Build Alternative, a new elevator would be constructed north of the Marion Street exit on Alaskan Way to improve pedestrian safety and reduce potential conflicts between pedestrians and vehicles. Wider stairs designed to meet future pedestrian demand would be adjacent to the new elevator, and both the elevator and stairs would connect to the new terminal with a new elevated walkway, replacing the existing pedestrian overpass. All pedestrian facilities will be designed to current codes and regulations, including the American with Disabilities Act (ADA).

In addition, improvements made to the pedestrian bridge over the Marion Street exit would likely increase the volume of pedestrians who use the bridge and reduce pedestrian volumes crossing the Marion Street exit at Alaskan Way.

Improvements will also be made to passenger-only ferry facility as part of the Build Alternative. In addition to an at-grade connection to Alaskan Way, the new facility will be connected to the future terminal building and the Marion Street pedestrian bridge by an overhead walkway in order to reduce the potential for pedestrian and vehicle conflict.

How would bicycle access change?

Under the Build Alternative a bicycle entry gate just north of Yesler will be operational. This will be the only entry point for bicycles and will help separate bicycle traffic from vehicular traffic. A permanent bicycle holding lane will be designated from the Bainbridge ferry, allowing bicycles a consistent place to load from that is separate from vehicular traffic. Existing bicycle lanes will be striped to both the Yesler and Marion exits. The bicycle storage area will be replaced near the stairs/elevator.

How would public parking change?

The Build Alternative is not expected to have an effect on public parking in the project area.

How would the project affect safety?

The Build Alternative is expected to improve pedestrian safety and reduce potential conflicts between pedestrians and vehicles, as described in the pedestrian section above. Safety under the Build Alternative will also be improved by eliminating the existing on-dock conflict point that currently exists between traffic offloading at Marion Street and traffic entering the holding lanes north of Marion.

Replacement of the timber structures at Colman Dock would enable WSF to provide the same access and vehicular holding capacity as today. Under the No Build Alternative, portions of the terminal may over time face weight restrictions for safety reasons, and possible closure, because of structural deficiencies.

How would traffic management during events change?

By the year 2020, sporting and other major events at Safeco Field, Century Link Field and the proposed Seattle Arena would likely continue to draw large crowds and result in high concentrations of traffic movements into and out of the stadium area before and after events. Vehicular and pedestrian-related congestion associated with such events would be managed in a manner similar to current practices in terms of detours, traffic control, and turning movement restrictions.

How would construction of the project temporarily affect transportation?

This section describes the major issues pertaining to construction activities and what actions should be taken to manage those issues and minimize their impact.

Because of the dynamic nature of construction activities, the transportation effects would vary according to the construction stage. All of the construction phases are described qualitatively in the following sections. The most disruptive construction stage to transportation (i.e., substantial sustained effects) would occur in Phase 4, which was analyzed quantitatively with the VISSIM model.

There would be no construction activities under the No Build Alternative; therefore, the following sections describe the construction-related impacts of the Build Alternative only.

What is the proposed construction approach?

The Build Alternative would require approximately 72 months to construct, which can be divided into four construction phases. The following sections describe the current planning for a likely construction sequence for elements of the Build Alternative, along with approximate construction durations. Some activities of Phases 3 and 4 are expected to overlap.

Phase 1

Phase 1 would last approximately 12 months. During Phase 1, construction of the western section of the new south trestle and rebuilding of Slip 3 would occur. A temporary platform for passenger-

only ferry service would be constructed on the south side of the trestle, followed by removal of the existing passenger-only ferry slip and construction of the permanent passenger-only ferry location on the southwest side of the dock. To maximize vehicle holding on the trestle, existing employee parking would be converted into vehicle holding and relocated to Pier 48. With the conversion of employee parking, vehicle holding would be slightly higher than the holding assumed for existing conditions.

Exhibit 11 compares transportation elements of Phase 1, as well as the other phases of construction, to existing conditions and the Build Alternative. There is some overlap of construction phases so the total construction duration is less than the addition of the 4 phases.

Exhibit 11. Construction Activities and Approximate Durations by Phase

Phase	Vehicle Holding	Pedestrian Entrances	Exit Lanes	Slips Available	Duration of Construction Phase
Existing Conditions	596	5	Marion St = 2 Yesler Way = 2	1, 2, 3	N/A
Phase 1	636	5	Marion St = 2 Yesler Way = 2	1, 2	12 months
Phase 2	542	5	Marion St = 2 Yesler Way = 2	2, 3	28 months
Phase 3	569	3	Marion St = 2 Yesler Way = 2	1, 3	24 months
Phase 4	498	3	Marion St = 2 Yesler Way = 2	1, 2	25 months
Full Buildout	611	4	Marion St = 2 Yesler Way = 2	1, 2, 3	N/A

Phase 2

Phase 2 would last approximately 28 months. The Slip 1 walkway would be removed, as well as a portion of the south trestle underneath what will be the new terminal building. The new permanent passenger-only ferry slip would be in use and an elevated pedestrian walkway extending from the new terminal toward the passenger-only slip would be constructed. During construction phases 1 and 2, the terminal would operate primarily out of Slips 1 and 2.

Phase 3

Phase 3 would last approximately 24 months. The entire existing terminal building would be demolished, and reconstruction of the trestle would occur. . The trestle beneath the terminal building will be reconstructed but the timber trestle north of the terminal building will remain and would be used for active holding to Slip 3. Onsite vehicular traffic would be maintained with temporary bridges as needed. Temporary pedestrian bridges from the new terminal building to the Marion Street overpass and to Slip 3 would be constructed. The Slip 2 transfer span/overhead loading would be removed during the beginning of Phase 3 and reinstalled at the end. Vehicle holding on the dock would begin to use the new south trestle and would accommodate fewer vehicles than under 2015 conditions.

Phase 4

Phase 4 construction would likely have the biggest impact on transportation elements. This phase is expected to last approximately 25 months. Demolition activities would continue, with the remaining portions of the north existing timber trestle being removed. Reconstruction would occur for the new trestle and terminal building, along with new pedestrian connections. As a result of the loss of the north trestle, vehicle holding would be 498 vehicles, which is approximately 98 vehicles less than 2020 No Build and 2020 Build conditions.

What transportation disruptions are expected during the most disruptive construction phase (Phase 4)?

Ferry Service

Ferry service would not change during construction compared to existing conditions. The same number of routes, at the same frequencies, would be provided.

Level of Service

Traffic operations during construction Phase 4 at signalized intersections in the study area were assessed to determine intersection LOS and average vehicle delay. The analysis assumes that the SR 99 bored tunnel is tolled so any anticipated diversion from tolling is included in this analysis. Exhibit 12 presents traffic operations for study area intersections for the 2020 PM peak hour construction

conditions. The operations at intersections to the south of the ferry terminal are anticipated to degrade from the 2020 No Build and Build Alternatives because of the reduced vehicle holding capacity on Colman Dock during Phase 4 construction.

During Phase 4 construction, there will not be adequate vehicle storage available on Colman Dock for the forecasted vehicle demand and therefore vehicles are expected to spill back onto Alaskan Way and cause delay to the study intersections. All intersections in the study area except for Alaskan Way S. at Jackson Street and Alaskan Way at Madison Street are expected to operate at LOS D or better during the 2020 PM peak hour. The intersections of Alaskan Way S. at Jackson Street and Alaskan Way at Madison Street are anticipated to operate at LOS E and F, respectively, with high delay. The delay at Alaskan Way S and Jackson Street is caused by spill-back from vehicles making a northbound left-turn at Yesler Way onto Colman Dock and these vehicles spilling back onto Alaskan Way S. The delay at Alaskan Way and Madison Street is caused by spill-back from the intersection of Alaskan Way at Marion Street in the southbound direction.

Exhibit 12. PM Peak Hour Level of Service—2020 Construction Conditions

Street	Cross Street	2020 Construction	
		LOS	Avg. Delay
Alaskan Way S.	S. Jackson St	E	71
Alaskan Way S.	S. Main St	B	12
Alaskan Way S.	S. Washington St	A	10
Alaskan Way S.	Yesler Way	C	23
Alaskan Way	Columbia St	B	17
Alaskan Way	Marion St	B	20
Alaskan Way	Madison St	F	156

LOS = level of service; Avg Delay = average delay per vehicle in seconds

Queues

In 2020, there is no planned off-site ferry holding. Therefore, any vehicles that cannot queue directly on Colman Dock would have to queue along Alaskan Way. Exhibit 13 illustrates the predicted average queue lengths along Alaskan Way. To capture queues that may be related to Colman Dock, northbound queues are reported for

intersections from Yesler Way south, and southbound queues are reported for intersections north of Yesler Way.

Average PM peak hour analysis shows that average PM peak hour queues during Phase 4 construction in the southbound direction, are expected to spill back to Madison Street, similar to 2020 Build conditions. However, the queues in the northbound direction are expected to exceed the queue lengths that are anticipated under 2020 Build conditions due to spill back from Colman Dock queuing on Alaskan Way.

Exhibit 13. Average PM Peak Hour Queues—2020 Construction Conditions

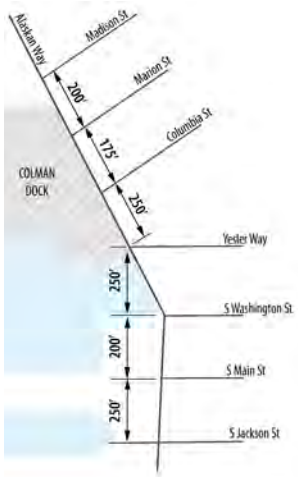
Street	Cross Street	Direction	Distance to Next Intersection[1]	2020 Construction
				Average Queue (feet)
Alaskan Way S.	S. Jackson St	NB through	~330 feet	1150
Alaskan Way S.	S. Main St	NB through	~ 250 feet	120
Alaskan Way S.	S. Washington St	NB through	~ 200 feet	140
Alaskan Way S.	Yesler Way	NB through NB left SB through	~ 250 feet	100 150 75
Alaskan Way.	Columbia St	SB through	~175 feet	75
Alaskan Way	Marion St	SB through	~200 feet	190
Alaskan Way	Madison St	SB through	~225 feet	1300

1. Distance measured from the stop bar back to the upstream intersection

VISSIM simulation shows spill-back at both Madison Street and S. Jackson Street that extends beyond the adjacent intersections; however, these queues are caused by delay at adjacent intersections. In the northbound direction, modeling showed queues along Alaskan Way from the left turn at Alaskan Way to Yesler Way for vehicles entering Colman Dock.

A large volume of traffic makes this left turn during the PM peak hour from a single left-turn lane. This spill-back is caused by a combination of the signal delay to turn left and queue spill-back from the ferry terminal. The on-dock ferry holding lanes are not expected to accommodate the typical weekday peak hour volume of traffic during construction.

What is the distance available for queuing between intersections?



In the southbound direction, the queues during construction along southbound Alaskan Way at Madison Street are caused by delay from Marion Street, as described under the level of service discussion above. Other study area intersections are not likely to have spill-back during a typical weekday peak hour.

Mitigation strategies for the expected increase in queues are discussed in a following section on Mitigation measures.

Transit

Access and connections between ferry service and transit service would be maintained through all phases of construction. WSF would coordinate with regional transit providers and the City regarding construction activities that might impact transit stops. Where transit stops must be relocated, the relocated stops will maintain access similar to 2015 conditions.

Freight

Truck circulation would be affected similarly to regular (non-truck) traffic along Alaskan Way with possible increased delays and queues at intersections along Alaskan Way. Freight access on Colman Dock is expected to be accommodated during construction.

Pedestrians and Bicycles

During Phase 4, pedestrian entrances would be provided at stairs, escalator and an elevator along Alaskan Way, as well as the overhead pedestrian bridge that crosses Marion Street. In addition to the new walkway from Alaskan Way to the passenger-only facility that will open during Phase 2, during Phase 4 the overhead walkway from the new terminal building to the passenger-only terminal will be in place and open for use. Pedestrian loading of vessels is expected to remain similar to 2015 conditions, with passengers accessing vessels via overhead loading.

Bicycles would continue to access the tollbooth via the travel lane marked with sharrows. The existing bicycle lane on the south side of Colman Dock will be maintained during construction.

Parking

To maximize vehicle holding on the trestle, employee parking would be converted into vehicle holding during construction. Employee parking would be relocated to Pier 48.

Event Traffic

Based on existing Safeco Field patronage counts, up to 47,000 attendees can be expected for a full-house baseball event, which may translate to roughly 14,000 additional vehicles on local arterials and regional facilities. Seahawks games, although typically held on Sundays, draw even larger crowds and result in greater levels of traffic demand. While a portion of the patrons for both types of events travel via ferry or public transit (5,000 to 7,000 persons), with some growth in these modes projected in the future, the majority of these event-goers are likely to continue to travel via private vehicle and/or carpool.

Construction activity on Colman Dock would include reduced vehicle capacity on Colman Dock, resulting in longer queues and wait times during large events when demand increases. The need for general traffic management for all transportation modes before and after events would continue throughout the construction period.

What transportation disruptions are expected during other construction phases (Phases 1 – 3)?

Ferry Service

Ferry service would not change during construction compared to existing conditions. The same number of routes, at the same frequencies, would be provided.

Traffic Operations

During Phase 1 of construction, the vehicle holding on the trestle would be slightly higher than existing capacity as a result of removing on dock employee parking. Therefore, LOS, delay, and queues at study area intersections during Phase 1 would be similar to the 2015 conditions.

During Phases 2 and 3, vehicle holding capacity on the trestle would decrease by 54 and 26 cars, respectively, relative to 2015 conditions. This would likely cause additional delays on peak days of travel, decreased LOS, and longer queues along Alaskan Way compared to the 2015 conditions. However, overall typical weekday traffic operations under Phases 2 and 3 are expected to be similar to existing conditions during a typical weekday.

Transit

Access and connections between ferry service and transit service would be maintained through all phases of construction. WSF would coordinate with regional transit providers and the City regarding construction activities that might impact transit stops. If transit stops must be temporarily relocated, it will be important to keep relocated bus stops as close to their existing location to allow passengers with special needs, such as the elderly and disable passengers, similar access to 2015 conditions.

Freight

Truck circulation would be affected similarly to regular (non-truck) traffic along Alaskan Way, with possible increased delays and queues at intersections along Alaskan Way. Freight access on Colman Dock is expected to be accommodated during construction.

Pedestrians and Bicycles

Pedestrian access during Phase 1 would be similar to 2015 conditions with four access points on Alaskan Way as well as the Marion Street pedestrian bridge.

Phase 2 would include construction of the new elevated walkway from the passenger-only ferry to the terminal building. This elevated walkway may not open for use until Phase 4. During Phase 3, pedestrian access would include stairs and the temporary elevator on Alaskan Way, and the Marion Street pedestrian bridge.

During Phase 1 access to the passenger-only facility will be provided via at-grade access from Alaskan Way to the temporary passenger-only ferry platform. Under Phase 2 the new walkway from Alaskan Way to the passenger-only facility will open. Pedestrian loading of vessels is expected to remain similar to 2015 conditions, with passengers accessing vessels via overhead loading.

Bicycles would continue to access the tollbooth via the travel lane marked with sharrows. The existing bicycle lane on the south side of Colman Dock will be maintained during construction.

Parking

To maximize vehicle holding on the trestle, employee parking would be converted into vehicle holding during construction. Employee parking would be relocated to Pier 48 during construction.

Event Traffic

The need for general traffic management for all transportation modes before and after events would continue throughout the construction period.

What is the proposed mitigation for the most disruptive construction phase (phase 4)?

Analysis of traffic operations during construction showed that impacts to the surrounding transportation system are expected under the most disruptive construction phase, Phase 4. Proposed mitigation includes a holding lane management strategy that will increase the on-dock vehicle holding capacity. This strategy will include management of the queue lanes on the dock to maximize the number of holding lanes as well as active lane management with on-site attendants that will guide vehicles onto the dock to reduce the space between parked vehicles. Based on similar strategies that have been implemented during other major construction projects like the AWVRP, it is expected that the proposed mitigation for this project will increase the vehicle holding capacity during Phase 4 construction from 498 to 584 vehicles, similar to existing conditions. These mitigation measures will have an effect on the intersection level of service and intersection queues as shown below. The other modes of traffic are not anticipated to change as a result of the mitigation.

Level of Service

Exhibit 14 presents traffic operations for study area intersections for the 2020 PM peak hour construction with mitigation conditions. Intersection LOS and delay were evaluated to confirm that the proposed mitigation scenario shows operations similar to 2020 No Build and Build alternatives. All intersections in the study area except for Alaskan Way at Madison Street are expected to operate at LOS D or better during the 2020 Phase 4 PM peak hour. The intersection of Alaskan Way at Madison Street is anticipated to operate at LOS F with high delay. The delay at Alaskan Way and Madison Street is caused by spill-back from the intersection of Alaskan Way at Marion Street in the southbound direction and is actually slightly higher with mitigation. Even with the slight increase in delay at one intersection, the overall traffic operations are anticipated to improve with mitigation. The increased delay at Alaskan Way and Madison Street is increased delay for southbound left-turns at this intersection. This is a directresult of improved operations to intersections further south, specifically Yesler

Street, allowing more vehicle throughput to travel northbound through the Marion and Madison Street intersections, causing great delays for vehicles waiting to turn left and head up the hill into the city center. .

Exhibit 14. PM Peak Hour Level of Service—2020 Construction with Mitigation Conditions

Street	Cross Street	2020 Construction with Mitigation		Change in Delay with Mitigation (sec)
		LOS	Avg. Delay	
Alaskan Way S.	S. Jackson St	D	51	-20
Alaskan Way S.	S. Main St	B	10	-2
Alaskan Way S.	S. Washington St	A	8	-2
Alaskan Way S.	Yesler Way	C	22	-1
Alaskan Way	Columbia St	B	17	-3
Alaskan Way	Marion St	B	20	-0
Alaskan Way	Madison St	F	166	+10

LOS = level of service; Avg Delay = average delay per vehicle in seconds

Queues

Exhibit 15 illustrates the predicted average queue lengths along Alaskan Way. To capture queues that may be related to Colman Dock, northbound queues are reported for intersections from Yesler Way south, and southbound queues are reported for intersections north of Yesler Way.

Similar to the 2020 No Build and Build Alternatives, average peak hour queue lengths during construction at both S. Jackson Street in the northbound direction and Madison Street in the southbound direction are expected to spill back to the adjacent intersections of S. King Street and Spring Street, respectively, and possibly beyond. Analysis shows that average PM peak hour queues during Phase 4 construction with mitigation are expected to be very similar to 2020 Build conditions.

Exhibit 15. Average PM Peak Hour Queues—2020 Construction with Mitigation Conditions

Street	Cross Street	Direction	Distance to Next Intersection[1]	2020 Construction with Mitigation	Change in Queue with Mitigation
				Average Queue (feet)	Average Queue (feet)
Alaskan Way S.	S. Jackson St	NB through	~ 330 feet	930	-220
Alaskan Way S.	S. Main St	NB through	~ 250 feet	90	-30
Alaskan Way S.	S. Washington St	NB through	~ 200 feet	115	-5
Alaskan Way S.	Yesler Way	NB through NB left SB through	~ 250 feet	90 120 75	-10 -30 -0
Alaskan Way.	Columbia St	SB through	~175 feet	70	-5
Alaskan Way	Marion St	SB through	~200 feet	185	-5
Alaskan Way	Madison St	SB through	~225 feet	1325	+25

1. Distance measured from the stop bar back to the upstream intersection

How will transportation disruptions be mitigated during other construction phases (Phases 1 – 3) and during peak travel days?

Impacts to the surrounding transportation system are not expected under phases 1, 2 and 3. However, as typical for an EA, this assumed the typical weekday PM peak hour volumes. It is recognized that there are days throughout the year during which higher volumes may occur and mitigation may be needed.

To help minimize potential traffic effects during special events as well as days with the highest demand at Colman Dock, WSF would develop a construction traffic management plan that would include the following:

- Continue ongoing coordination with the Alaskan Way Viaduct Replacement Project and the Elliott Bay Seawall Project to ensure that detour plans developed as part of these projects are consistent with other construction activities and provide adequate access to Colman Dock.

- In coordination with the Elliott Bay Seawall Project, develop strategies for the use of Alaskan Way to improve traffic operations during construction that can accommodate ferry-queuing during special events.
- Coordinate with the Alaskan Way Viaduct Replacement Project and the Elliott Bay Seawall Project to create a signing and wayfinding strategy to help travelers access Colman Dock that is consistent with other construction activities.
- Update the management plan developed as part of the Alaskan Way Viaduct Replacement Project to increase on-dock vehicle storage to help reduce queuing on Alaskan Way.
- Identify and incorporate the needs of and impacts on pedestrian and bicycle flow, including mitigation for sidewalk closures and requirements related to the ADA.
- Implement efforts to ensure the safety of non-motorized travelers during construction. These efforts may include protected pathways, signage, maintaining existing sidewalks, or pathway connections.
- Provide for incident and emergency response.
- Develop methods and frequency of inspection and maintenance of all traffic control throughout the project area.
- Identify contact methods and the personnel available to make decisions and ensure that issues are addressed in a timely and appropriate manner, as well as response times for any conditions requiring attention and response 24 hours a day.
- Develop procedures for incorporating the needs and impacts of event traffic, including coordination with Seattle Center, Safeco Field, and Century Link Field.
- Develop procedures for communicating project issues to public information personnel and the public.

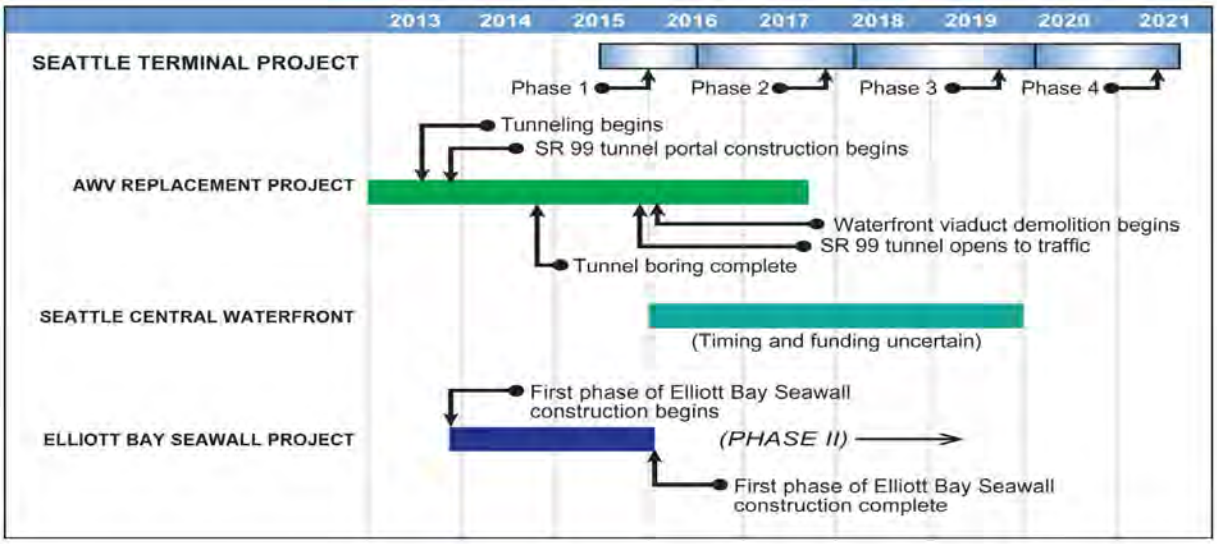
What are the cumulative impacts of the project?

Cumulative impacts are effects on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. An evaluation of cumulative effects provides an understanding of the project in terms of the "big picture."

What are the operational cumulative effects?

The cumulative effects evaluation assesses future conditions after project completion, including other future projects that may affect transportation by the time the Seattle Multimodal Terminal Project is completed. Construction schedules and completion dates for the major projects near Colman Dock are shown in Exhibit 16 below. The new transportation system components anticipated to be in operation include the following:

Exhibit 16. Proposed project construction schedules and completion dates



- Alaskan Way Surface Street Improvements—The City of Seattle is planning improvements to Alaskan Way as part of the Central Waterfront Project. The preliminary timeline for improvements associated with the redevelopment of the central waterfront is during the 2016-2018 timeframe. However, the plan is very preliminary as of this writing, designs are conceptual, and no funding for construction projects has been

committed. Therefore, this analysis assumed the central waterfront improvements to Alaskan Way would not be in place by 2020.

- Alaskan Way Viaduct Replacement Project— This WSDOT program is comprised of several projects in downtown Seattle. This program includes replacing SR 99 between S. Royal Brougham Way and Roy Street with a bored tunnel.
- Elliott/Western Connector—This WSDOT project would connect Pike Street to Battery Street with a grade-separated crossing of the Burlington Northern Santa Fe mainline railroad tracks. It also includes bicycle and pedestrian facilities.
- Mercer West Project—This City of Seattle project extends from Fifth Avenue N. to Elliott Avenue. Mercer Street will be restriped and signalized between Fifth Avenue N. and Second Ave W. to create a two-way street with two lanes in each direction and left-turn pockets. The project will also restripe and resignalize intersections to convert Roy Street to two-way operations from Fifth Avenue N. to Queen Anne Avenue N.
- Elliott Bay Seawall Project—This City of Seattle project will replace the 8,000-foot-long seawall along Seattle's waterfront to protect the shoreline along Elliott Bay, including Alaskan Way from S. Washington Street to Bay Street.
- Alaskan Way Promenade/Public Space—This City of Seattle project is located west of the new Alaskan Way surface street between S. King Street and Pike Street. Between Marion and Pike Streets the promenade will be approximately 70 to 80 feet wide. Access to piers will be via service driveways. Other potential open spaces include a triangular space north of Pike Street and east of Alaskan Way, as well as parcels created by the removal of the Alaskan Way Viaduct between Lenora and Battery Streets.
- Center City Connector Transit Study— This City of Seattle planning effort is evaluating potential downtown streetcar alignments to connect the First Hill and South Lake Union streetcar lines.
- Puget Sound Regional Council Four-County Assumptions—These travel demand model assumptions include PSRC

growth/land use assumptions and regional transit and highway/roadway improvements. This information is based on the current Metropolitan Transportation Plan (Destination 2030) (as adopted).

- Transit Agency Six-Year Plans—Other regional capital projects include park-and-ride expansions, direct access facilities, in-line stop facilities, high-occupancy vehicle lane construction, and other operational roadway improvements.
- King County Metro RapidRide Corridors—Includes RapidRide services that provide high-frequency service and bus priority improvements to highly traveled routes within King County Metro's service area.

The Seattle Multimodal Terminal Project's long-term cumulative effects on transportation are limited. The project would not generate traffic and would improve operating conditions compared with leaving the existing facility in place. If the project were not constructed, it is likely that storage capacity would be reduced on the existing dock over time because of safety concerns, leading to possible spill back onto local street, increased congestion and service degradation.

What are the cumulative effects of construction?

During the project's construction phase, several other projects are expected to be under construction in the downtown area. WSF, WSDOT, and SDOT have been monitoring these projects' construction schedules and coordinating to avoid major construction conflicts and to minimize effects to traffic to the extent practicable. Construction dates are subject to change, but notable projects that are likely to have construction that would occur close to or simultaneously with the construction schedule for the Seattle Multimodal Terminal Project include the following:

- Elliott Bay Seawall Project (2013-2016)—The central portion of the seawall (Virginia Street to S. Washington Street), near Colman Dock, is scheduled to be completed in early 2016.
- Alaskan Way Viaduct Replacement Project (2011-2016)—This project is scheduled to be completed in late 2015, with demolition of the existing Alaskan Way Viaduct to occur in 2016.

- Central Waterfront Project (exact dates unknown, but likely to overlap with the Seattle Multimodal Terminal Project).

Overlapping construction schedules could have a cumulative effect on the project area. Together, these projects could intensify traffic congestion through downtown. This would cause problems for all drivers, including transit and freight. The following discussion describes the overlapping construction activities expected to coincide with the proposed construction schedule of the Seattle Multimodal Terminal Project.

Traffic Phase 1 (April 2014 – July 2016)

According to plans, construction of the Elliott Bay Seawall would be completed and the associated effects on Alaskan Way would be eliminated before demolition of the Alaskan Way Viaduct in 2016. Demolition would have some traffic impacts on the Alaskan Way. Various city streets between S. King Street and Battery Street would experience periodic street closures to facilitate viaduct demolition.

Along with affecting general-purpose traffic, the Elliott Bay Seawall construction is expected to affect freight operations along Alaskan Way. WSDOT, the City, and the Port of Seattle have been working collectively to develop construction staging plans for the Alaskan Way Viaduct Replacement Project and the Elliott Bay Seawall Project.

These staging plans include detouring traffic off Alaskan Way to a temporary road located under the Alaskan Way Viaduct for the full duration of the Elliott Bay Seawall Project. In addition to the temporary road, a minimum of two additional lanes would be provided west of the Alaskan Way Viaduct between Madison Street and Yesler Way to facilitate ingress and egress at the Colman Dock Ferry Terminal. The temporary roadway system would be a flexible network that could be modified throughout construction of the seawall along the central waterfront.

Traffic Phase 2 (August 2016 to May 2018)

During the early portion of Traffic Phase 2, construction of the Elliott Bay Seawall Project and the Alaskan Way Viaduct Replacement Project will be completed. As part of the demolition of the Alaskan Way Viaduct in mid-2016, the Marion Street pedestrian bridge replaced. WSDOT is planning on maintain access to the pedestrian bridge at all times, other than short-term off-peak closures, through viaduct demolition and Alaskan Way reconstruction.

Traffic Phase 3 (June 2018 to May 2020) and Traffic Phase 4 (June 2020 – June 2021)

During Traffic Phases 3 and 4, traffic conditions along Alaskan Way will remain unchanged. As the Seattle Multimodal Terminal Project's design and construction planning move forward, project partners and other agencies will continue to work together to minimize possible cumulative effects and coordinate construction schedules.

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Appendix E – Cultural Resources Discipline Report

FINAL

CULTURAL RESOURCES DISCIPLINE REPORT SEATTLE MULTIMODAL TERMINAL AT COLMAN DOCK PROJECT

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Executive Summary

Washington State Ferries Division (WSF) of Washington State Department of Transportation, the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA) are analyzing the impacts associated with WSF's proposal to replace the aging and seismically vulnerable components of the Seattle Multimodal Terminal at Colman Dock (SMT) (project). The proposed action includes replacing the timber portion of the dock with a new and reconfigured steel and concrete dock, replacing the vehicle transfer span and overhead loading structures for Slip 3, providing improved pedestrian connections to transit, and replacing the passenger-only ferry facility. As part of the environmental documentation for the project and to comply with Section 106 of the National Historic Preservation Act (NHPA), the FTA and FHWA, in cooperation with WSF, are required to determine if significant historic properties are located within the project's area of potential effect (APE) and to evaluate the project's effects on these properties.

ICF International (ICF) archaeologists and Gray Lane Preservation and Planning (Gray Lane) architectural historians conducted a landscape history analysis, literature review, and reconnaissance-level built environment survey of the APE. The purpose of this analysis was to identify archaeological and built environment resources within the APE, evaluate two previously unevaluated archaeological sites (45KI1012 and 45KI1013) for their potential to be eligible for listing in the National Register of Historic Places (NRHP), analyze the project's effects on such resources, and assess the potential for encountering as-yet undocumented archaeological resources. Following preparation of the draft of this report, additional field work was conducted by Environmental Science Associates (ESA) to further evaluate the eligibility of 45KI1012 and 45KI1013. The sites were subsequently determined not eligible for listing in the NRHP by FTA.

An archaeological record search and reconnaissance-level built environment survey identified eight cultural resources within or directly adjacent to the APE. Of these, one is listed in the NRHP (the Washington Street Boat Landing), two were previously determined eligible for listing in the NRHP (Fire Station No. 5 and the Elliott Bay Seawall), one is a Seattle City Landmark (Pioneer Square Historic District), and four were previously determined not eligible for listing in the NRHP. Fire Station No. 5 and the Washington Street Boat Landing would not be adversely affected by the project. Similarly, the project would not adversely affect the portions of the Elliott Bay Seawall and the Pioneer Square Historic District that are within the project area.

Review of the landscape history within the APE indicates that there is limited potential for encountering submerged or buried archaeological deposits in primary depositional context. Several factors, including the APE's location over water, repeated episodes of waterfront development, and continued, regular exposure of the location's seabed from tidal fluctuation, make it unlikely that archaeological deposits would retain integrity, as evidenced by the condition of 45KI1012 and 45KI1013.

Since it is anticipated that no adverse effects on NRHP-eligible resources would result from the project, a finding of no adverse effects to historic properties is recommended for this undertaking under Section 106 of the NHPA.

FTA, FHWA, and WSF will implement best management practices (BMPs) and monitor Fire Station No. 5 to determine actual vibratory levels and implement appropriate protective measures if vibratory levels exceed the FTA damage threshold during Phase IV of construction.

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Acronyms and Abbreviations

ACHP	Advisory Council on Historic Preservation
APE	Area of Potential Effects
CFR	Code of Federal Regulations
DAHP	Washington State Department of Archaeology and Historic Preservation
DTU	Dredge Test Unit
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
Great Northern	Great Northern Railway Company
HPI	Historic Property Inventory
I-5	Interstate 5
MOHAI	Museum of History and Industry
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
Northern Pacific	Northern Pacific Railway Company
NRHP	National Register of Historic Places
PSPD	Pioneer Square Preservation District
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
SLS&E	Seattle, Lake Shore, and Eastern Railroad
SMC	Seattle Municipal Code
SMT	Seattle Multimodal Terminal
WAC	Washington Administrative Code
WISAARD	Washington Information System for Architectural and Archaeological Records Database
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

Chapter 1
Introduction

The Washington State Ferries (WSF) Division of the Washington State Department of Transportation, the Federal Highway Administration (FHWA), and the Federal Transit Administration (FTA) are evaluating impacts associated with replacing the aging and seismically vulnerable components of the Seattle Multimodal Terminal at Colman Dock (SMT) (project). The purpose of the project is to preserve the transportation function of the aging, deteriorating, and seismically deficient facility so that it can continue providing safe and reliable service. The project would also address safety concerns related to conflicts between vehicles and pedestrian traffic, as well as operational inefficiencies. As part of the environmental documentation for the project and to comply with Section 106 of the National Historic Preservation Act (NHPA), the FTA and FHWA, in cooperation WSF, are required to determine if significant historic properties are located within the project's area of potential effect (APE) and to evaluate the project's effects on these properties.

The purpose of this cultural resources discipline report is to identify historic properties in the APE, evaluate these resources for their potential to be eligible for listing in the National Register of Historic Places (NRHP), analyze and make recommendations regarding the project's effects on NRHP-eligible resources, assess the potential for encountering as-yet undocumented archaeological resources, and offer recommendations for the resolving of potential adverse effects to historic properties.

Regulatory Framework

Section 106 of the National Historic Preservation Act

To comply with Section 106 of the NHPA, FTA and FHWA, in cooperation WSF, must consider the effects of the project on historic properties. Historic properties are defined as "any prehistoric or historic district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places maintained by the Secretary of the Interior" (36 Code of Federal Regulations [CFR] 800.16[l]1). Implementing regulations for Section 106 provide guidance on how the National Environmental Policy Act (NEPA) and Section 106 processes can be coordinated [36 CFR 800.8(a)] and set forth the manner in which the NEPA process and documentation can be used to comply with Section 106 [36 CFR 800.9(c)]. Identification of historic properties and assessment of effects of the undertaking in a manner consistent with existing NHPA regulations (36 CFR 800.4 through 36 CFR 800.5) are among the provisions. Properties qualify for listing in the NRHP if they are least 50 years old, and meet at least one of four criteria of eligibility(36 CFR 60.4):

A. Association with events that have made significant contributions to the broad patterns of our history;

B. Association with the lives of persons significant in our past;

C. Embodiment of the distinctive characteristics of a type, period, or method of construction, or representation of the work of a master, or possession of high artistic value, or representation of

a significant and distinguishable entity whose components may lack individual distinction; and/or

D. Has yielded or may be likely to yield important information about the past.

Properties eligible for listing in the NRHP must also retain substantial integrity of location, design, setting, materials, workmanship, feeling, and association.

An adverse effect is found when an undertaking alters—directly or indirectly—any characteristic of a historic property that qualifies the property for inclusion in the NRHP in a manner that diminishes the integrity of the property's location, design, setting, materials, workmanship, feeling, association, or physical integrity (36 CFR 800.5(a)(1). All characteristics that qualify a historic property for listing in the NRHP are considered, including those that may have been identified subsequent to the original evaluation of the property's NRHP eligibility.

State and Local Regulations

State Environmental Policy Act (SEPA) (Revised Code of Washington [RCW] 43.21C) implementing rules (Washington Administrative Code [WAC] 197-11) require identification of historical, archaeological, and cultural resources listed in or eligible for listing in the NRHP or in local or state registers. State and local historical registers often incorporate NRHP criteria into their own evaluation systems. This is the case for the Washington Heritage Register.

On the local level, the City of Seattle's Historic Landmark Preservation Ordinance (Seattle Municipal Code [SMC] 25.12) protects properties of historic and architectural significance. An object, site, or improvement that is more than 25 years old may be designated for preservation as a landmark if it has significant character, interest or value as part of the development, heritage or cultural characteristics of the city, state, or nation; if it has integrity or the ability to convey its significance; and if it falls under one of six criteria (SMC 25.12.350):

A. It is the location of, or is associated in a significant way with, an historic event with a significant effect upon the community, city, state or nation;

B. It is associated in a significant way with the life of a person important in the history of the city, state or nation;

C. It is associated in a significant way with a significant aspect of the cultural, political, or economic heritage of the community, city, state or nation;

D. It embodies the distinctive visible characteristics of an architectural style, or period, or of a method of construction;

E. It is an outstanding work of a designer or builder; or

F. Because of its prominence of spatial location, contrasts of siting, age or scale, it is an easily identifiable visual feature of its neighborhood or the city and contributes to the distinctive quality or identity of such neighborhood or the city.

Under the City of Seattle's SEPA regulations, properties that are likely to meet City landmark criteria must be formally reviewed for designation before demolition. This determination and other review decisions concerning landmarks are made by the Seattle Landmarks Preservation Board.

A portion of the City of Seattle Pioneer Square Preservation District falls within the project's Area of Potential Effects (as described below). The Pioneer Square Preservation Board is charged with implementing district ordinance guidelines (SMC 23.66.115), and require a Certificate of Approval for the following:

- Alteration, demolition, construction, reconstruction, restoration and remodeling of any structure;
- Any material and visible changes to the exterior appearance of an existing structure or to the public rights of way;
- New construction, removal, demolition or alteration of signage or the placement of new signs;
- The principal use of any structure, or space and any change of use after initial approval.

None of these scenarios is anticipated as part of this project.

Area of Potential Effects

To consider the project's effects on historic properties, it is first necessary to define the geographic area where project activities "may directly or indirectly cause changes in the character or use of historic properties, if any such properties exist" (36 CFR 800 16[d]). This geographic area is termed the *area of potential effects* (APE). For this project, the APE is defined as the Colman Dock trestle footprint and open water areas west of the footprint where construction activities are expected to occur, the parcels directly adjacent to the north and south of the trestle, and extending eastward to the westernmost edge of the existing Alaskan Way Viaduct (Figure 1-1 and Figure 1-2). Appendix A includes correspondence regarding the APE.

Archaeological sites are typically subject to direct effects in areas where ground disturbance could occur, termed the *area of potential ground disturbance*. Historic structures, too, can be directly affected by construction activities and may be indirectly affected by noise, vibration, or changes to the visual environment associated with the construction or use of the project. Although minor and temporary construction-related indirect effects (e.g., dust, noise, vibration, or glare) are anticipated for historic resources in the project vicinity, no permanent indirect effects to historic resources outside of the area of potential ground disturbance are expected.

Project Description

WSF proposes to replace the aging and seismically vulnerable components of the Seattle Ferry Terminal at Colman Dock in order to maintain ferry service in the future. The FTA and the FHWA are the federal co-lead agencies responsible for reviewing the proposal for compliance with the National Environmental Policy Act (NEPA).

Colman Dock is located on Pier 52, along the central waterfront of downtown Seattle, Washington. The northern portion of Colman Dock is a timber structure that has deteriorated over time and is both seismically vulnerable and at the end of its service life. Initially constructed in 1938, the timber dock was rebuilt in 1964 and expanded in the northwest corner in 1971; it is still supported in large part by many of the original 1938 timber piles and structural components. The terminal building and the vehicle and passenger loading bridges of Slips 2 and 3 were built in 1964 on independent

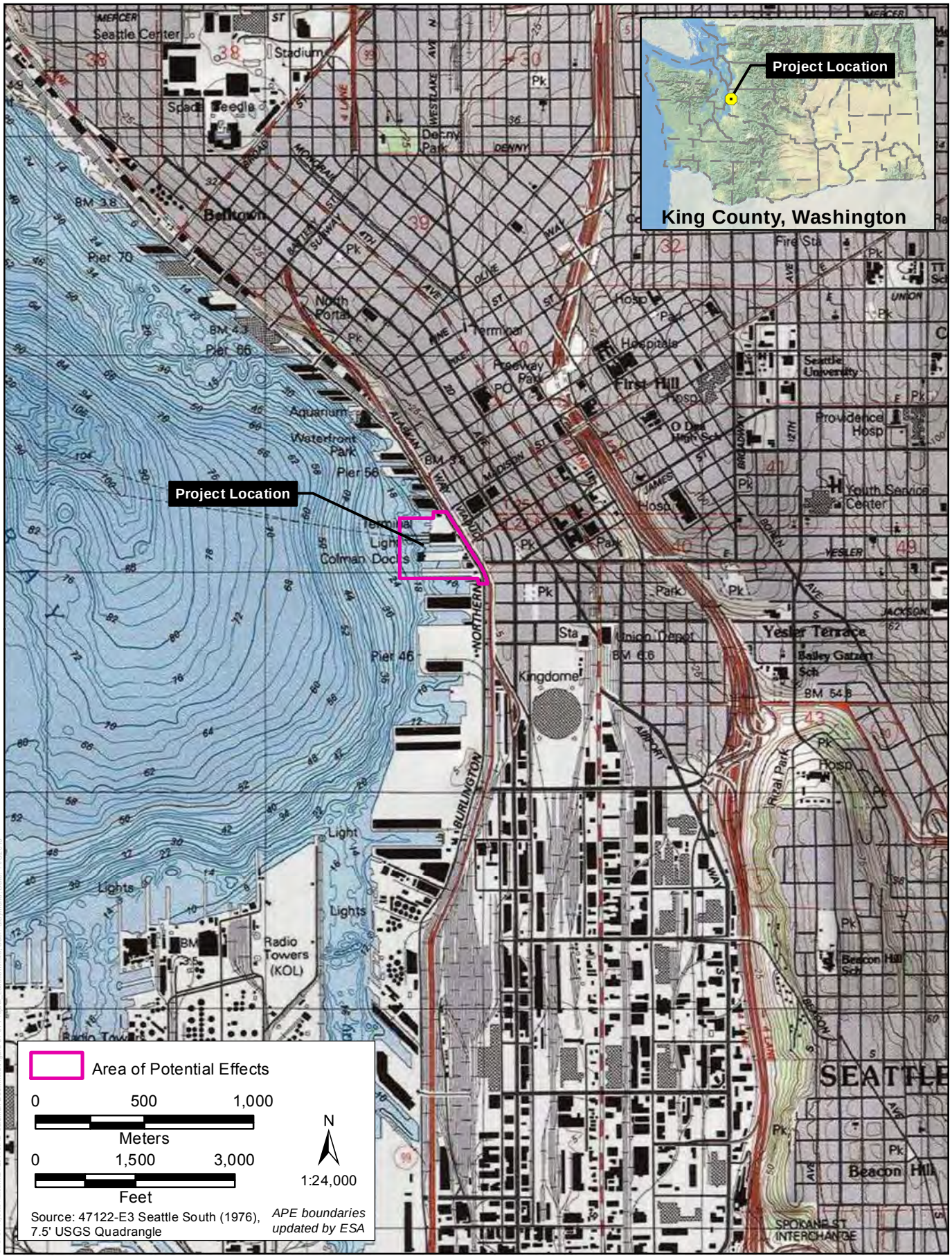

Figure 1-1
Project Location
Seattle Multimodal Terminal at Colman Dock

Figure 1-2
Area of Potential Effects
Seattle Multimodal Terminal at Colman Dock

foundations. Due to their degraded conditions, these components require regular maintenance, which can cause lane closures and disrupt operations.

Key elements of the Seattle Ferry Terminal Project include:

- Replacing and re-configuring the timber trestle portion of the dock;
- Replacing the main terminal building;
- Reconfiguring the dock layout to provide safer and more efficient operations;
- Replacing the vehicle transfer span and the overhead loading structures of Slip 3;
- Maintaining a connection to the Marion Street pedestrian overpass;
- Replacing the passenger-only ferry (POF) facility on the southern edge of Colman Dock.

Much of the northern trestle area would be left as open water after construction; the design replaces the northern holding lane capacity on the south side of the terminal. The reconfiguration increases near shore habitat and narrows the facility's frontage along Alaskan Way by 150 feet. The total overwater coverage for the reconfigured terminal, including the POF facility, would increase by about 5,200 square feet. Mitigation for the increased overwater coverage would include removal of an equivalent area of overwater coverage in Elliott Bay or elsewhere in Puget Sound.

When the south trestle of the Seattle Ferry Terminal was built in 1990, WSF placed a clean sediment cap over the contaminated sediments in the construction area. The current proposal would also place a clean sediment cap in the new construction areas, to contain contamination in the underlying sediment and prevent leaching into the marine environment. In addition, the Project would include basic stormwater treatment for all new and replaced areas of the terminal.

Construction would be phased to minimize disruption to ferry service. The phasing would maintain holding lane capacity on the dock to allow ferry loading during construction, and WSF anticipates that current ferry schedules would be maintained. The construction would last for six years, from 2015 through 2021.

This abbreviated description of the project is for the convenience of the reader, and is intended to be consistent with the details included in the project description included in the project's NEPA Environmental Assessment (EA). See Chapter 3 of the EA for a full description of the No Build and Build Alternatives analyzed and the general construction schedule. Figure 1-3 shows the terminal in its existing condition. Figure 1-4 shows the construction phases of the project. See Chapter 3 of the EA for

Washington State Ferries

Washington State Department of Transportation

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NOT TO SCALE

SOURCE: WSDOT, 2011

Figure 1-3
Existing Project Site
Seattle Terminal Project
Seattle, Washington

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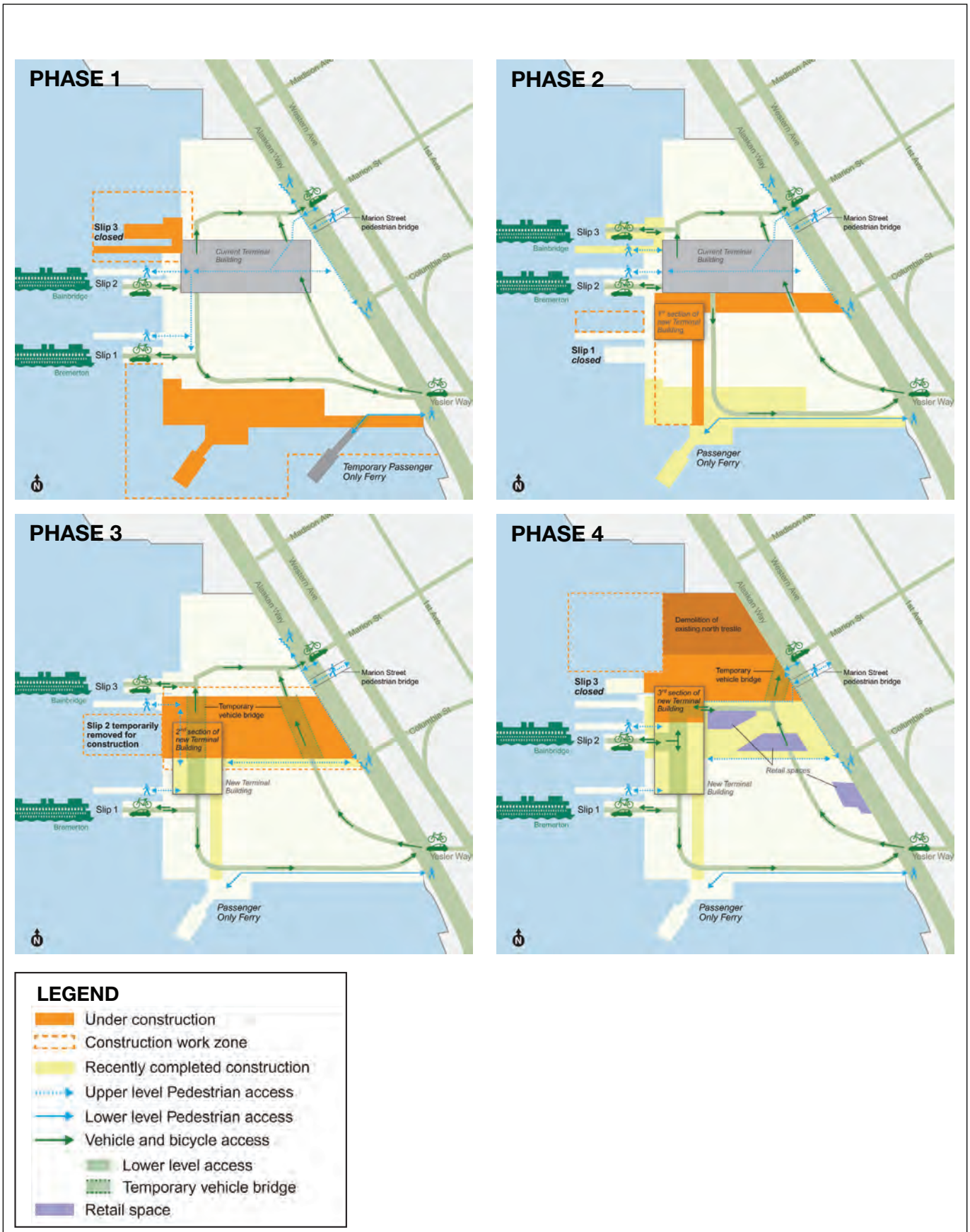

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Figure 1-4
Construction Phases
Seattle Multimodal Terminal at Colman Dock

There are two potential types of disturbance associated with each project element: those that would result in disturbance to the seabed below the SMT, and those that would result in modifications to the SMT structure only. Figure 1-5 depicts how these categories of disturbance are anticipated to be distributed across the APE.

Document Organization

This discipline report is presented in the following order:

- **Chapter 1, Introduction.** Chapter 1 provides a project description, project background, purpose of the discipline report, and definition of the APE.
- **Chapter 2, Environmental and Cultural Setting.** Chapter 2 presents the environmental setting and historical background information for the project vicinity.
- **Chapter 3, Expectations.** Chapter 3 presents a framework for assessing archaeological site potential and predicting site types in the APE, as well as provides a framework for assessing archaeological significance.
- **Chapter 4, Methods.** Chapter 4 describes the methods used to identify and evaluate archaeological sites and historic buildings, and the process used to research the landscape history in the APE.
- **Chapter 5, Results.** Chapter 5 presents the landscape history in the APE and the results of the identification and evaluation effort and assesses archaeological site potential.
- **Chapter 6, NRHP Eligibility Evaluations and Assessment of Effects.** Chapter 6 presents NRHP eligibility evaluation statements for sites 45KI1012 and 45KI1013 and identifies potential effects on historic properties, as defined in 36 CFR 800.5.
- **Chapter 7, Recommendations and Conclusions.** Chapter 7 provides recommendations for additional cultural resources investigations and guidelines for assessing archaeological site significance in the event that additional archaeological investigations of the seabed below the SMT are necessary.
- **Chapter 8, References.** Chapter 8 provides the references cited in this cultural resources discipline report.

Figure 1-5
Proposed Project Elements - Ground Disturbance
Seattle Multimodal Terminal at Colman Dock

Chapter 2
Environmental and Cultural Setting

This chapter presents the environmental and cultural setting used to frame cultural resource significance and expectations. Content is adapted from the *Archaeological Treatment Plan, SR 99: Alaskan Way Viaduct Replacement Project* (Schneyder et al. 2011).

Environmental Setting

Geology

The APE is located in the Puget Lowland, a structural and topographic basin that lies between the Cascade Range and Olympic Mountains (Schuster 2009:2). The modern topography of the Puget Sound basin is primarily the result of three forces:

- Surface scouring and moraine formation caused by the most recent glacial advance, known as the Vashon stade of the Fraser glaciation which took place in Puget Sound between 18,750 and 16,950 years ago (Goldstein 1994; Porter and Swanson 1998);
- Deposition of glacial sediments caused by glacial retreat between 16,950 and 16,400 years ago (Goldstein 1994; Booth et al. 2005; Porter and Swanson 1998); and,
- Post-glacial wave action and fluvial forces acting in concert with sea-level rise and local tectonic movement (Collins and Montgomery 2011; Finlayson 2006; Shipman 2008).

During the Vashon stade, a period of glacial advance, Seattle was covered with glacial ice from 17,400 to around 16,400 years ago. At this time, the continental glaciers contained significant volumes of water in the form of glacial ice, trapping water that would have otherwise flowed into the ocean. As a result of the removal of this significant water mass, eustatic sea level (the change in sea level due to removal or addition of water) was 410 +/-15 feet lower than it is today. As the continental glaciers receded and released water mass, global sea levels rose at a nearly constant rate between circa 15,000 and 7,000 years ago. Since then, sea-level rise has slowed, rising an additional 15 to 25 feet and reaching near-modern levels around 2,000 years ago (Flemming et al. 1998:340)

Concurrently, as a result of the weight of glacial ice during the last glacial maximum, the ground surface in the Seattle area was compressed. As glacial ice receded from Puget Sound, the ground surface rebounded rapidly, rising approximately 200 feet before stabilizing around 9,000 years ago (Thorson 1989:1171; Diether et al. 1995:1289).

As glacial ice advanced into Puget Sound, glacial melt- and streamwater accumulated against the southern margins of the continental ice sheet, creating a series of meltwater lakes, which drained to the Chehalis River through a series of spillways located in south Puget Sound. Still blocking the Strait of Juan de Fuca, glacial ice began to recede and the glacial lakes enlarged and coalesced into a single lake. The lake was termed Lake Russell as it drained through the Black Lake spillway in Olympia, and Lake Bretz as it subsequently drained though the Leland Creek spillway on the northeastern Olympic Peninsula (Thorson 1989:1164). Once glacial ice receded north of the Olympic Peninsula,

the previously impounded meltwater drained into the Strait of Juan de Fuca. Marine water backfilled the low-lying areas in the Puget Lowland as far south as Seattle (Diether et al. 1995:1289).

The APE is located north of the Seattle fault zone, a contact between uplifting tertiary bedrock south of Seattle and Seattle basin bedrock. Periodically, the strain caused by the movement of these two terranes is relieved through rapid slipping along the fault, resulting in earthquakes that cause uplift of the ground surface in some areas, and subsidence in others, along with tsunamis or large waves. The last large earthquake to occur along this fault is estimated to have happened around 1,100 years ago (Johnson et al. 1999). This earthquake resulted in as much as 22 feet of uplift at Restoration Point (Bucknam et al. 1992), ten feet of uplift at Alki Point, and three feet of subsidence in the vicinity of the APE, and was accompanied by a tsunami (Atwater and Moore 1992).

Prior to historical and modern development of Seattle, the APE was located below the low water line near the shoreline margin of Elliott Bay (Bortelson et al. 1980). Historical and modern development has extensively modified the topography of the APE.

Cultural Setting

Precontact

Precontact cultural chronologies of the Pacific Northwest and the Puget Sound area have been developed by numerous archaeologists (including, but not limited to, Ames and Maschner 1999; Blukis Onat et al. 2001; Greengo and Houston 1970; Kidd 1964; Matson and Coupland 1995; Nelson 1990). Studies of the archaeology and prehistory of Puget Sound and surrounding areas typically divide the prehistoric cultural sequence into multiple phases or periods from 12,500 to 225 years ago. These phases are delineated by changes in regional patterns of land use, subsistence, and tool types over time. Archaeological cultural chronologies provide a useful framework for analysis but do not necessarily reflect tribal views of history, cultural boundaries, affiliations, and time. This document uses the archaeological cultural chronology developed by Ames and Maschner (1999) for the Pacific Northwest coast to help describe the patterns in precontact cultural developments in the Puget Sound. The following section summarizes Puget Sound prehistory, sorted by the cultural sequence periods provided by Ames and Maschner (1999).

Paleo-Indian Period (Prior to 12,500 Years Ago)

Few documented archaeological sites in North America undisputedly date earlier than 14,500 years ago, and none are located in the Puget Sound area (Meltzer 2003). The Clovis culture represents the first undisputed widespread evidence for human occupation on the continent, although an increasing amount of research in support of earlier human occupations continues to challenge this view (Dillehay et al. 2008; Erlandson et al. 2007; Gilbert et al. 2008). This culture, dated between 12,800 and 12,500 years ago in other regions, is identified by characteristically large-fluted stone bifaces and bone technology. Clovis assemblages are characterized by extensive bone and stone technology and, on the west coast of North America, a wide but sparse distribution of sites (Ames and Maschner 1999:65). Based on these data, it is hypothesized that the Clovis people were highly mobile terrestrial mammal hunters (Bonnichsen and Turnmire 1991; Waguespack and Surovell 2003). Although there are no confirmed Clovis site assemblages in the Puget Sound area, at least eight isolated Clovis style points have been collected from across the region (Avey 1991:21; Croes et

al. 2008:108; Stein et al. 2004; Wessen 1988). These isolates are typically part of private collections, lacking precise provenience information. However, even without precise provenience, their broad distribution indicates widespread land use by the Clovis culture in Puget Sound.

Archaic Period (12,500 to 6,400 Years Ago)

Although less common than Pacific-period sites discussed below, numerous Archaic-period archaeological sites can be found throughout the Pacific Northwest. According to Ames and Maschner (1999), Archaic-period sites are characterized by a pattern of generalized resource use (terrestrial and aquatic resources), cobble and cobble flake tools, the emergence of microblade technology in some areas, leaf-shaped bifaces, and a wide spatial distribution in multiple environments.

Throughout Puget Sound, upland sites with heavily weathered metamorphic-rock flakes, cores, and lanceolate, or Cascade-style points are commonly assigned to the Archaic period. A few stratified archaic period sites with faunal remains have been identified south of Puget Sound in the southern Pacific Northwest (Site 35WS4 and Site 35WS8 [Butler 1993; Cressman et al. 1960] and Site 45LE223 [Daugherty et al. 1987]) and north of Puget Sound on the Fraser River delta in British Columbia (Glenrose Cannery [Matson and Coupland 1995:70]). The Glenrose Cannery site is unique because it is the only Archaic-period site that contains evidence of aquatic and marine resource exploitation, in addition to the evidence for terrestrial resource exploitation typically encountered in sites from this period. No coastal archaeological sites attributed to the Archaic-period have been recorded in Puget Sound. It is most likely that such sites have been submerged, eroded or deeply buried as a result of rapid eustatic sea-level rise since the end of the Pleistocene epoch and valleys infilling with sediment since the early Holocene.

Early Pacific (6,400 to 3,800 Years Ago)

During the Early Pacific period, sea-level rise began to slow as shorelines approached their modern elevations. Shell middens began to appear in the Pacific Coast archaeological records during this period (Ames and Maschner 1999). The paucity of earlier shell middens is attributed to inundation, burial, or destruction as a result of sea-level rise (Moss 2011). Artifact assemblages are more diverse than in previous periods and include many bone, antler, and groundstone implements, as well as objects for personal adornment. Exploitation of upland and riverine environments continued throughout this period but sites in littoral settings (i.e., shell middens) provide the most detailed evidence of human landscape use during this period.

Shell middens record the first exploitation of littoral environments in the Puget Sound region (Larson and Lewarch 1995). These sites contain a diverse assemblage of resources taken from inland, littoral, and marine environments. A single T-shaped labret recovered from West Point sites (45KI428 and 45KI429) may be the earliest expression of social stratification status in Puget Sound (Ames 1994; Larson and Lewarch 1995). Archaeological materials recovered from these sites indicate they were used as places of long-term occupation. Site 45PI72 is the earliest recorded shell midden in Puget Sound and contains archaeological materials indicative of generalized subsistence of both littoral and terrestrial environments (Wessen 1989).

Middle Pacific Period (3,800 to 1,800/1,500 Years Ago)

The Middle Pacific period is characterized by a cultural florescence throughout the Pacific Northwest (Ames and Maschner 1999). The development of art similar to ethnographically documented styles and permanent social inequality—two of the hallmarks of Pacific Northwest cultures—took place during this time. Technological innovation and intensification in the form of increasingly complex composite food-procurement technology (e.g., toggling harpoons, fish weirs) and greater numbers of groundstone artifacts may be the result of continued environmental stability. Decreased mobility at this time is indicated by the development of large wooden plank houses, sometimes together in villages, which may have contributed to the development of social inequality across the region (Ames 1994; Schalk 1977). This period is also characterized by increased warfare and interpersonal violence as evidenced by physical trauma indicators observed in burials from this time (Ames and Maschner 1999).

Sites in the Puget Sound region conform to the general patterns of cultural development and human land use that are observed throughout the region. For example, cultural components 2 and 3 at West Point (45KI428 and 45KI429) are dated to the Middle Pacific period (Larson and Lewarch 1995). Year-round occupation with a broad-spectrum diet continued at the site until approximately 2,700 years ago when sea-level rise appears to have greatly affected site function, limiting both its use during the year and the number of activities performed. The artifact assemblages from these components are not indicative of the regional trend toward technological intensification. Evidence from inundated or "wet" sites like the Biederbost site (45SN100) suggests a more varied toolkit from this period than is seen from non-waterlogged sites during this and previous periods (Miss 1991; Nelson 1976). Non-littoral or inland sites from this period are more common than earlier in the occupational history of Puget Sound, and many of these sites contain evidence of long occupational sequences (e.g., Greengo and Houston 2007; Shong et al. 2007).

Late Pacific Period (1,800/1,500 to 225 Years Ago)

The Late Pacific period is characterized by continued environmental stability and what researchers have suggested is cultural stasis (Ames and Maschner 1999). Archaeological sites from this period are often thought to represent an extension of ethnographically observed lifeways (e.g., heavy reliance on salmon and littoral resources, as well as the prevalence of large communal living structures). Analysis of faunal materials from numerous coastal and riverine sites in the south-central Pacific Northwest indicate that salmon remained an important, consistently exploited, resource in the region (Butler and Campbell 2004). There is a sharp increase in inferred warfare on a regional scale that is coupled with a peak regional population circa 1,000 years ago (Ames and Maschner 1999). Burial customs become highly variable during this period as well.

Late Pacific period occupations in Puget Sound appear to be early expressions of ethnographic lifeways as observed elsewhere in the region. Assemblages from two components at the West Point sites indicate continued use of the site as a fishing location (Larson and Lewarch 1995). Additionally, Larson and Lewarch (1995) note that the large numbers of clams recovered from these components may be an early expression of historic clam-drying practices along Elliot Bay. Chatters (1987) reports that *Tualdad Altu* (45KI59) or "King Salmon's House," located in Renton, contained several nearly 60-foot-long houses, which were apparently occupied year-round, starting 1,500 years ago and ending just a few decades later. *Sbabadid* (45KI51), also located on the Black River and occupied close to the same time as the Renton High School Site (45KI501), yielded evidence of heavy salmon use, many items of personal adornment, and evidence of long-term occupation and social

differentiation (Lewarch 2006). Other sites in the Puget Sound region attest to the importance of salmon. The Renton High School site (45KI501) and the Allentown and White Lake sites (45KI438 and 45KI438A) were used within the last approximately 500 years and are ideally located for salmon exploitation and processing (Lewarch 2006; Lewarch et al. 1996). These sites are dominated by salmon remains and reflect seasonally occupied fishing camps.

Ethnographic

The APE is located within the traditional territory of the Duwamish people (Miller and Blukis Onat 2004:56–114). The Duwamish are a Southern Lushootseed-speaking people who lived in and around Elliott Bay, Lake Washington, Lake Union, and Salmon Bay, and on the Duwamish, Black and Cedar Rivers. Many descendants of the Duwamish people are now members of several federally recognized tribes including the Muckleshoot Indian Tribe, Suquamish Tribe, Snoqualmie Tribe, and Tulalip Tribes, as well as the non-federally recognized Duwamish Tribe.

Traditionally, native groups around Puget Sound inhabited areas surrounding rivers and creeks during the spring, summer, and fall to procure resources like salmon (*Oncorhynchus* spp.) (Haeberlin and Gunther 1930: 26), which was either immediately consumed or preserved and stored for winter use (Castile 1985; Haeberlin and Gunther 1930: 22). Often, especially during bountiful runs, a family could catch and process enough fish to provide food to last through the winter. After the fish runs, families moved into the uplands to collect berries and hunt land mammals (Miller 1999:20). Marshes and adjoining woodlands were sources of abundant plant and animal life, which provided food and raw materials for the Duwamish. These seasonal encampments often consisted of portable, light-weight mat shelters made from cattails or other marsh plants and were used by small family groups (Haeberlin and Gunther 1930: 18–19). Large wooden plank houses provided shelter when individuals were not spread across the region collecting resources. Numerous plank houses were often located together, in a village-like setting. These plank houses often contained extended family groups and were loosely organized by status (Ames and Maschner 1999: 147–148). Spiritual ceremonies were of particular importance during the winter months and took up much of an individual's time during this season (Miller and Blukis Onat 2004: 41).

Like other Native American groups, those of Puget Sound were greatly affected by diseases spread as a result of European American contact in North America (Boyd 1999). The first European explorer to the Puget Sound region, Captain George Vancouver, observed that smallpox had apparently already affected Puget Sound groups prior to his arrival (Suttles and Lane 1990:499). With increased European American contact, many Native American groups were displaced from their traditional territories and were placed on reservations. In 1855, many Duwamish were relocated to the Fort Kitsap reservation (later known as Suquamish and Port Madison Indian reservation), but by the next year, were relocated to places like Bainbridge Island and their traditional territory around the Duwamish River (Ruby and Brown 1992:73). The Muckleshoot reservation eventually became home to many Duwamish tribal members.

Historical

Early Exploration and Settlement

The first European to enter Puget Sound was Captain George Vancouver, an officer in the British Royal Navy. In command of the ship *Discovery* and with both diplomatic and commercial goals in

mind, Vancouver came to the Pacific region on an exploratory expedition in 1791. Vancouver named many of the geographic features along the way (Bagley 1916:3–6). In 1841, American Naval Lieutenant Charles Wilkes surveyed much of the North American Pacific coast, including the Puget Sound, and is credited with naming Elliott Bay after his midshipman (Thomas 2004:139).

Shortly after Wilkes' visit, the fledging United States secured its claim on the Oregon Territory, encompassing the areas today known as the states of Oregon, Washington, Idaho, and portions of Montana and Wyoming. With this secured and the Donation Land Claim Act of 1850, settlement throughout the Pacific Northwest opened to Americans who were attracted to the region's green, expansive valleys (Hayes 1999:171; McCarthy 2009:66). In response, a group of Midwestern settlers, led by Arthur Denny, arrived in the fall of 1851at what is now Alki Beach in West Seattle. Shortly thereafter, they moved eastward across Elliott Bay (Waterman 1922:188). The Denny party much preferred this second location to the windswept beach; the group settled and renamed the community after the local Native American leader, Chief Sealth (Coman and Gibbs 1949:56; Klingle 2007:28; Thrush 2007:37).

In 1853, the new town of Seattle was officially platted (Bagley 1916:25; Schwantes 1996:125, 238). Lumber soon became the community's main industry and the first sawmill was built by Henry Yesler that same year (Bagley 1916:25; Ficken 1987:39). Yesler's mill was located at the foot of Mill Street (today Yesler Way) and employed both Native Americans and European American settlers (Andrews 2005:12). In 1854, Yesler shipped at least twelve loads of lumber to San Francisco and several to Hawaii and Australia (Ficken 1987:24). Soon after completing his sawmill, Yesler built a wharf, which became the commercial center for the town since travel by land was still difficult and the majority of people and goods arrived via ship (Bagley 1929:367; Finger 1968:155–156).

Despite Arthur Denny's friendship with and respect for Chief Sealth, peaceful coexistence with the native peoples of Puget Sound was short lived. American settlement in the Puget Sound area resulted in the occupation and alteration of areas important to Native American traditional lifeways (Thrush 2007:79–80). After the establishment of the Washington Territory in 1853, the new territorial governor began drafting agreements that would require the removal of the area's indigenous populations to make the land available for further European American settlement. Enacted in three councils called the Medicine Creek Treaty (1854 - south Puget Sound), the Point Elliot Treaty (1855 - northern and eastern Puget Sound, including Seattle), and the Point No Point Treaty (1855 - Hood Canal to the Strait of Juan de Fuca), these agreements called for lands to be handed over to the United States in exchange for retained rights to traditional gathering areas, money, and the relocation of native peoples to designated reservations (Buchanan 1859; Buerge 1989:22–23; Klingle 2007:35; Pierce 1855; Slauson 2006:3).

Despite the signing of these treaties, many Native Americans refused to relocate, possibly hoping to obtain their own reservation rather than share one with tribal rivals. However, they waited in vain as no new reservations were granted (Klingle 2007:35–36). In 1855, native frustration over treaty agreements exploded in the Yakima Indian War. Several regional tribes, including the Yakama and Wenatchee, united together and crossed the Cascade Mountains, raiding settlements and even launching an attack on the city of Seattle itself (Buerge 1989:23). In response to the hostile conflict, Seattle passed an ordinance in 1865 restricting Indian encampments to only the most outlying regions of the area, often next to muddy tide flats (Klingle 2007:38). Some Native Americans camped on a rocky, human-made peninsula known as Ballast Island to escape expulsion (Dorpat 1984:44; Watt 1959:58–59). Located at the foot of Washington and Main Streets, south of the Stone and

Burnett Wharf, Ballast Island was created by dumping rubble and rock ship ballast into the bay during the 1870s and 1880s (Dorpat 1984:44).

Early Seattle Economy

After the hostilities and expulsion of the Native Americans, Seattle entered a decade of economic depression. Some settlers feared for their lives and fled the region entirely, leaving behind empty homes, abandoned businesses, and fewer consumers for Seattle's goods (Klingle 2007:37). Gradually, however, Seattle reemerged as the city's ample natural resources brought new settlers back to the area. Lumber, Seattle's first industry, flourished in the late 1800s. Within ten years of Yesler's first manufactured planks, more than ten sawmills were churning out lumber in places such as Seattle, Alki Point, Port Orchard, Port Madison, Bainbridge Island, Port Gamble, Bellingham, and Seabeck (Ficken 1987:28–29; Grant 1891:243; Kirk and Alexander 1995:220). In 1860, King County sawmills produced five million board feet totaling $100,000. Production increased in later years with ten million board feet manufactured in 1870 and 40 million in 1880 (Grant 1891:243–244).

In the 1860s, vast quantities of high-quality coal were discovered near Newcastle, promising further natural resource exploitation in Seattle. Initially, a lack of transportation infrastructure made it too costly to mine for export. However, this changed with the 1871 completion of the Seattle Coal and Transportation Company's conveyance system which moved coal cars by both railroad and barge to Seattle's wharves (Bagley 1916:126; Droker 1977:20,23; Goodyear 1887:106–107). Still, the system was unwieldy and expensive, requiring that coal be transferred many times between railroads and barges before it reached its final destination in Elliott Bay (Droker 1977:19–21; Goodyear 1887:106–107).

Although Seattle's early economy was dominated by lumber and coal, a number of other industries emerged as well. Additional export commerce included the transporting and processing of local resources including fish, hops, and wheat from east of the Cascades (Ward 1876:17–18). Businesses catering to local needs also developed, such as shoemakers, tanneries, a furniture maker, a gristmill, breweries, and brick makers (Bagley 1929:362; Buerge 1986:196; Finger 1968:43–44,74–75; Grant 1891:90–91; Prosch 1969:80–81; Ward 1876:80; Watt 1959:101,188–189). As the area grew, Seattle became the provision center for other communities supplying foodstuffs, household goods, and machinery in exchange for natural resources (Boswell and McConaghy 1996c:4; Magden 1991:6–7).

Land Development

Seattle's terrain created many obstacles for early residents and commercial activities. Steep hillsides, flood-prone rivers, and acres of mudflats with extreme tides hampered transportation and restricted economic growth (Klingle 2007:45). Part of the transportation problem was the condition of the area's early roads. During a large portion of the year, these unpaved dirt tracks became so muddy that they trapped horses and wagons. As a result, the city began covering the roads in the 1870s with wooden planks and, in a few cases, cobblestones. Still, travel across town by road was slow, often making it faster to take a boat (Buerge 1986:100). In the late-nineteenth century and early-twentieth century, Seattle worked to remedy these problems by reclaiming the expansive tide flats, regrading the steep landscape, and constructing railroads.

Despite its efforts to pave transportation corridors, Seattle's steep landscape continued to hinder travel. To remedy the issue, Seattle began to level the streets. In 1876, ordinances were passed that

established standards for street grades, leading to a series of substantial regrading projects. Regrading included Mill Street (South Yesler Way) from First to Eighth Avenues, and First Avenue from Mill Street to Pike Street. Work did not proceed without trouble. Raising the grade of First Avenue required cribbing to shore up the fill and work was halted completely on Mill Street due to multiple landslides (Bagley 1929:373–374). Other street regrades followed, including Pike and Union Streets (1882) and Jackson Street from Lake Washington to downtown (1883) (Buerge 1986:106). Some of this work was funded by fees issued to business owners who profited from regrade improvements that improved access to their establishments (Finger 1968:315–317).

In 1889, a devastating fire sparked further alterations to Seattle's topography (Schwantes 1996:258; Warren 1989:18–28). On June 6, 1889, a glue pot boiled over and ignited some wood shavings in a basement workshop located at the southwest corner of Front and Madison Streets. Attempts to douse the flames with water intensified the blaze, and the fire spread quickly, eventually engulfing 30 blocks and burning approximately 116 acres of Seattle's burgeoning downtown to the ground (Dorpat 1984:15; Klingle 2001:44; Warren 1989:18–28).

Despite their loss, many residents saw the fire as beneficial to Seattle, allowing them to rebuild and create a new plan for downtown (Buerge 1986:113, 115; Jacobs 1908:189–190). In only two months following the event, the city issued 362 building permits and within two years, 3,500 new buildings were constructed in Seattle (Buerge 1986:113, 115; Jacobs 1908:190). Many of these new buildings were made with red brick in the Richardson Romanesque style, as seen today in the Pioneer Square-Skid Road National Historic District. The designs of the new buildings and their extensive use of brick and stone were partially a result of new city ordinances, which required that all new buildings be fireproof and built of masonry (Andrews 2005:46–47, 50; City of Seattle 1889). The city also went to work repairing infrastructure, such as sewers, streets, and sanitation, which had long been a problem before the fire (Buerge 1986:113,115).

After the 1889 Seattle fire, Seattle's growth began to exceed its supply of level land close to the city center. The solution that city officials and businesses alike turned to at the end of the century was the reclamation of Seattle's tide flats. Located around and within Seattle, these tidelands encompassed an area more than 2,000 acres in size that was largely exposed during low tide but submerged under eight to 16 feet of water during high tide (Engineering Record 1908b:601). Entrepreneurial Seattleites had already begun using these areas with little landform change by constructing an elaborate network of wharves, pilings, buildings elevated on piers, and planked walkways over these muddy waters (Commissioner of Tidelands n.d.; Sanborn-Perris Map Company 1893).

In 1895, the Seattle & Lake Washington Waterway Company began filling the south tidelands. Led by Eugene Semple, a former Washington Territory governor, the company secured funding to create more useable land close to the city center by filling the south tidelands. Materials for this filling were obtained through the excavation of a deep-water channel that would connect the Duwamish River to Elliott Bay, known as the East and West Waterways, and the excavation of a canal that would connect Lake Washington and Elliott Bay through Beacon Hill, known as the South Canal (Bagley 1916:356; Benoit 1979:ii; Raley 2010:5; *Tacoma Daily News* 1895:1). Initially, the focus of excavations was the East and West Waterways and here dredge ships worked non-stop, pumping the sand and mud to the tide flats between Railroad Avenue and Third Avenue South, south of the APE (*Seattle Post-Intelligencer* 1895a:3, 1895b; *Seattle Times* 1895). By the end of 1896, the Seattle & Lake Washington Waterway Company had excavated 2,000 feet of channel to deep water in Elliott Bay and raised some 50 acres of tideland approximately two feet above high tide (Bagley 1916:384).

Shortly thereafter, acres of additional tideland were filled as work on the South Canal began and dredging continued on the East and West Waterways (Bagley 1916:384–385; Benoit 1979:29,34). Between 1901 and 1904, excavations on the South Canal continued but thereafter, the route was ultimately abandoned as public sentiment turned against it. Work on the East and West Waterways was complete by 1905 (Bagley 1916:384–385; Benoit 1979:29, 34).

Klondike Gold Rush and Industrial Development

Seattle's rapid growth, experienced since its founding, slowed to a crawl during the Panic of 1893. A four-year economic depression caused by a series of East Coast bank failures, the Panic hit the source of Seattle's capital. Without a financier, investment in construction, infrastructure, and economic development slowed to a crawl (Andrews 2005:66; Boswell and McConaghy 1996a:107–110). However, Seattle's fortunes were dramatically changed by the arrival of the *Portland* on July 17, 1897. Docked in Seattle's harbor, the steamer ship arrived with a "ton of gold" from Alaska's Yukon River and sparked a mass exodus of people to Alaska, including many Seattleites, known as the Klondike Gold Rush (*Seattle Post-Intelligencer* 1897:1). The city of Seattle boomed as it became the main point of embarkation and supply center for the Klondike. The city's merchants, shipping companies, restaurants, theaters, and hotels struggled to keep up with the prospectors' demands (Andrews 2005:82–88).

As Seattle's economy grew with the Klondike Gold Rush, increasing demands for manufactured and processed goods led to a rapid expansion of local industry. The now-dry tidelands, improved through dredging and subsequent land-filling, became a prime location for manufacturing and warehousing facilities by offering room for expansion and lower prices than expensive downtown real estate. By 1905, this area was home to factories and processing plants providing everything from boxes to pickles, flour, and syrup. Major transportation facilities, including freight depots and massive wharves, were also built to move the growing volume of manufactured goods (Sanborn Map Company 1904).

A belated celebration of the gold rush, known as the Alaska-Yukon-Pacific Exposition, was a major turning point in the history of the city of Seattle. Held in 1909, this event showcased Seattle to the world, celebrated its achievements, and demonstrated its economic potential (Diller 1915:10). Over a period of 138 days, more than 3.7 million people visited the exposition held at the new University of Washington campus (Warren 1981:102,104–105). The event's impact was felt throughout the city with the construction of new hotels, housing, and other amenities. Waterfront and infrastructure improvements were also completed (Boswell and McConaghy 1996c:7).

Transportation Development

Quick, reliable transportation connecting the city and its goods to other consumer markets was, and still is, an important part of economic growth and potential. In the late-nineteenth century, railroads were the transportation of choice and Seattle worked tirelessly to obtain a coveted transcontinental railroad connection. In 1873, Seattle appropriated funds for the construction of the Northern Pacific Railway Company (Northern Pacific) only to realize that the contract was awarded instead to Tacoma (Grant 1891:147–148; Reiff 1981:47). Despite this setback, Seattle citizens pledged over $700,000 in money and land to construct their own railroad, the Seattle and Walla Walla Railroad (later Columbia and Puget Sound Railroad). This line was to connect these two cities through Snoqualmie Pass (Armbruster 1999:51). Progress on the Seattle and Walla Walla Railroad was slow

and eventually halted completely due to a lack of funds, land disputes, and changing ownership (Armbruster 1999:55–56,70–71).

In 1885, Judge Thomas Burke and a number of prominent businessmen developed plans for a new cross-country link. The Seattle, Lake Shore, and Eastern Railroad (SLS&E) was to extend from Ballard along the northern shores of Lake Union and Lake Washington, through the Snoqualmie Pass and on to eastern Washington (Armbruster 1999:51,100–101). Like the Seattle and Walla Walla, SLS&E suffered from financial difficulties and was never completely finished. Eventually, it was purchased by Northern Pacific in 1891 (Armbruster 1999:128).

By the 1890s, several major railroads were vying with each other for position in Seattle's growing market, as well as for space on the prime real estate of the reclaimed tidelands. Northern Pacific, who had passed over Seattle earlier, began offering direct transcontinental service to Seattle by 1889. Another transcontinental railroad, the Great Northern Railway Company (Great Northern) eyed Seattle as its potential terminus. As part of the negotiations, Great Northern's owner James Hill demanded a 60-foot right-of-way on the waterfront's Railroad Avenue. The City Council almost allowed the deal but Seattle city engineer Reginald H. Thomson argued against it on the grounds that a major railroad along the waterfront would create greater congestion and stop commercial development. Thomson suggested instead that Great Northern, together with Northern Pacific, build a tunnel that would travel beneath Seattle's downtown to freight facilities on the tidelands south of Pioneer Square. Both parties agreed and construction was soon underway (Andrews 2005:62–66,72).

The Great Northern and Northern Pacific railroad tunnel, finished in 1905, took a crew of 1,000 men laboring a year and a half to complete. The mile-long tunnel traveled from the King Street Station (completed in 1906) under South Washington Street just west of Fourth Avenue South where it curved to the west and emerged out on Elliott Avenue between Stewart and Virginia streets. Today, the tunnel is still in use and exists underneath the Alaskan Way Viaduct with one of the viaduct's piers sharing a foundation footing with the tunnel (Andrews 2005:72–73; Phelps 1978:73).

Although the tunnel was completed, competition, traffic, and access remained chaotic on Railroad Avenue and the waterfront. Throughout its early development, Seattle's waterfront was a bustling center for the transportation and shipment of goods and people, but with much of the area privately owned, no traffic laws were enforced, making disorganization and accidents commonplace. Congestion continued to worsen with the arrival of Union Pacific Railroad in 1910. When the Panama Canal opened that same year, its impact resounded up and down the Pacific Coast. Promising to bring substantial expansion to trade and shipping, the Panama Canal made the standardization and modernization of Seattle's port necessary—a feat already being completed by state-owned rivals in San Francisco, Portland, and Vancouver, British Columbia (Port of Seattle 1981:12).

In 1911, Seattleites voted to create a municipally owned Port of Seattle (Andrews 2005:75–76; Port of Seattle 1981:15). With the waterfront under the city's control, funding was obtained for the new port commission in 1912. In short order, construction was underway on what was to be the largest pier on the west coast, a new slip, and a four-story warehouse. Seattle's efforts paid off and in 1916, the Port of Seattle handled more cargo than any other West Coast harbor. Two years later, Seattle was second in the nation only to New York in foreign and domestic imports and exports (Port of Seattle 1981:18–20).

The Automobile and Change

Transportation, which was formerly dominated by railroads, streetcars, and steamboats, was dramatically altered by the automobile in the early-twentieth century. Giving rise to the pleasure drive, the automobile changed transportation by providing individuals with the means for long-range, cross-country transportation. In Seattle, development, and eventually the downtown landscape, changed to adapt to this new technology and the culture that surrounded it. With the rise of the automobile, changes were necessary because overland transportation corridors now had to accommodate a flood of new users, whereas previously they were developed primarily to address local needs (Crowley et al. 2005:20–23; Sheridan 2008:3–4).

After the automobile came to Washington in 1899, new state departments dedicated to the improvement and development of state highways soon followed. The State Highway Board was established in 1905 and was authorized to develop twelve state highways and improve 41 miles of existing roads. However, local interests were reluctant to release control of transportation to the state so little progress was made. In 1911, the Permanent Highway Act was enacted, allowing the state to collect taxes for road improvements, which were, up to that point, completed by the counties. Additional funding sources were obtained with the passing of federal assistance bills in 1916 and 1921. This financial stimulus allowed the state of Washington to develop a plan in 1926 outlining 17 primary state highways to connect both rural and populated areas together under one system (Crowley et al. 2005:20–23; Dorpat and McCoy 1998:81–85; Sheridan 2008:4).

The first highway planned under the new Washington system was the Pacific Highway (later known as US 99 and SR 99). By 1923, over 306 miles of the route were completed and paved, but urban areas remained congested (Crowley et al. 2005:35; Dorpat and McCoy 1998:81–85; Sheridan 2008:5). At the same time, a new Ford automobile manufacturing plant was opened in Seattle, which brought more cars to the city's crowded streets (Ford News 1923:6). Seattle city planners turned to limited-access speedways as the solution (Sheridan 2008:5). In 1931, the Aurora Speedway was completed, providing a direct and widened route into the north end of Seattle. This stretch of roadway, running from the east side of Queen Anne Hill to north of Green Lake, had no traffic signals or intersections (Dorpat 1984:67; Phelps 1978:93).

By the 1930s, the automobile was further complicating the chaos of Railroad Avenue's commercial sector (Neal and Janus 2001:52–53; Hershman et al. 1981:39–40). Railroad Avenue was a long trestle road, over 150 to 180 feet wide in places, with a tangle of tracks, trucks, and automobile traffic. To address the issue, Seattle began building seawalls and subsequently filled and paved the route. This monumental task was completed in 1936 and shortly thereafter, discussions began of connecting the Aurora Speedway to this newly improved corridor (Dorpat and McCoy 1998:160; Sheridan 2008:6–7).

World War II drew attention and traffic away from Railroad Avenue and the desire for an Aurora Speedway connection. However, the issue was brought to the forefront again when cars began to return to Railroad Avenue after the war. This—coupled with the Federal Highway Act of 1944 which provided much-needed funding—enabled formal planning to begin in the late 1940s on what would eventually become the Alaskan Way Viaduct (Dorpat and McCoy 1998:88–89; Sheridan 2008:8). Headed by the Seattle Engineering Department with review from the Department of Highways and the Public Roads Administration, the first design was produced in August 1947. The proposal outlined the construction of the first phase of the viaduct, a six-lane two-deck reinforced concrete structure stretching from Battery Street to South Dearborn Street (Sheridan 2008:10; Wartelle

1947). Although some property was purchased to accommodate access ramps for the new structure, the viaduct was specifically designed to minimize right-of-way purchases, preserve existing facilities, minimize disruption during construction, and provide parking (Finke 1948:4; Sheridan 2008:11). In late 1949, the design and funding for the Alaskan Way Viaduct was finalized and construction began immediately. Over the next several years, the elevated freeway was built in five sections (Sheridan 2008:13). The Aurora Speedway was finally connected to the downtown Seattle waterfront when the Battery Street Tunnel opened on July 24, 1954 (Sheridan 2008:18; Washington Department of Highways and Washington State Highway Commission 1956:32).

Automobiles continued to alter the Seattle landscape into the 1960s as many residents moved away from Seattle's center and began commuting by car. This decentralization of the workforce resulted in ever-increasing traffic. As a result, Interstate 5 (I-5) was completed in the 1960s, replacing the Alaskan Way Viaduct as the primary north-south corridor. Parking demands increased with the increased traffic, and many business leaders proposed to demolish old buildings to make room for parking garages. Some of these buildings and neighborhoods were saved through local activism, such as Pike Place Market. Others, like the Seattle/Oriental Hotel, were demolished as developers labored to meet growing demands (Andrews 2005:181, 182–185; Lewarch and Kaehler 2003:2).

World Wars and Manufacturing

Seattle's economy and development in the early-twentieth century continued to be tied to the production and shipment of products. During World War I, production focused on wartime industries, such as shipbuilding. Seattle manufacturers contributed significantly to the material needs of the conflict, producing 20% of all ships built for the war effort (Berner 1991:27–28,60,178–180). However, although the war stimulated the economy, there was not a great increase in the number of Seattle businesses as simply more people were employed by existing local manufacturers (Sale 1976:116–117,126). As a result, during the Great Depression, the city felt the full impact of the economic downturn as Seattle's manufacturing industry dropped by 29%. Seattle's shipbuilding industry sustained some of the largest losses and many shipyards were closed (Berner 1992:172–175; Sale 1976:137).

Seattle's economy was energized once again with the onset of World War II. The dominant industries were shipbuilding and airplane manufacturing, but other products were also produced for the war effort including trucks and lumber. Boeing, which manufactured airplanes, and Pacific Car & Foundry (later PACCAR), who supplied steel, pig iron, and other materials for the production of railroad boxcars and tanks, were the major employers during World War II. The city's burgeoning industry outgrew the local employee base, and people from all over the state, country and beyond were brought in to staff the plants. As a result, Seattle's population increased significantly. Between 1939 and 1941, the population doubled, taxing infrastructure and services (Berner 1999:3,45–46; City of Renton 1989:5; Sale 1976:137,234–235).

After World War II, Seattle's manufacturing shifted with changing consumer demands and at the same time, new technology was transforming the way those products were transported. Commerce that had once been Seattle's industrial base, such as mining, logging, and sawmilling, ceased to play a major role (Meier 1980:43). In their place, Boeing emerged as the new industrial power, employing one-half of all Seattle workers in the production of commercial airplanes (Berner 1999:172–175; Sale 1976:187–189). Changes in the shipping industry, including the advent of container shipping, led to the redevelopment of the port. Seeking more space for container yards, the port moved southward toward Harbor Island although the central waterfront did service some freight into the

late twentieth century (Berner 1999:45–46; Dorpat 2006:167; Dorpat and McCoy 1998:43; Sale 1976:234–235).

Chapter 3
Expectations

This chapter presents expectations for archaeological sensitivity and expected property types for both precontact and historical archaeological resources in the APE. The sections that follow are adapted from the *Archaeological Treatment Plan, SR 99: Alaskan Way Viaduct Replacement Project* (Schneyder, Elder, et al. 2011). Expectations are developed for precontact resources based on an analysis of landforms and their relationship to human behavior, while historical archaeological resource expectations are based on the area's historical development.

Precontact Archaeology

The precontact expectations were generated using a landform analysis approach that discusses the likely landform types that currently occur, or have previously occurred, in the APE during the period in which humans occupied Puget Sound. These landforms were identified from previous archaeological and geotechnical investigations in the APE vicinity.

Landform Analysis

The following expectations about depositional context and archaeological site potential were developed using a landform characterization approach. Landforms are useful analytical units for generating archaeological expectations because each type has a discrete set of physical attributes (e.g., age, depositional environment, stability, accessibility, resources) (Shipman 2008). Together, these physical attributes provide physical constraints that affect how humans interact with the landscape, what material remains (i.e., archaeological deposits) they leave behind, and how they are preserved. They are also useful because differences in landform types can be visually recognized at the macroscopic scale.

The vicinity of the APE is along the coastal margin of Elliott Bay, an area that has been subject to filling during the historic period. Three landform types likely to be found in this environment are discussed in this section. A summary table of these landforms and a selection of their physical attributes are provided in Table 3-1.

Table 3-1 Landforms Likely Present in the Vicinity of the APE

Landform	Age	Accessibility	Stability	Resources
Tide flat	Holocene	Inundated for long periods during the day.	Vertical accretion	Fish, shellfish.
Subtidal coastal	Holocene	Permanently inundated.	Vertical accretion	Fish, aquatic plants.
Intertidal beach	Holocene	Inundated for long periods during the day.	Variable	Fish, shellfish, tool stone, aquatic plants.

Coastal

The modern Seattle waterfront has been extensively modified by historical and modern development that buried or altered the predevelopment shoreline landform components. In spite of this modification, research by Fung and Davis (2005:14), using Shipman's (2008) hierarchy, characterized the landform upon which the APE is situated as a tide-dominated delta shoreline. Given that the Duwamish River has rapidly prograded during the middle to late Holocene, it is anticipated that landform components typically associated with bluff-backed beaches may also have been present prior to the Duwamish River reaching its current location.

Assuming the landform components commonly associated with these landform types as present prior to historical and modern development of the Seattle waterfront, three landform component types would have likely been located in the APE: tide flats, subtidal coastal, and intertidal beach. The landform component types presented in this section are modeled after types presented by Shipman (2008) and adapted by Schneyder et al. (2011). The following sections provide a brief description of each expected shoreline landform component type.

Tide Flats

Tide flats are relatively flat plains incised by sinuous or winding tidal channels and are commonly described as intertidal flats (Reading and Collinson 1996:213). They form along coasts or in lagoons, estuaries, and embayments where the depositional effects of tidal action are the dominant landscape formation processes. Tide flats are formed between the mean-high- and low-tide level, and are subject to two cycles of inundation and exposure each day. They are composed of interlaminated sediments that range from sandy to silty, with sediments becoming increasingly fine as they approach land because of decreasing tidal energy in these locations (Reading and Collinson 1996:213).

Although tide flats have been forming in Puget Sound since the recession of the Puget Lobe of the Cordilleran Ice Sheet during the late Pleistocene (around 13,500 years before present), sea levels have only approached their modern elevation in the last 5,000 to 6,000 years, during the middle Holocene (Shipman 2008:6). As a result, tide flat deposits identified near modern-day sea level were deposited during the mid-Holocene or later.

Tide flats do not support vegetation (Waters 1992:259), but provide habitat for burrowing bivalves and a variety of fish. As a result, these landform components are ideal locations for faunal resource procurement. However, since tide flats are inundated for extended portions of the day, they cannot be used for habitation or resource-processing activities that require long periods of time. As a result, physical evidence of human use of tide flats would be limited to isolated tools and resource procurement sites.

Subtidal Coastal

This category encompasses a variety of landform component types that are located in the subtidal zone. Such landform components include subtidal flats, distributary channels, and tidal channels. The ground surfaces of these landform components may include coarser sediments than the surrounding intertidal landforms, but this is dependent on the speed at which water flows through these areas and the size of the sediment source (Reading and Collinson 1996:183).

Like any landscape depression, subtidal coastal landform components infill over time. As a result, only features associated with the late-Holocene, predevelopment landscape would be recognizable by their negative topographic relief relative to the surrounding estuarine sediments.

Since the ground surface associated with these landform components is permanently inundated, human activities would not have occurred directly on the surface. Instead, human activities would be limited to the capture of marine and estuarine resources from boats. Resources procured from this landform component would include fish, aquatic mammals, and waterfowl. Only isolated tools lost during resource collection activities are expected in these deposits.

Intertidal Beach

These landform components include the beach face and low-tide terrace, and can be found on beaches primarily shaped by wave action. Such landform components are extremely unstable and are constantly reworked by wave action, creating seaward-dipping or cross-bedded sedimentary laminations. Intertidal beach landform components are composed of sediments eroded and deposited by wave action (Waters 1992:256). As sea level transgresses (increases in elevation), sediments associated with these landform components remain, as high energy wave action is replaced by lower energy tidal forces.

While in the active intertidal zone, these landform components are in a constant state of erosion and deposition. Once they pass below the intertidal zone, they become subtidal landform components, which are described above. Although intertidal beach landform components can contain shellfish and lithic material, their frequent inundation combined with near-constant erosion and deposition prevents the formation of archaeological deposits in primary depositional context.

Property Types

Two precontact property types are anticipated to be present in the APE given the expectations about landforms and their attributes (e.g., stability and accessibility) discussed previously. The precontact property types presented in this section are modeled after types, developed by Lewarch and Larson (2003:6-1–6-11), that focus on characterizing the activities represented by an archaeological assemblage (e.g., fishing and fish capture location) rather than the composition of the assemblage (i.e., the artifacts) itself. Table 3-2 presents the precontact property types anticipated to be present in the APE, and their associated features and artifacts.

Table 3-2 Precontact Archaeological Property Types

Property Type	Activity—Features and Artifacts
Fish Capture and Processing	Fish Capture Locations – Wood weirs and traps, basket traps, occasional fish hooks, netting, net weights, spears and rakes.
	Fish Processing Locations – Hearth features, ground or chipped stone knives, post or pole holes, wooden remnants of drying structures, and accumulations of fish bone.
Shellfish Processing	Shellfish Capture Locations – No archaeological signature.
	Shellfish Processing Locations – Shell middens, hearths, and pole or post-holes for drying racks.

Both property types are considered limited activity sites. Limited activity sites are used for specific resource collection and processing tasks for a limited amount of time. This often results in very diffuse and difficult-to-identify deposits, with some exceptions (e.g., features associated with shellfish processing or fish capture).

Shellfish Processing

Shellfish-processing locations are associated with littoral environments where shellfish can be harvested nearby, although they may also be situated in riverine environments where freshwater shellfish are readily available. Shellfish harvesting is technologically simple and leaves little or no archaeological signature with the possible exception of digging sticks used to harvest clams. On the other hand, shellfish processing is much more visible archaeologically and would be more easily identified through numerous discarded shells and the accumulation of shell middens. Accumulations of shell and shell middens provide an ideal environment for preserving bone, and can, therefore, contain the bones of vertebrate faunal prey and even human remains from burials. Middens are often directly associated with long-term habitation sites, but this is not always the case. Features associated with shellfish processing other than shell middens, include, but are not limited to, hearths and pole or post holes for drying racks.

Fish Capture and Processing

Fish capture and processing sites are typically discrete and located in riverine, lacustrine, or marine littoral environments. The types of technology found in association with the capture location are directly related to targeted species and the body of water where the capture takes place. These sites contain features and artifacts related to fish capture, which include but are not limited to, wood weirs and traps (stone is used along northwestern Olympic Peninsula), basket traps, fish hooks, netting, net weights, and spears (Castile 1985; Haeberlin and Gunther 1930; Stewart 1977). Artifacts and features associated with fish processing can include hearth features, ground or chipped stone knives, post or pole holes, wooden remnants of drying structures, and accumulations of fish bone.

Historical Archaeology

Historical Development Analysis

This section uses data from historical and comparative research to define expectations for assessing archaeological sensitivity and to develop anticipated historic-period archaeological property types in the APE. Historical archaeological sensitivity is based on knowledge of the spatial organization of historic parcels and structures, as well as the types of activities that result in the deposition of objects that create archaeological deposits and identify which deposits typically have the data required to address relevant research questions. The knowledge of these variables results in specific expectations regarding the areas in which important archaeological information would occur within the APE.

During the nineteenth and twentieth centuries, several over-water piers were built in the APE and used for industrial and commercial activities. These piers were expanded, destroyed, and rebuilt on several occasions, and ultimately demolished prior to construction of the SMT. Demolition of the piers would have resulted in the destruction and removal of the habitable surfaces upon which

historic activities would have occurred. There is the potential, however, for the APE to contain architectural remnants from the demolished piers and refuse deposits along pier margins. Refuse deposits are likely to reflect the function of the activity that created them (Walker and Ziesing 2002:121). For example, refuse deposits associated with lumber mills may include wood scraps, sawdust, and dimensional lumber.

The presence of residential, commercial, and industrial areas over a period of time often results in the formation of archaeological sites. Analysis of the expectations for historical archaeological deposits establishes a framework for the identification of anticipated property types and the development of a research design.

Property Types

Two historic-period archaeological property types have the potential to be present in the APE: architectural and refuse. Each historic-period property type is summarized in Table 3-3 and described under separate headings in this section. The property types identified are likely to be associated with commercial and industrial development.

Table 3-3 Historic-Period Archaeological Property Types

Property Type	Features – Characteristics
Architectural	Foundations – Brick alignments, concrete slabs, piers and pilings. Decking/Planking – Wood boards – in ruin. Floors – Concrete, wood, or tile – in ruin.
Refuse	Sheet Refuse – Thin layer of refuse that may have accumulated over time, versus large discrete layers of refuse representing several events. Dumps – Concentrated refuse that may represent a single refuse event or several events. Chronological sequence of several events may be represented horizontally rather than vertically.

Architectural

Architectural property types include features comprising the remains of once-standing structures or buildings representative of residences, domestic outbuildings, commercial (e.g., retail, offices, services), industrial, social (e.g., temples, theaters, community organizations), and religious structures. Specific characteristics of such architectural property types may include foundations, walls, floors, pads, pilings, footings, “robber trenches” (where footings once lay), or any other extant architectural elements. Structural remains from previously standing buildings and outbuildings may be present; although, structural remains are often not determined significant unless the architectural details are unique, are not well documented in the archival record, or represent the work of a master.

Refuse

Based on a review of research conducted for refuse deposits, refuse deposits typically have increased data potential when they are associated with a specific household, neighborhood, community, or ethnic/socioeconomic group, rather than deposits with broader associations (Schneyder, Cascella, Fernandez et al. 2010). As the number of groups associated with a given refuse

deposit increases, the potential for collecting and associating data with any specific group that may have deposited the refuse decreases.

In addition to the general considerations for refuse deposits described above, the effect of the APE-specific environmental conditions must be considered. Since the APE is located over water, and the various constituents of refuse deposited along the pier margin may have differential buoyancy (i.e., whole bottles and wood debris may float before settling to the seafloor, bricks and glass fragments will sink immediately), the distribution of refuse deposits along the seafloor may not be spatially related, or only selectively spatially related, to the initial depositional event. Non-cultural factors, such as water/wind current direction and duration of refuse buoyancy are likely to play a conditioning role in the distribution of refuse deposits along the seafloor.

In light of these considerations, recognition of locally deposited intact refuse deposits is imperative for providing meaningful archaeological analysis and addressing project research questions. Table 3-4 summarizes the likely range of refuse deposit types within the APE by depositional event.

Table 3-4 Attributes of Anticipated Refuse Deposits

Cultural Activity	Description	Structure
Sheet refuse	Artifacts (refuse) discarded and accumulated over a period of time.	Stratified or Mixed
Massive intentional fill	Industrial and structural debris, possibly combined with sediments.	Mixed

Sheet Refuse

In a terrestrial environment, sheet refuse is a low-density scatter of artifacts that can be made up of primary or secondary refuse. Sheet refuse deposits are recognizable because they are typically in direct proximity or association with a property boundary, contain multiple episodes of deposition documenting long-term use, are dispersed across a small area, and primarily consist of small items (Sullivan and Griffith 2005:25). Over time, as refuse accumulates and is not removed, stratified deposits can be created. Mixed deposits can be created through various formation processes, such as repurposing or recycling deposited materials, scavenging by animals, and changes in land use (Schiffer 1987:27–143). However, submerged sheet refuse is often found in mixed context. Mixed deposits in a submerged environment can be created by long term disposal in areas experiencing low sediment load.

When the source of sheet refuse is a residence or a commercial building in an urban area, the refuse scatter will be in close physical proximity to the structure and will primarily contain small items. According to Sullivan and Griffith (2005:35), larger items and accumulated trash from a property were likely transported to another, more distant location. Sheet refuse accumulation is less likely after 1910 when the citizens of Seattle first voted to establish a municipal, publically funded waste collection and disposal system (Thomson 1910). However, occasional opportunistic over-pier refuse disposal is likely to have occurred well into the present.

Massive Intentional Fill

Massive intentional fill may include a mixture of sediments, debris, or concentrations of materials associated with domestic, commercial, or industrial activities. Massive intentional fill is deposited during a single event; however, it is possible that discrete lenses of debris may be visible in a

stratigraphic profile. Subsequently, the characteristics of massive intentional fill should include substantial deposits that span a large area and may be deep, have likely been compacted or leveled, and contain mixed deposits of domestic, commercial, or industrial debris. Isolated artifacts found within this fill lack clear contextual associations and are seldom likely to yield important information beyond the *terminus post quem*[1] dating of fill event(s).

Assessing Significance

The NRHP recognizes properties that are significant at the national, state, and local levels. According to the NRHP (36 CFR 60), the quality of significance in American history, architecture, archaeology, engineering, and culture exists in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association. Properties that have the potential to be eligible for listing in the NRHP are properties that are at least 50 years old, unless they possess exceptional significance, meet one or more of the four criteria listed below, and retain integrity of their character-defining features.

A building or site can be considered for inclusion in the NRHP if it meets at least one of the following criteria (36 CFR 60):

A. Is associated with events that have made a significant contribution to the broad patterns of our history;

B. Is associated with the lives of persons significant in our past;

C. Embodies the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represents a significant and distinguishable entity whose components might lack individual distinction; or,

D. Has yielded, or might be likely to yield, information important in prehistory or history.

Eligible properties and historic districts must retain key character-defining features, or integrity, to convey their significance as a resource. *Integrity* refers to a property's ability to convey its significance. To convey this significance, a historic property must have enough intact physical characteristics or features to communicate its significance under one or more of the NRHP criteria. NRHP guidelines recognize seven aspects, or qualities, that define integrity. National Register Bulletin 15(1995) defines these aspects, which are summarized as follows:

- **Location.** The resource is located where it was originally constructed.
- **Design.** The design of the resources is in its original form, plan, and style.
- **Setting.** The physical environment of a historic place (refers to the character of a place not the specific place).
- **Materials.** The physical elements used in construction of the property at a particular time.
- **Workmanship.** The physical evidence of craftsmanship during the period of significance.
- **Feeling.** The property's ability to express a particular sense of time.
- **Association.** The "direct link" between the property and an important event or person.

[1] *Terminus post quem*, refers to the notion that the earliest date for the latest object of manufacture will provide the most reliable date to determine the "point after which" a context was deposited.

All of the eligibility criteria require that a historic property retain multiple characteristics of integrity, although the specific characteristics that need to be retained differ between each eligibility criterion. For example, under criteria A and B a historic property must, at minimum, retain integrity of location, setting, materials, feeling, and association (National Park Service 1995:48). Under criterion D, a historic property must retain integrity of location, materials, and association (Little et al. 2000:37).

Evaluating Archaeological Property Significance

The level of data and integrity required to consider an archaeological property significant varies depending on whether one is evaluating a precontact or historic property. Stratified precontact archaeological properties in primary depositional context are typically considered significant under criterion D in the absence of unusual mitigating factors. Under the same criterion, historical archaeological properties must be able to address relevant research questions that could not be addressed through archival research alone. If a historical archaeological site is to be considered under criteria A or B, the site must convey its association to a specific event or trend within a period of significance (criterion A) or be closely associated with an important person's productive life and must be a property that is closely associated with that person (criterion B) (National Park Service 1995:12, 15).

Archaeological Resources Typically Considered Not Eligible for the NRHP

Research and previous archaeological investigations in filled shoreline environments along the Seattle waterfront (Miss et al. 2010:75) have provided insight into types of resources that may be present in the APE that have limited data potential beyond recordation. Features and deposits typically considered not eligible for the NRHP include:

- Pilings, decking, trestle, ballast and railroad track and ties, unless of clearly unusual construction;
- Remains of infrastructure including abandoned utilities, portions of seawall, and brick or planked roadways, unless of clearly unusual construction;
- Mass deposits of wood, lumber, coal, or cinders;
- Demolition debris in the form of loose bricks, mortar, or other architectural materials; and,
- Historic-era artifacts within unstratified dredge spoils or regrade fill that are not associated with a feature or stable surface.

Chapter 4
Methods

This chapter describes the methods used to conduct a cultural resources assessment. As outlined in Chapter 1, Introduction, this cultural resources discipline report has three goals: to identify and evaluate previously documented cultural resources for their potential to be eligible for listing in the NRHP; record and evaluate as-yet undocumented built environment structures for their potential to be eligible for listing in the NRHP; and to assess the potential for encountering as-yet undocumented archaeological deposits in the APE. The following methods have been selected to address each of these goals.

Landscape History Analysis

A landscape history provides the necessary framework to develop archaeological expectations in the APE. Two categories of landscape history research methods are presented below: geologic research and historical research. The following reports were consulted for both categories: Gillis et al. 2005a; Gillis et al. 2005b; Huber et al. 2010; Rinck and Valentino 2009; Miss et al. 2010; Miss, Matson, Valentino, et al. 2008; Miss, Valentino, Rinck, et al. 2008; NWAA 2006; Schneyder, Cascella, and Simmons 2010; Schneyder, Cascella, and Elder 2011; Schneyder, Elder, et al. 2011; Valentino et al. 2010; and Wegener et al. 2010.

Geologic Research

Archaeologists reviewed geologic maps and geotechnical bore logs from the project vicinity to develop an area-specific geological context. This landscape history was used in conjunction with the landform expectations outlined in Chapter 3, Expectations, to develop a framework with which to assess the potential for encountering buried or submerged precontact archaeological deposits in the APE. The following sources were consulted to characterize the geology of the project vicinity:

- U.S. Geological Survey Publications Warehouse (http://pubs.er.usgs.gov/#home:7:30);
- Natural Resources Conservation Service Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm);
- Washington Department of Natural Resources, Division of Geology and Earth Resources Publications (http://www.dnr.wa.gov/ResearchScience/Topics/GeologyPublicationsLibrary/Pages/pubs.aspx)
- Washington Department of Natural Resources, Division of Geology and Earth Resources Subsurface Geology Information System (https://fortress.wa.gov/dnr/geology/?Site=subsurf);
- Geological Society of America (http://www.gsapubs.org/); and
- Science Direct (http://www.sciencedirect.com/).

Historical Research

For this project, research of primary and secondary source data was conducted to identify previously recorded historic properties, historical developments that influenced the APE and important architectural, engineering, and development trends that would help inform the historic significance of resources in the APE.

Historians and archaeologists conducted in-depth research to establish an area-specific historical context to assist in the evaluation of NRHP eligibility of historical archaeological resources, identify areas with sensitivity for historical archaeological sites, and identify areas where historical development activities altered the landscape—possibly reducing the potential for precontact and historical archaeological sites.

The following lists the contacted organizations and the extensive information provided on known and expected historic properties associated with communities in the APE.

- Washington State Department of Historic Preservation (DAHP):
  - Determinations of NRHP Eligibility at DAHP,
  - Historic Resources Inventory files at DAHP,
  - Historic Property Inventory (HPI) files at DAHP's online database, the Washington Information System for Architectural and Archaeological Records Data (WISAARD), and
  - NRHP nomination forms at DAHP;
- The WSDOT Bridge Inventory Database:
  - Detailed information about the trestles and loading spans;
- City of Seattle Historic Preservation Division (Department of Neighborhoods)
  - List of Seattle landmarks and landmark nominations,
  - Information on the Pioneer Square Preservation District;
- Sanborn Fire Insurance Company (maps);
- King County Assessor's Office;
- Seattle Municipal Archives:
  - Database of photographs;
- HistoryLink (online encyclopedia of Seattle, King County, and Washington State history);
- University of Washington:
  - Suzzallo Library,
  - Burke Museum,
  - Special Collections and Manuscripts;
- Museum of History and Industry (MOHAI)—historic photographs database; and
- Seattle Public Library—Seattle Room.

Literature Review

Archaeologists conducted a literature review using the WISAARD to identify previously documented cultural resources and previous cultural resources inventory and evaluation efforts in and directly adjacent to the APE. WISAARD contains all cultural resources records that are on file with DAHP. The records search was supplemented with ethnographic place name and historically described Native American site data obtained from *The Alaskan Way Viaduct and Seawall Replacement Project, Research Design for Identification of Archaeological Properties, Part I: Native American Properties* (Miss and Hodges 2007).

Field Survey and Historic Resource Inventory

All historic resources (built in or before 1965) within the APE were previously recorded and evaluated for the Alaskan Way Viaduct Replacement Project historic resources survey in 2009. DAHP has concurred with all of the determinations of NRHP eligibility for these resources. These historic resources have been recorded, as appropriate, in DAHP's WISAARD database, the Washington Heritage Register, the City of Seattle list of landmarks and historic resources survey database, and, if listed, the NRHP. The boundaries of national and local historic districts were also identified. Multiple studies and reports were used to collect and refine information about historic buildings and structures in the APE. The City's comprehensive survey of downtown properties (City of Seattle 2007–2008) was a major source of information for assessing the significance of previously recorded historic buildings and structures, as well as NRHP districts in the APE.

Underwater Site Investigation

Maritime archaeologists conducted additional underwater site investigations at 45KI1012 and 45KI1013 in June 2013 (ESA 2013). Investigations were conducted during an extreme low tide which exposed landward sections of the sites and allowed for an on-site meeting with WSDOT, DAHP, and other stakeholders. Methods included terrestrial and underwater survey, mapping, video and still underwater photography, and subsurface testing. Underwater Dredge Test Units (DTUs) were excavated at both sites in order to determine if there were subsurface deposits. Five DTUs were excavated at 45KI1012 and two DTUs were advanced at 45KI1013.

Chapter 5
Results

This chapter summarizes the results of the landscape history analysis, literature search, historic built environment survey, and underwater evaluation.

Landscape History

Geology

As described in Chapter 2, Environmental and Cultural Setting, the APE was intermittently covered with glacial ice during the Pleistocene. Ice from the most recent glacial advance, termed the Vashon advance, covered the APE from 17,400 years ago to around 16,400 years ago (Troost and Booth 2008:2). As glacial ice receded from the project vicinity, but continued to prevent the drainage of meltwater into the Strait of Juan de Fuca, the APE was inundated by glacial lake water (Thorson 1989:1168). Since humans could not have inhabited areas occupied by glacial ice or lakes, the upper contact of glacial, glaciofluvial, or glaciolacustrine deposits represents the maximum depth at which archaeological deposits can be found. Across the APE, the upper interface of glacial deposits range from 22.5 to 64.5 feet below the ground surface (Shannon & Wilson 1968, 1982).

Once glacial ice no longer blocked the Strait of Juan de Fuca, the previously entrained meltwater drained from Puget Sound and marine water quickly backfilled subglacial troughs as far south as the Seattle area (Thorson 1989:1168). As isostatic rebound slowed and sea levels continued to rise, marine water backfilled further into Puget Sound and the marine shoreline rose in elevation. Areas that became exposed to, and later inundated by, rising waters were subsequently shaped by the coastal geomorphic processes that they were exposed to, such as tidal and wave action. During this period, landward shoreline erosion occurred across the entire APE, as evidenced by the widespread presence of beach sediments below the ground surface (Shannon & Wilson 1968, 1982) and the occurrence of the predevelopment bluff face inland of the APE—an indicator of the landward-most extent of shoreline erosion (Bortelson et al. 1980:Sheet 7). As a result of landward erosion, the post-glacial terrestrial surface of glacial deposits in the APE have been eroded and reworked.

After the shoreline margin eroded landward of the APE, and as sea levels continued to rise to the extent that the ground surface was located below the zone of hydrodynamic effect for wave action, fine sediments began to accumulate on the ground surface. Between 4.5 and 11.5 feet of fine organic sediments accumulated on the ground surface in the APE prior to historic landscape modification (Shannon & Wilson 1968, 1982). During the historic period, industrial and commercial activities resulted in the deposition of between 11.5 and 48.5 feet of fill in the APE (Shannon & Wilson 1968, 1982). Figure 5-1 depicts the sequence of geomorphic processes that occurred in the APE prior to the historic period, based on the descriptions provided above. Figure 5-2 depicts the locations of the geotechnical bores used to conduct the geologic analysis.

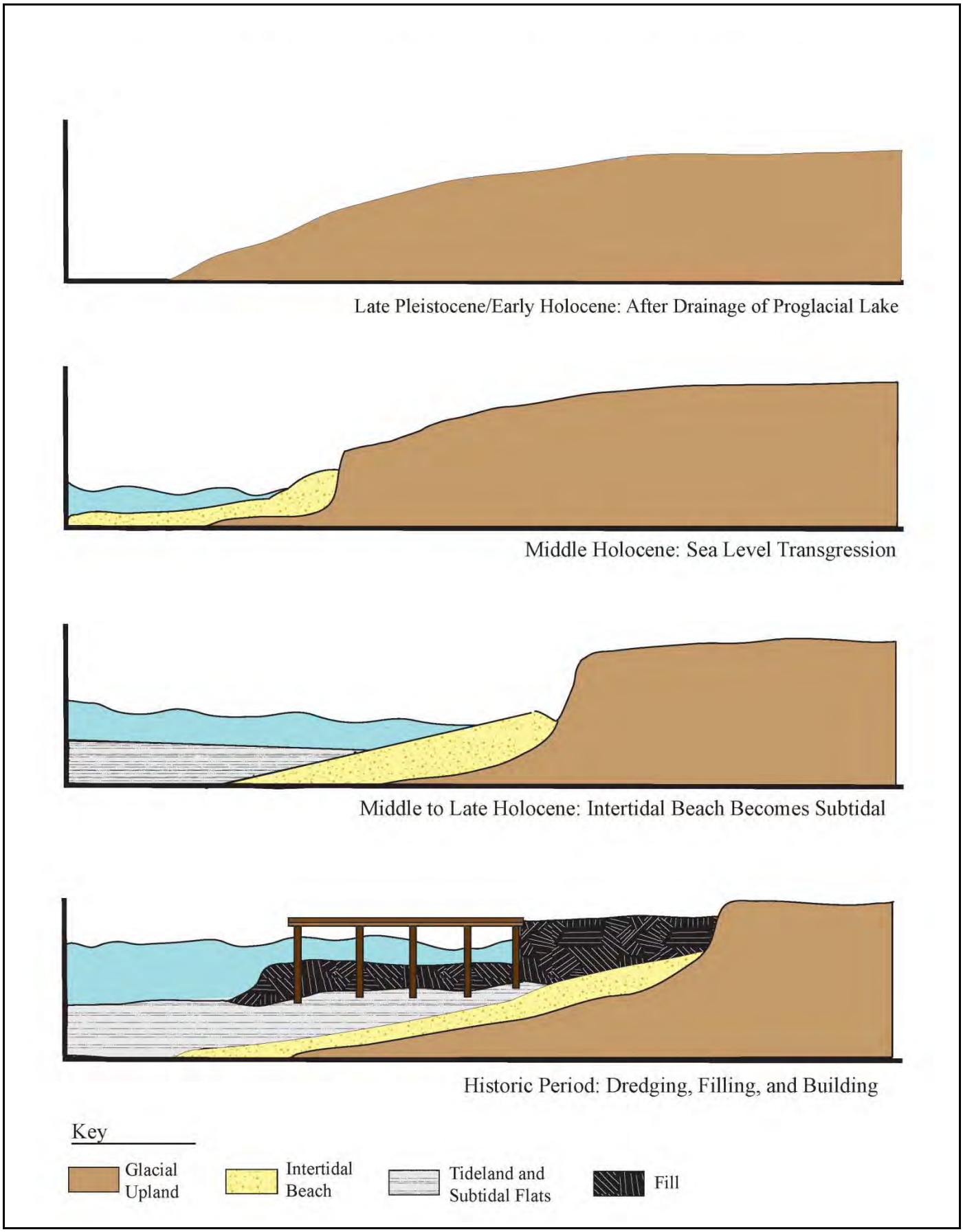

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Figure 5-1
Landform Change Prior to Historic Development

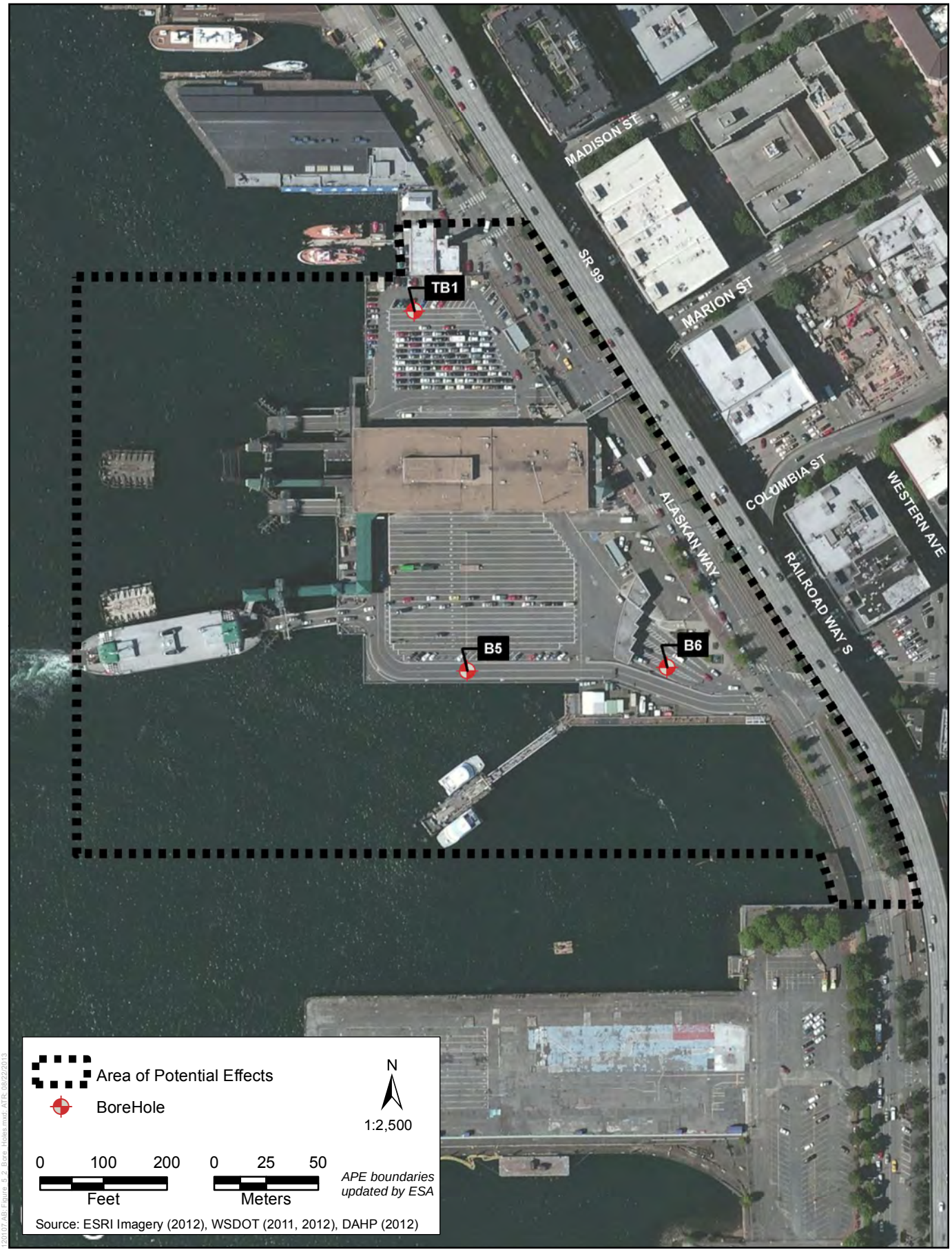

Figure 5-2
Geotechnical Borehole Locations
Seattle Multimodal Terminal at Colman Dock

Historical Development

At the time of Seattle's initial settlement in 1852, the APE was undeveloped and located entirely under water (Alden 1854) (Figure 5-3). However, the shoreline in the vicinity of the APE was one of the earliest to be developed in the area. Here, just east of the southern margin of the APE, the first sawmill was built by Henry Yesler in 1853 at the foot of Mill Street (today Yesler Way) (Bagley 1916:25; Ficken 1987:39). Initially, Yesler's sawmill did not include a wharf and lumber had to be rafted out to waiting vessels in the harbor (Andrews 2005:12; Finger 1968:299). This changed in 1854 when Yesler built his first wharf. However, the dock only reached a short distance and was not sturdy, with pilings only placed in hand-dug holes. Throughout the 1850s, most ships anchored offshore and were unable to use this first dock (Finger 1968:299).

In 1859, Yesler began a series of improvements to his dock. Extending it toward deeper waters, by the early 1860s Yesler added length to the wharf until it was 200 feet long, still located just east of the southern margin of the APE (Finger 1968:300). Yesler also began reinforcing his wharf against the teredo, a worm-like mollusk that tunnels into submerged wood (Didžiulis 2011:3). To deter damage, which could destroy oak timbers in less than a year, Yesler piled rocks, ballast, cut-off slabs, and sawdust between pilings. On top of this, he placed dirt and planking and then finished the teredo shielding with sand and gravel on top (Finger 1968:300). These methods reportedly kept teredo infestation focused on the outside pilings, which were more easily replaced than inner supports (Didžiulis 2011:6; Finger 1968:300). Soon, other waterfront dwellers copied some of Yesler's techniques, although their goal could have been land reclamation rather than teredo prevention (Klingle 2007:51).

During the late 1860s and early 1870s, Seattle trade increased, largely because of the early development of coal exports. During this time, the Yesler wharf took on a larger role as it began to serve more businesses and customers. The wharf was expanded until it was 650 feet long and 200 feet wide, entering the APE at its southern margin for the first time. New businesses emerged in the additional wharf space, including warehouses, a water tank, an ice-house, a black-smith shop, stores, and saloons (Finger 1968:301–302).

The 1870s saw still more expansion to the Yesler wharf. Yesler leased the wharf's sawmill to first Preston & McKennon (1872), and then James Colman (1874). Under Colman, much of the sawmill's dilapidated machinery and structural deficiencies were replaced and repaired between September 1874 and the spring of 1875 (Bagley 1916:230; Finger 1968:301; *Seattle Daily Times* 1957:9). Also, between 1874 and 1875, a 300-foot branch of the wharf was built extending to the north and west (Figure 5-4). Housed on this offshoot were two large coal bins, one each for the Renton and Talbot coal companies (Finger 1968:301–302; Lawson 1875). Also in 1875, a flour mill was constructed on the main section of the wharf (Finger 1968:301).

The additions of the mid-1870s dramatically increased the capacity of Yesler's Wharf. In all, the wharf was said to have the capacity to serve six vessels at once during this period (Finger 1968:301–302). However, Yesler's finances were starting to feel the strain from his commitments on the waterfront and elsewhere in the city. In 1876, he sold the sawmill on the wharf to Colman for $45,000 (*Seattle Daily Times* 1972:13). With a financial burden relieved, Yesler began work on the wharf again and in 1877 announced plans to add another 250 feet in length to the main dock (Finger 1968:304).

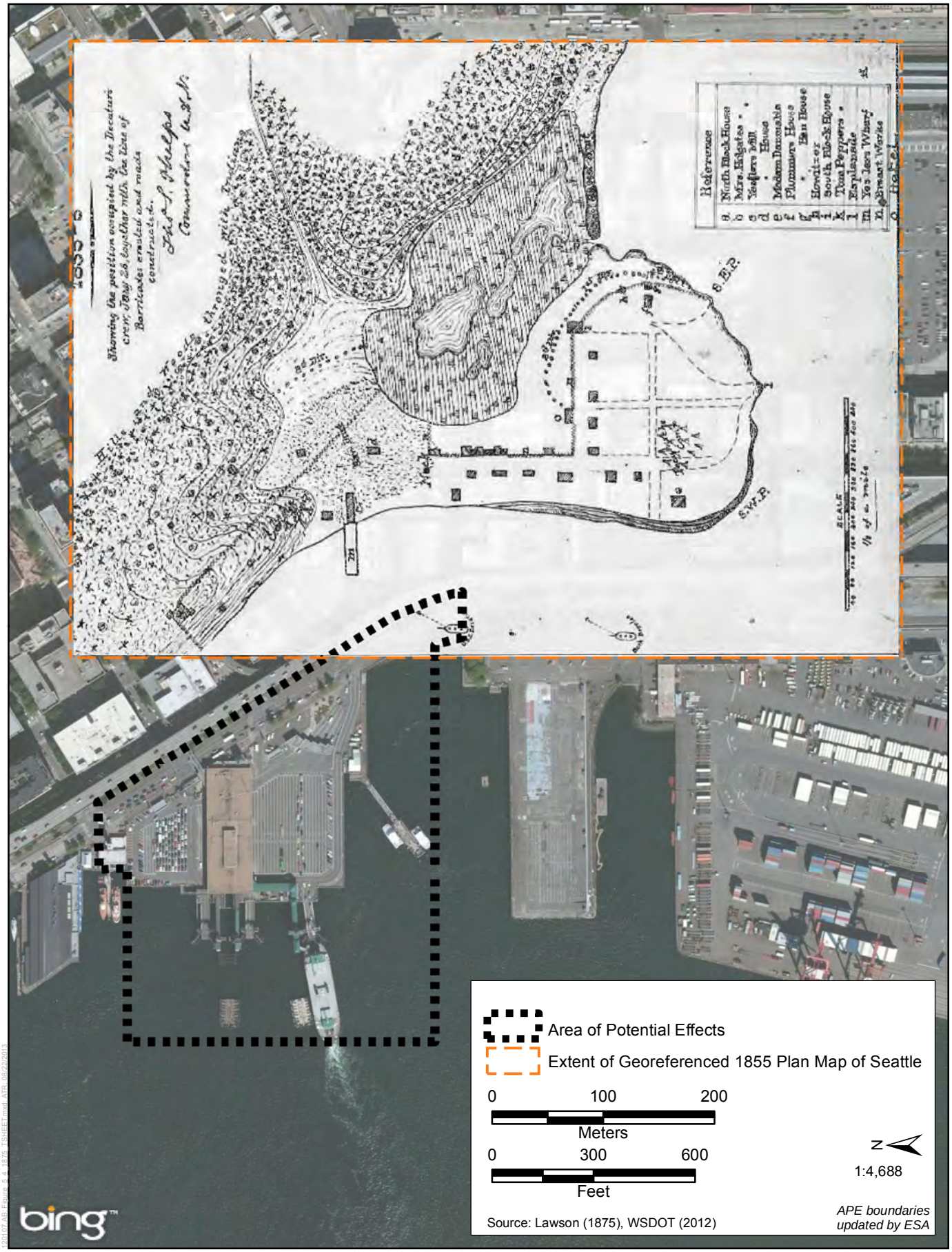

Figure 5-3
1855 Shoreline (Plan Map of Seattle Overlay)
Seattle Multimodal Terminal at Colman Dock

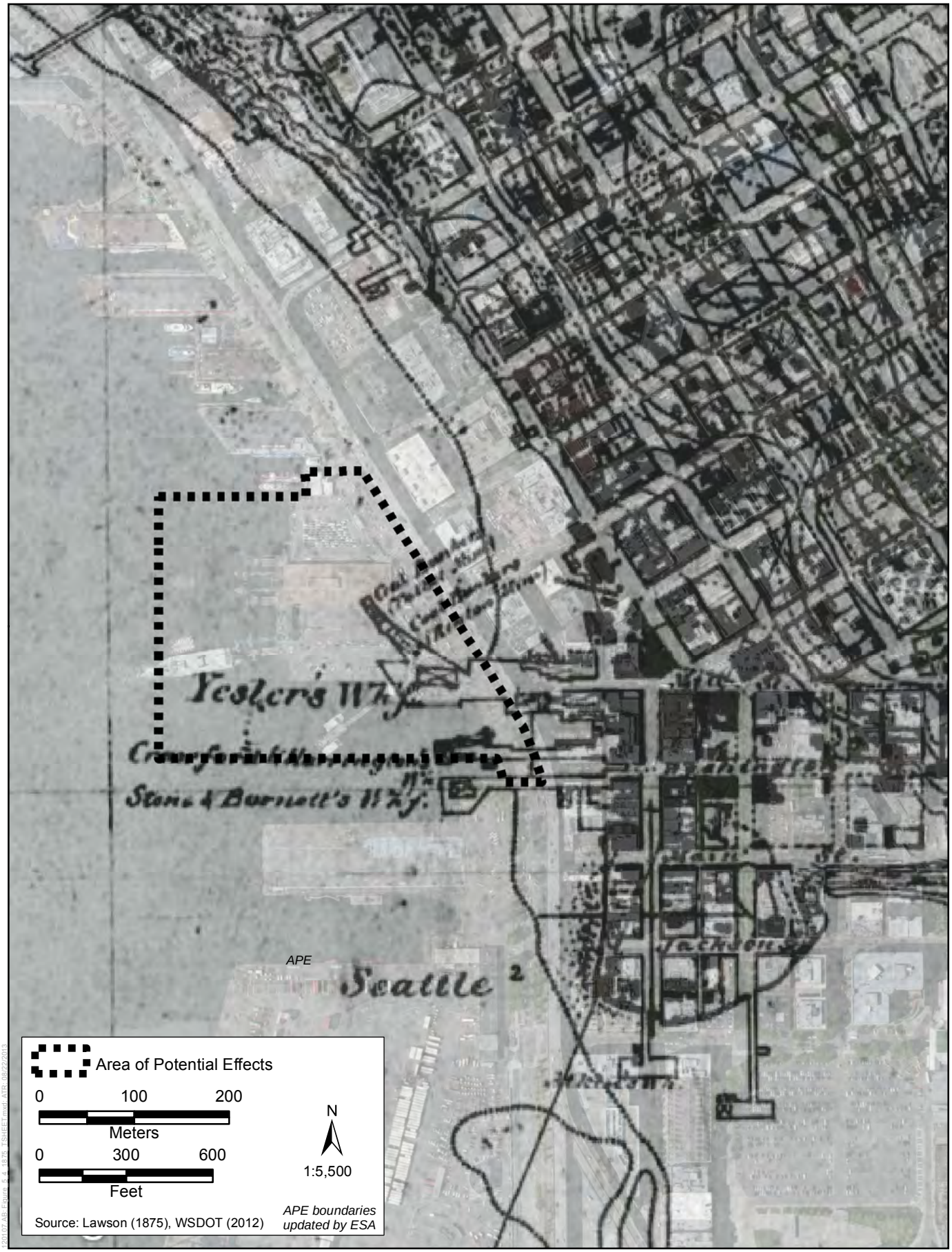

Figure 5-4
1875 Shoreline (Coast Geodetic Survey T-Sheet Overlay)
Seattle Multimodal Terminal at Colman Dock

At the end of the 1870s, uninhibited prosperity of the wharf took a slight hit. In 1879, a fire broke out and consumed Colman's Mill along with three other buildings on the wharf (Conover 1954:64). However, Yesler did not personally suffer losses from the mill's destruction, and he began rebuilding almost immediately. By the early 1880s, the sawmill was rebuilt and the wharf added a boiler shop and more saloons (Finger 1968:304).

Prosperity and trade in Seattle continued to increase and the 1880s saw further expansion to the Yesler wharf, along with the development of adjacent properties. Colman, who had purchased the adjoining lot to the north of Yesler, built a new dock on the property in 1882 (Figure 5-5) (Crowley 1998:72). The following year, Yesler began building another extension to his wharf, expanding the northward arm. However, Colman filed a lawsuit arguing that Yesler was cutting off access to his wharf. A heated battle ensued and the outcome ruling allowed Yesler to keep his wharf's northward arm as currently constructed, but blocked him from any further extensions in that direction (Finger 1968:305–307).

On June 6, 1889, the Great Fire of Seattle began only a few blocks from the APE. Struggling to contain the flames in the heavily wooden construction, Seattle's firefighters attempted to create fire breaks to stop the spread. In one such effort, large amounts of dynamite were placed under the center of Colman Dock and discharged. Unfortunately, the firefighters' efforts failed and not only did the flames continue to move up the waterfront, but Colman Dock was completely consumed by the fire. Ultimately, 116 acres of the central business district were destroyed, including both the Yesler wharf and Colman Dock (Bagley 1916:423; *Seattle Post-Intelligencer* 1889:1). No burn layers associated with this event have been documented in the geotechnical bores that have been excavated in the APE (Shannon & Wilson 1968, 1972).

After the fire, the waterfront remerged from the ashes and both Yesler and Colman were quick to rebuild. A little over a week after the fire, Yesler's Wharf was functional enough to unload some passengers and freight. Within a year, the wharf measured 460 feet by 220 feet and included 18 buildings (Finger 1968:312). Colman also rebuilt but focused his new dock to primarily serve Puget Sound's private ferries (Figure 5-6) (Brewer et al. 2003:136). To the north, a slip for the West Seattle Ferry was built, along with a short, wide dock housing warehouses, two cement businesses, and a machine shop (Sanborn-Perris Map Company 1983). During this same period, the first Fire Station No. 5 was built at the foot of Madison Street and equipped with the fireboat *Snoqualmie* (Sanborn Map Company 1905; Sanborn-Perris Map Company 1983; Wickwire 2000:2).

Although he went to the trouble of rebuilding his dock, Yesler wanted out of the business. Shortly after completing the new dock, Yesler sold his wharf in August 1890 to the Northern Pacific (Dorpat 2005:91; Finger 1968:314; Miss and Hodges 2007:B-4; Armbruster 1999:122, 126–128). Northern Pacific owned and operated the wharf until the early 1900s. In 1901, Northern Pacific purchased the Seattle & International Railroad (formerly the Seattle Lake Shore & Eastern incorporated in 1885), which occupied prime Railroad Avenue frontage, included a Canadian line branch, and traveled to lucrative coal mines (Armbruster 1999:122, 127, 133, 138-140). To prepare for the anticipated increased volume, Northern Pacific demolished Yesler's Wharf in 1901. The following year, Northern Pacific removed the fill that had accumulated over the years beneath Yesler's Wharf, which is evident on historic maps prior to 1900, and likely towed it out and dumped it in Elliott Bay (Curtis 1902; Dorpat 2005:91,153–154; Goold 1899; Historic Preservation Program 2007:7). Deep deposits of fill with wood debris currently located under Alaskan Way in the southeast margin of the APE (Shannon & Wilson 1968) are likely disturbed materials related to multiple filling events that occurred at the Yesler wharf from the late 1860s until 1904). Some portion of the disturbed

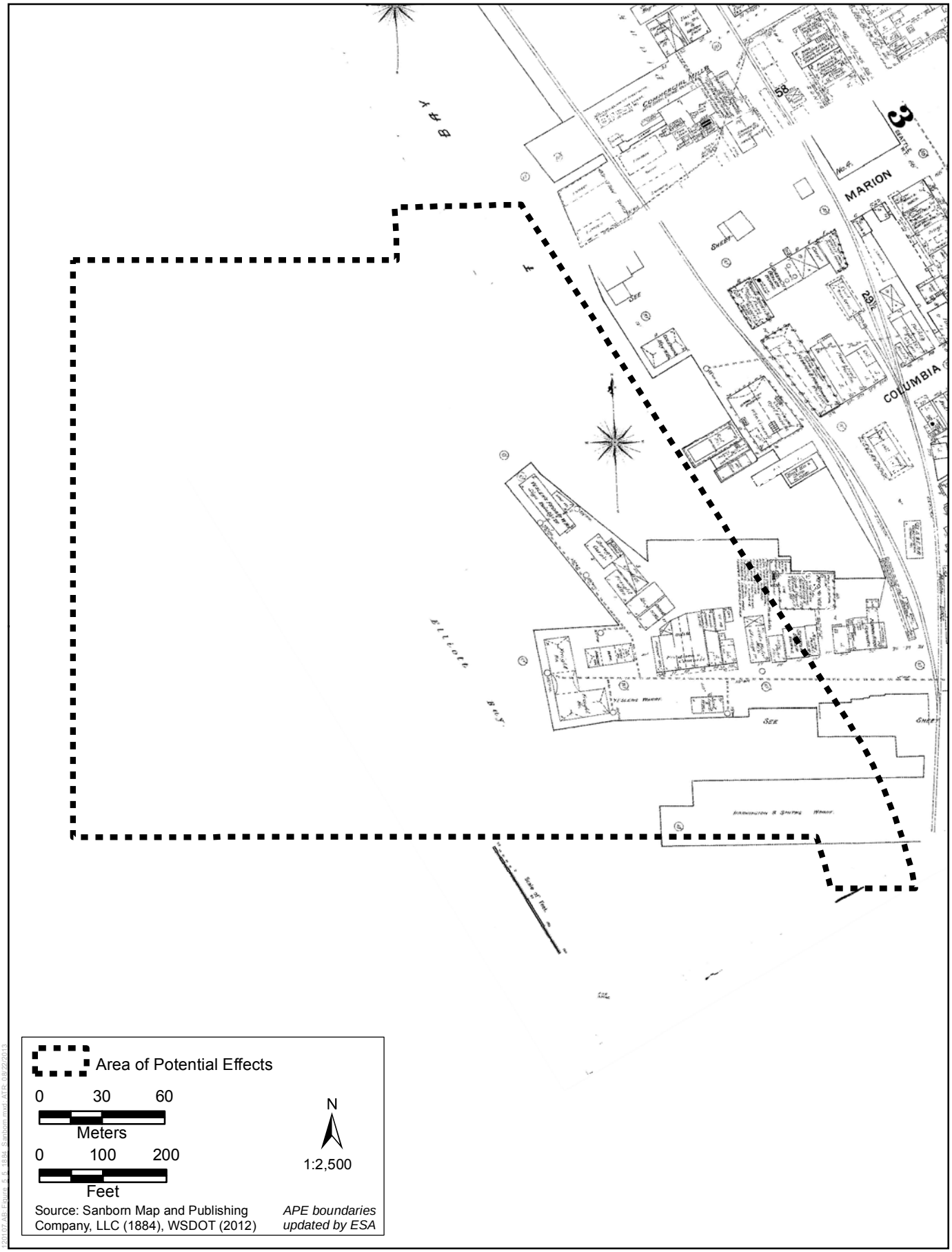

Figure 5-5
1884 Shoreline (Sanborn Fire Insurance Overlay)
Seattle Multimodal Terminal at Colman Dock

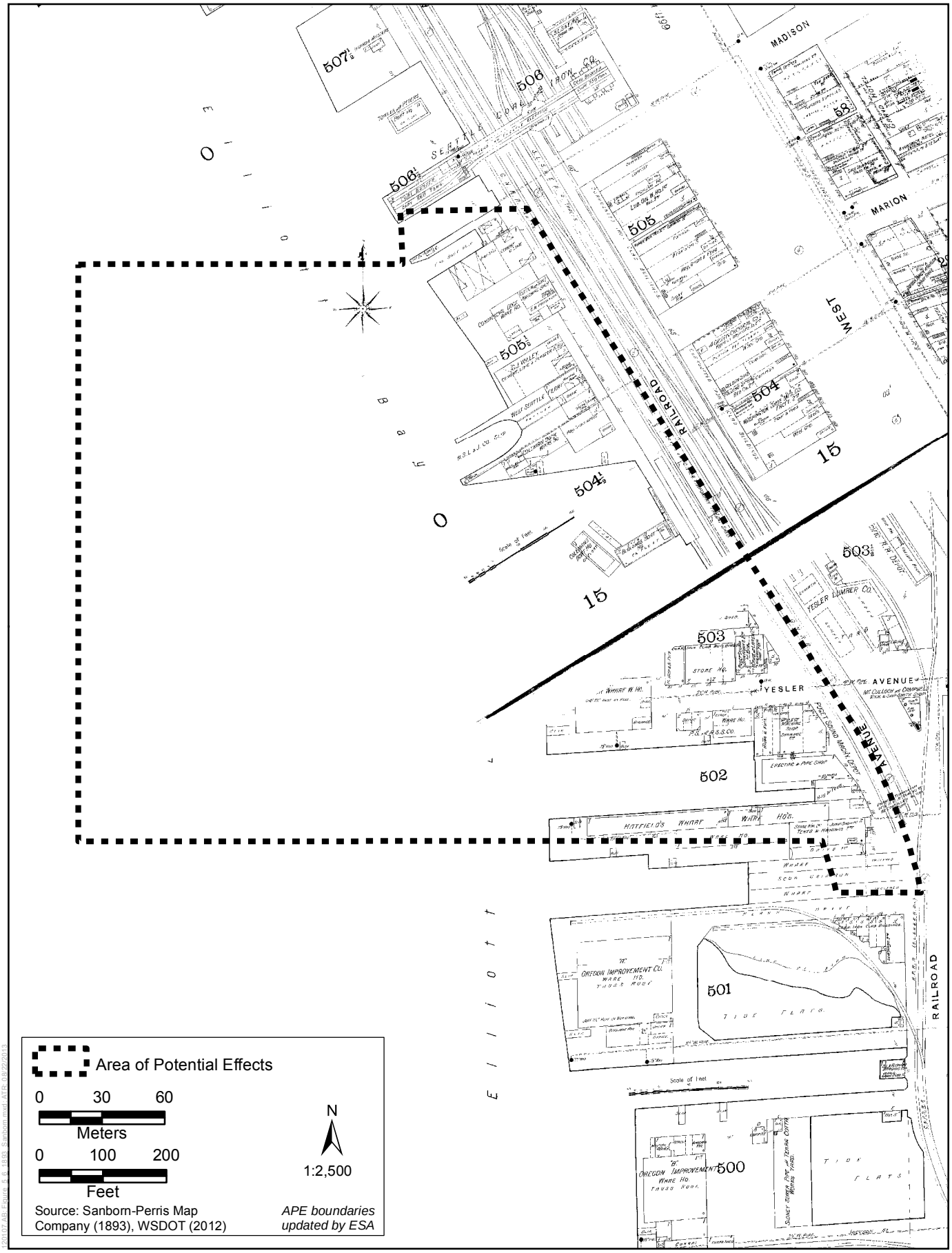

Figure 5-6
1893 Shoreline (Sanborn Fire Insurance Overlay)
Seattle Multimodal Terminal at Colman Dock

materials may represent filling events at Yesler's wharf (late 1860s until 1901) that were not fully extracted during dredging in 1902.

In the early-nineteenth century, most piers were demolished and rebuilt with a diagonal orientation to allow for improved freight mobility along the waterfront. This rebuilding of the waterfront also saw an increased focus on local transportation (Figure 5-7). By 1904, Northern Pacific had built Piers 1 and 2 (later renamed Piers 50 and 51) (Dorpat 2005:153–154; Historic Preservation Program 2007:7). Between 1893 and 1905, the two docks located between Fire Station No. 5 and Colman Dock—previously the West Seattle Ferry and a dock occupied by warehouses—were demolished and rebuilt. The West Seattle Ferry remained but was rebuilt at an angle; the warehouse dock was replaced with a pier for the steamer *Flyer*. The *Flyer* was one of the fastest local ferries, operating four daily trips between Seattle and Tacoma (Bagley 1916:120; McClary 2005; Sanborn Map Company 1905; Sanborn-Perris Map Company 1983; Sundquist 2010:44). Fire Station No. 5 was demolished in 1902 and replaced with a larger two-story station (Sanborn Map Company 1905; Sanborn-Perris Map Company 1983; Wickwire 2000:2).

Traffic on the Seattle waterfront continued to increase and although the structures in the APE were only a few years old, they were soon expanded or replaced to accommodate the additional needs. In 1908, Colman expanded his dock to include a domed waiting room and clock tower (Brewer et al. 2003:136). In 1910, the *Flyer* pier, just north of Colman Dock, was demolished and the Grand Trunk Dock was built, the largest pier on the Seattle waterfront at that time. Designed by Blackwell and Baker, this dock was the destination of the Grand Trunk Pacific Company's luxurious steamers from Vancouver, Victoria, and other northwest locations (Dorpat 2005:181; Historic Preservation Program 2007:7). Meanwhile, Northern Pacific's Pier 1 and Pier 2 were leased to other steamliner companies. By 1910, Pier 2 was leased to the Alaska Steamship Company, which serviced Alaska and the Bering Sea, and remained under the company's operation for several decades. By 1912, Pier 1 was leased to its first steamship company, the Alaska Pacific Steamship Company, and thereafter was also operated by Canadian Pacific Steamship Company and the Luckenbach Lines (Baist 1912; Beaton 1917:255, 1918:379, 1919:173; Kroll Map Company 1920, 1930; Pacific Ports Inc. 1920:364; United States Bureau of Corporations 1910:240).

With all of the activity on the Seattle waterfront in the early 1900s, docks in the APE also sustained damages during this period that required repairs or full reconstruction. In 1912, the Grand Trunk Dock was struck by the *Alameda* steamship, but damage was minimal (*Seattle Times* 1912). That same year, the *Alameda* also struck Colman Dock, toppling the stately tower, which was quickly rebuilt (Brewer et al. 2003:136). In 1914, one of the largest impacts on this area of the waterfront occurred: the Grand Trunk Dock, for unknown reasons, exploded in flames. Firefighters from nearby Fire Station No. 5 rushed to the scene and were soon joined by firefighters from all over the city. The flames spread quickly and the fire was so intense, many boats seeking to provide assistance were turned away to prevent other vessels from catching fire. Nearby, Colman Dock's roof caught fire from the radiant heat and only the quick action of the United States revenue cutter *Unalga* saved it, although it suffered heavy water damage. When the smoke finally settled, five people perished and the Grand Trunk Dock was a total loss (Stein 2001). The charred piles were quickly recapped and topped with another terminal (Dorpat 2005:181).

In the early to mid-1900s, the waterfront continued to undergo changes in an effort to modernize and provide additional facilities. Possibly in direct response to the Grand Trunk Dock fire, Fire Station No. 5 demolished its existing wooden structure in 1916 and built a new, two-story brick

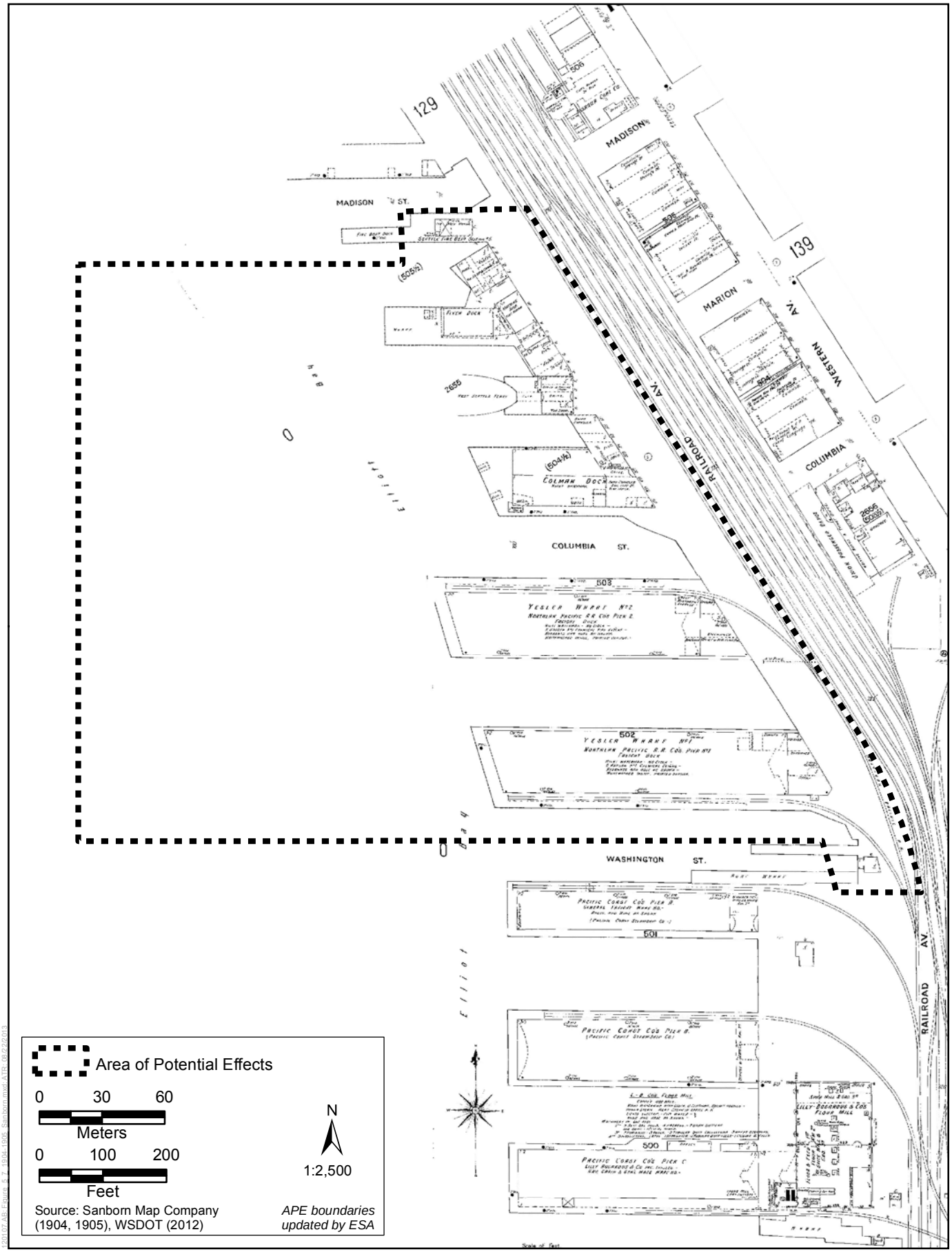

Figure 5-7
1904-1905 Shoreline (Sanborn Fire Insurance Overlay)
Seattle Multimodal Terminal at Colman Dock

structure, which opened by 1917 (Wickwire 2000:2). On Colman Dock, a new slip for automobiles was built to handle the ever-increasing ferry demands in 1923. Just over a decade later, a portion of Colman Dock was demolished in 1937 to build a new terminal for the Black Ball Line (Crowley 1998:73; Hershman et al. 1981:42). In 1945, the neighboring Grand Trunk Dock was joined to Colman Dock and was also brought into use as a ferry slip (Figure 5-8).

The APE underwent extensive development in the early 1960s. In 1961, Pier 51's shed was removed and replaced with a restaurant, the Polynesia, along the southern margin of the APE (*Seattle Times* 2010). Also in 1961, Fire Station No. 5, which had become structurally unsound, was demolished and a new building, which still stands, was opened in December 1963 (Wickwire 2000:2). The Pier 1 (50) warehouse was demolished in 1962 and the pier was connected to Pier 2 (51). These combined piers served as berths to the *Dominion Monarch*, a liner from England that served as a hotel during the World's Fair, and the *Skagit Belle*, a rebuilt sternwheeler (*Seattle Daily Times* 1962:21). In 1965, both the Colman Dock ferry terminal and former Grand Trunk Dock were demolished in advance of the construction of the SMT, which officially opened on May 18, 1966 (Durio 2004; Hyak 1967:4; *Seattle Times* 1965).

WSDOT planned and implemented the southward expansion of the SMT during the latter portion of the twentieth century. In 1980, WSDOT acquired both Pier 1 (50) and Pier 2 (51). At the time, the piers were only occupied by the Polynesia Restaurant and a parking lot. However, after an investigation, WSDOT determined that both piers were structurally unsound and closed them to the public on May 7, 1980 (*Seattle Daily Times* 1980:1). The Polynesia Restaurant was removed by crane the following year and the piers were subsequently demolished in advance of the southward expansion of the SMT, which began in 1990 (*Seattle Times* 1982:B2, 1990). During the expansion project, a protective fill cap, ranging from 46 to 61 centimeters (18 to 24 inches), was placed on the seabed below the SMT to seal contaminated sediments, which reduced the potential for suspension when driving piles for the concrete trestle constructed in 1990 (CH2M Hill 2005). A timeline of major events that occurred in the APE is provided in Table 5-1.

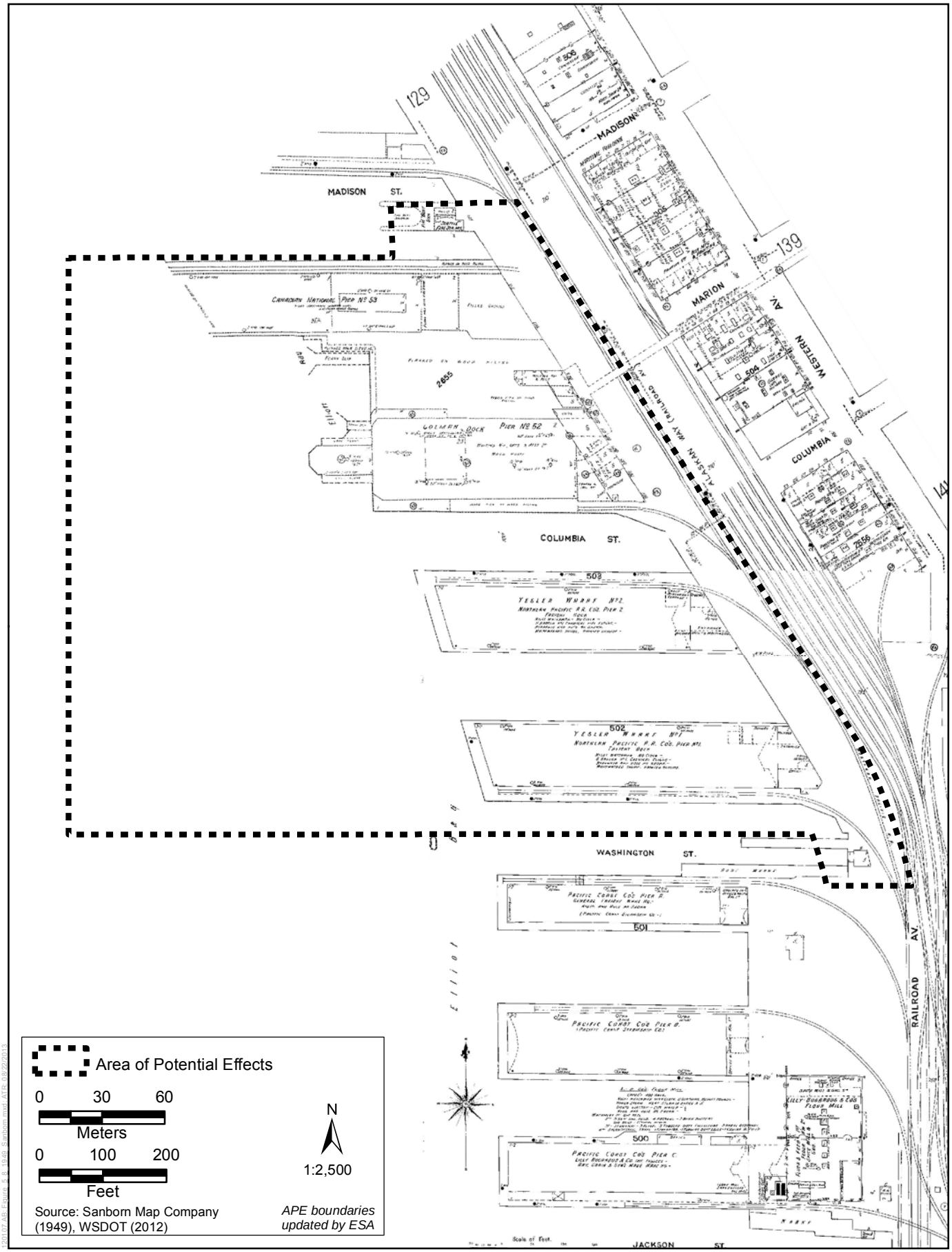

Figure 5-8
1949 Shoreline (Sanborn Fire Insurance Overlay)
Seattle Multimodal Terminal at Colman Dock

Table 5-1 Timeline of Major Events in the Vicinity of the APE

Event	Dates
Yesler's first sawmill built.	1853
Yesler's Wharf built.	1854
Yesler's Wharf extended to reach 200 feet in length	1859–early 1860s
Yesler's Wharf extended to reach 650 feet in length and 200 feet wide. Enters the APE for the first time. Businesses include warehouses, a water tank, ice-house, black-smith shop, stores, and saloons.	
Yesler's Wharf sawmill repaired and updated.	September 1874–spring 1875
Yesler's Wharf extended in a new branch 300 feet to the north. Two coal bins were housed in this location.	1874–1875
Flour mill built on Yesler's Wharf.	1875
Sawmill and three other buildings on Yesler's Wharf are destroyed in a fire.	1879
Yesler's sawmill rebuilt.	early 1880s
Colman Dock built.	1882
Great Fire of Seattle. All wharfs destroyed.	June 6, 1889
Yesler's Wharf rebuilt to 460 feet long by 220 feet wide, supporting 18 buildings.	1890
Yesler sells his wharf to Northern Pacific.	August 1890
Colman Dock rebuilt.	1890–1893
West Seattle Ferry dock built.	1890–1893
Warehouse dock, housing warehouses, two cement businesses, and a machine shop, built.	1890–1893
Fire Station No. 5 built.	1891
Yesler's Wharf demolished.	1901
Fill from under Yesler's dock dredged.	1902
Piers 1 and 2 built.	1902–1904
West Seattle Ferry dock demolished and rebuilt.	1893–1905
Warehouse dock demolished. Flyer Dock built.	1893–1905
Fire Station No. 5 demolished and rebuilt.	1902
Colman Dock expanded to include a domed waiting room and clock tower.	1908
Flyer Dock demolished; Grand Trunk Dock built.	1910
Colman Dock and tower damaged by steamship *Alameda* and repaired.	1912
Grand Trunk Dock damaged by steamship *Alameda* and repaired.	1912
Grand Trunk Dock destroyed by fire and rebuilt.	1914
Colman Dock damaged by fire and repaired.	1914
Fire Station No. 5 demolished and rebuilt.	1916–1917
Washington Street Boat Landing opened.	1920
Colman Dock adds a new automobile slip.	1923
Colman Dock-portion demolished and a new Black Ball line terminal built.	1937
Grand Trunk Dock joined to the Colman Dock.	1945
Pier 2 (51) shed removed and replaced with the Polynesia restaurant.	1961
Fire Station No. 5 demolished. Rebuilt.	1961–1963

Event	Dates
Pier 1 (50) warehouse demolished. Piers 1 (50) and 2 (51) connected.	1962
Colman Dock and Grand Trunk Docks demolished. Seattle Ferry Terminal is built to replace them.	1965–1966
WSDOT buys and condemns Pier 1 (50) and Pier 2 (51) for safety reasons.	1980
Polynesia Restaurant removed from Pier 2 (51).	1981
Pier 1 (50) and Pier 2 (51) demolished.	1981–1990
Seattle Multimodal Terminal expanded to Pier 1 (50) and Pier 2 (51) former locations.	1990

Summary

As sea levels rose during the Holocene, the ground surface within the APE underwent landward erosion and subsequent inundation. Once inundation occurred, the seabed was largely inaccessible for human occupation except during periods of low tide, and was continuously affected by tidal and wave forces. One of the earliest areas of development along the Seattle waterfront during the historic period, the APE was subject to repeated episodes of pier, wharf, and dock construction and demolition over open water, as well as filling associated with Yesler's original wharf and widespread dredging. All wharf structures within the APE that were built before 1965 were dismantled in advance of the construction and subsequent expansion of the SMT. Prior to construction of the SMT, no overwater structures were located in the central western portion of the APE.

Given that the APE is located in an area that has experienced frequent and extensive development, and that portions of the APE would have had no overwater structures until the late-twentieth century, the potential for encountering intact, and significant archaeological deposits on the seabed across the APE is considered low.

Literature Review

In January 2013, an architectural historian and archaeologist conducted a search of reports for cultural resources surveys that occurred in or directly adjacent to the APE and all documented cultural resources within the APE, using the WISAARD database. They also reviewed cultural resources documentation for the APE vicinity provided to WSDOT as part of the Elliott Bay Seawall Project.

Cultural Resources Reports

Four cultural resources investigations have occurred in the APE, including an underwater reconnaissance survey (Roberts 2011a), an underwater inventory survey (SWCA 2012), a geoarchaeological study (Rinck 2011), and underwater testing at two sites (ESA 2013). The underwater archaeological reconnaissance and inventory surveys, conducted in support of the Elliott Bay Seawall Project, occurred seaward of the current seawall and covered a substantial portion of the seabed below the SMT in the APE. The reconnaissance survey identified four underwater archaeological sites, two of which are located in the APE (45KI1012 and 45KI1013). The subsequent inventory provided additional documentation of the site and recommended that both sites had the potential to be eligible for listing in the NRHP (Roberts 2011a; SWCA 2012). The

underwater testing at 45KI1012 and 45KI1013 was conducted in support of the Seattle Multimodal Terminal at Colman Dock Project (ESA 2013). The results of testing are discussed in Chapter 6.

The geoarchaeological study was also conducted in support of the Elliott Bay Seawall Project and used data from previously excavated geotechnical bores landward of the current seawall (the eastern margin of the APE) to assess the potential for encountering archaeological deposits. The study separated the Seattle waterfront into a series of geoarchaeological study units, two of which contain the APE (units 33 and 42). Although significant gaps between boreholes were noted for the geoarchaeological study units located in the APE, none of the boreholes in the APE contained cinders and one borehole (CB-17b) contained a thin deposit of wood embedded within deposits of silty fill (Rinck 2011:A-7–A-12). The absence of cinders and relatively minor deposits of wood debris is far less than anticipated for an area that previously contained a large sawmill that was destroyed by the Great Fire of Seattle during the historic period.

Cultural Resources Records

Eight previously recorded cultural resources are located in the APE (Figure 5-9). Of these, two structures (the Elliott Bay Seawall and the Washington Street Boat Landing) and one building (Fire Station No. 5) were previously determined eligible for listing in the NRHP[2]. HPI forms for the eligible resources are presented in Appendix B. Further, a small portion of the locally designated Pioneer Square Preservation District is located in the APE.

Two archaeological sites are located within the APE (45KI1012 and 45KI1013); they have been determined not eligible for listing in the NRHP (FTA 2013) (Appendix C).

The WISAARD database also indicated that one property, the ferry *M.V. Vashon*, is located in the APE. However, the *M.V. Vashon* was decommissioned in 1982, and taken to Alaska where it ran aground and sank in 1986 (*Seattle Times* 1986). Table 5-2 summarizes the previously recorded cultural resources that are currently located in the APE[3].

Underwater Testing

In June 2013 underwater testing was conducted at two sites within the APE, 45KI1012 and 45KI1013.

45KI1012

Site 45KI1012 is located [redacted] The site consists of a mound of boulders and cobbles (approximately 225 feet long by approximately 155 feet wide) with sand, gravels, and wood material directly abutting the seawall beneath Colman Dock (Piers 50-51) (Marcotte and Johnson 2013a:Figures 2 and 3). In profile, the site is approximately 7-10 feet above the sea floor at its eastern end directly abutting the

[2] The Elliott Bay Seawall, a historic property, is located along the eastern margin of the APE. Since the project is anticipated to commence after the Elliott Bay Seawall Project, it is anticipated that the seawall will have been demolished by the time the project commences.

[3] Table 5-2 does not include two recorded resources within the APE, the Colman Dock or Yesler Wharf/Decatur Anchorage, because these represent "places" rather than archaeological sites. Both of these resources have been previously determined not eligible for listing in the NRHP.

seawall, and decreases in height as it continues along the seabed deeper into the bay to the west (Marcotte and Johnson 2013a:Figure 4). Approximately 90 remnant wooden pilings of varying heights are present within the site matrix. The site is covered by gravels ranging in size from pebble to boulder, and is interspersed with isolated modern and historical cultural materials. Historical cultural materials generally dating to early to mid 20th century include bottles, domestic ceramics, metal objects, and brick (including some marked samples) previously recorded and relocated during survey. Modern cultural materials consist of bottles, a license plate, miscellaneous metal objects, and other debris likely discarded from the dock above or Alaskan Way. Along the centerline of the site toward the western boundary, remnant pilings increase. The remains of decaying pilings, damaged from marine borers and partial removal are present at and just below the surface, covered by the gravel and cobble matrix (Marcotte and Johnson 2013a:Figures 5-6). The condition of the pilings varied widely, with some cut flush to the surface of the mound and others appearing to have been snapped off mechanically leaving a jagged remnant. This variation in condition suggests multiple demolition events in the APE. In one area there is a concentration of wood planking including end cuts. Analysis of chronologically diagnostic glass items observed during the survey revealed that these items ranged from the middle-nineteenth century to the middle-twentieth century in age (SWCA 2012:4-9–4-12; Held et al. 2012:2).

45KI1013

Site 45KI1013 is located [redacted]. The site represents four surface scatters of artifacts and debris, and also contains several remnant pilings. Subsurface investigations included two DTUs; both were sterile (ESA 2013:6). Descriptions of the four artifact concentrations that comprise 45KI1013 are provided below.

- **Concentration 1.** The northern-most artifact concentration, Concentration 1 comprises several clusters of discarded bottles. Analysis of the chronologically diagnostic bottles observed in this concentration indicates that they range from the early- to middle-twentieth century. Modern materials, including aluminum cans, glass bottles, and other debris are also present in the concentration.
- **Concentration 2.** The western-most artifact concentration, Concentration 2 comprises pressed glass tableware, whole and broken bottles, glass and ceramic fragments, and wooden pile remnants. Analysis of the chronologically diagnostic artifacts observed in this concentration indicates that the scatter ranges from the late-nineteenth century to the middle-twentieth century.
- **Concentration 3.** The southern-most artifact concentration, Concentration 3 comprises a small scatter of whole bottles dated to the middle-twentieth century. Modern debris is scattered on the surface of the concentration.
- **Concentration 4.** The eastern-most artifact concentration, Concentration 4, comprises glass vessel fragments, ceramics, metal items, brick, intact bottles, and modern debris. Analysis of the chronologically diagnostic artifacts observed in this concentration indicates that the scatter ranges from the late-nineteenth century to the middle-twentieth century. This concentration was originally recorded during the underwater reconnaissance survey (Roberts 2011a), and some of the artifacts could not be relocated during the subsequent investigations. Since this concentration is located in the intertidal zone and subject to breaking waves, some of the

artifacts likely drifted ashore, as evidenced by the occurrence of metal, ceramic, brick, bottles, and modern debris lying on the subaerially exposed riprap along the seawall.

Ethnographic Places and Native American Sites

Although several ethnographically named places and historically described Native American sites are located in the vicinity of the APE, none are located in the APE (Miss and Hodges 2007:16). This is expected, given that the APE was below the low water line prior to historical development (Bortelson et al. 1980:Sheet 7) and largely covered by piers during the historic period.

[redacted]

Figure 5-9
Cultural Resource Locations
Seattle Multimodal Terminal at Colman Dock

Table 5-2 Previously Recorded Resources in the APE

ID	Resource Name	Resource Type	Description	NRHP Status	Author and Date
1	Fire Station No. 5	Historic Building	Modern fire station constructed in 1963.	Eligible.	Sheridan 2009
2	Elliott Bay/Alaskan Way Seawall	Historic Structure	Waterfront seawall, slated for replacement in 2016.	Eligible.	Sheridan 2009
3	Pioneer Square Preservation District	Local Historic District	Local preservation district governed by a preservation board.	N/A	N/A
4	Pier 52/53 (Colman Dock)	Historic Building/ Structure	Ferry terminal building and dock built in 1966.	Not eligible.	Durio 2004
5	Seattle Steam Heat and Power Company Saltwater Suction Pipes	Historic Object	Twenty-four (24)-inch cast-iron pipes used to supply saltwater to the Steam Heat and Power Company and for fire prevention.	Not eligible.	Schwab 2010
6	45KI1012	Archaeological Site	A large mound of boulders and cobbles interspersed with timbers and remnant pilings with historic debris scatter.	Not eligible.	Roberts 2011a, 2011b; SWCA 2012; ESA 2013; Marcotte and Johnson 2013a
7	45KI1013	Archaeological Site	A historic debris scatter consisting of several concentrations of intact and broken bottles and ceramics with occasional modern trash.	Not eligible.	Roberts 2011a, 2011c; SWCA 2012; ESA 2013; Marcotte and Johnson 2013b
8	Washington Street Boat Landing Pergola	Historic Structure	Galvanized iron shelter constructed in 1920.	Listed 1973; also within the Pioneer Square Preservation District.	Skolnik 1973

Chapter 6
NRHP Eligibility Evaluations and Assessment of Effects

This chapter presents NRHP eligibility evaluation statements for 45KI1012 and 45KI1013 and identifies potential effects to historic properties, as defined in 36 CFR 800.5.

NRHP Eligibility Evaluations

To determine whether these sites have the potential to be eligible for listing in the NRHP, they must be at least 50 years old (unless they retain extraordinary significance), meet at least one of four significance criteria, and retain sufficient integrity to convey their significance as historic properties. The following sections evaluate the NRHP eligibility of both sites based on these requirements.

45KI1012 (ID #6)

Though 45KI1012 was once inferred to be associated with the original Yesler's Wharf (1854–1889) (SWCA 2012:4-12), the 2013 fieldwork suggests the site is a remnant of the Northern Pacific Railway Company (Northern Pacific) pier and that the site has been significantly modified (ESA 2013). While 45KI1012 overlaps with the historic location of the seaward end of Yesler's Wharf and the Northern Pacific dock, the site extends beyond the footprint of Yesler's Wharf, and closely matches the footprint of the Northern Pacific wharf. There is ample documentation that the Northern Pacific demolished Yesler's Wharf and dredged under it before constructing Piers 1 (50) and 2 (51). The Northern Pacific reportedly dumped significant amounts of stone and gravel under their various piers, including Piers 1 and 2 beginning in 1902 (SWCA 2013: 109). Based upon review of historic maps, aerial images, and WSDOT's site cap plan which included topographic lines, the site boundaries align with the Northern Pacific wharf.

Age

As indicated in Chapter 5, Results, the vicinity of 45KI1012 has undergone several cycles of development between the nineteenth and twentieth centuries.

The mound has been modified numerous times including during maintenance and renovation of Piers 1 (50) and 2 (51) (between 1902 and 1962), construction of the seawall (1910s), demolition of Piers 50 and 51 (1980s), laying of the sediment cap (1989), and during construction of the Colman Dock south trestle (1990s). Thus, the site cannot be associated with a specific time period. The site is described as containing glass, ceramic, metal, and brick items. Although SWCA (2012:4-10) only presents chronologically diagnostic artifacts from the late-nineteenth century in the site summary and NRHP eligibility evaluation, review of the full list of diagnostic artifacts on the site addendum form reveals that chronologically diagnostic artifacts are from a broad chronological period, ranging from the late-nineteenth century to the middle-twentieth century (Held et al. 2012:2). These items are also located in an area that was consistently covered by over-water structures starting in the middle-nineteenth century (see Chapter 5, Results, Historical Development), and thus, would have been inaccessible for primary deposition except for periods of structure fire, demolition, or

construction. This suggests that these items are in secondary depositional context and can only be used to establish the date that each diagnostic artifact entered the water.

In summary, it is unclear whether the boulder and cobble mound, wooden piles, and wood debris were elements of a single structure or of successive structures. The glass, metal, ceramic, and brick fragments scattered across the site are most likely in secondary depositional context and cannot be reasonably associated with a discrete time period.

Criteria

Criterion A: Associated with events that have made a significant contribution to the broad patterns in our history.

Under criterion A, an archaeological site must not only convey chronological association with historic events or trends, but its specific association must be considered important as well (Little et al. 2000:22). Assuming that the contents of 45KI1012 are structural remnants from any or all of the over-water structures that were built in the vicinity of the site, 45KI1012 can—at a minimum—be associated with a trend in the development of the Seattle waterfront throughout the twentieth century.

The site cannot be associated with any specific, significant event. Further, there is no evidence of the Great Fire of 1889 that destroyed Yesler's first dock. The site is associated with Northern Pacific, and possibly even Yesler's post-1890 dock, but it does not have integrity of design, setting, materials, feeling, or association. The site's primary association is location. The structural remnants that comprise the site represent minor elements of a series of the wharves and piers that embody the historical trend in the development of the Seattle waterfront—elements that served no notable or important contribution to this trend. Thus, the site cannot be associated events that have made a significant contribution to the broad patterns in our history.

Criterion B: Associated with the lives of persons significant to our past.

Under criterion B, an archaeological site must be associated with an important person's productive life, must be a property that is most closely associated with that person, and must illustrate that person's important achievements (National Register Bulletin 1995:14-15). Given the considerable modifications to the waterfront, Site 45KI1012 cannot be associated with a specific individual.

Even if the entire site could be associated with a specific property, and the important persons with whom they were associated, it is highly unlikely that the structural remnants alone would adequately illustrate the importance of that individual's achievements. The use of piles and fill (Klingle 2007:51) to support wharf and pier structures was widespread along the Seattle waterfront and in the greater Puget Sound, and thus, is not uniquely characteristic of a specific individual. Thus, the site cannot be associated with the lives of specific persons significant to our past.

Criterion C: Embody the distinctive characteristic of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic value, or that represents a significant and distinguishable entity whose components may lack individual distinction.

As a mound of cobbles with remnant wood pilings and relatively sparse artifacts from a chronologically broad range Site 45KI1012 does not embody the distinctive characteristic of a type, period, or method of construction. It does not represent the work of a master, possess high artistic

value, or represent a significant and distinguishable entity whose components may lack individual distinction. The site lacks integrity of design, setting, workmanship, feeling, and association, and has been heavily impacted by and modified by subsequent development, including construction of the seawall along Alaskan Way, Northern Pacific pier demolition and construction, sediment capping, the installation of concrete piles, as well as erosion from marine borers and tidal fluctuation.

Based on location, it could be part of the fill Yesler placed during his last phase of dock expansion, but the materials comprising the mound do not match published descriptions of the type of fill Yesler used. Further, the site location closely aligns with the Northern Pacific pier, and the site materials closely match their method of pier construction.

Criterion D: Have yielded, or may be likely to yield, information important in prehistory or history.

The diagnostic artifacts observed across 45KI1012 originated from a wide chronological range (i.e., mid-nineteenth century to the middle-twentieth century [Held et al. 2012:2]), and were located in an area that was nearly constantly covered by wharves, piers, and docks since the middle-nineteenth century. Further, there is no stratigraphic association; all the artifacts are on a single surface – the seabed (ESA 2013). Therefore, it is highly likely that these items represent a combination of loose refuse deposited during wharf, pier, or dock demolition or construction events, and refuse that was carried and deposited by the movement of water over time. These items are most likely in secondary depositional context and cannot be associated with a particular individual or group.

Although it is possible there is a remnant of earlier phases of construction preserved below one meter, the geotechnical cores do not provide evidence of this. The upper one meter of site materials appear to represent one construction event among the many that have occurred in the area. Given the extensive number of piles (wooden and concrete) driven into the mound since 1902, and the construction of the seawall and Alaskan Way, it is unlikely that significant deposits remain that could impart new or important information. Thus, the site has not yielded, and is not likely to yield, information important in prehistory or history.

Significance Recommendation

Site 45KI1012 does not meet the NRHP criteria of significance. While the site is related to the development of the Seattle waterfront in the late nineteenth and early twentieth century, it retains only integrity of location. Further, the site lacks the integrity necessary to meet any of the NRHP criteria: it is not related to a specific or significant event (Criterion A), it cannot be associated with a specific individual (Criterion B), it is not a rare type of construction nor does it represent the work of a master (Criterion C), and it does not contain archaeologically significant data (Criterion D). Even if the site could be associated with a historically significant event or person, or could yield information important to history, it lacks sufficient integrity to convey this association. Therefore, 45KI1012 is recommended not eligible for listing in the NRHP.

45KI1013 (ID # 7)

45KI1013 has no subsurface component and no evidence of discrete episodes of deposition (ESA 2013). At least three of the concentrations contain modern debris, and the diagnostic artifacts from each indicate a broad chronological range, extending from the late-nineteenth century to the

middle- twentieth century. The concentrations of artifacts at this site represent the underwater equivalent of a terrestrial surface sheet scatter, and therefore are not considered significant.

Age

The chronological timeline for the deposition of the four clusters of scattered artifacts at this site is unclear. It is plausible that the site began forming in the historical past and is still in the process of forming as additional refuse is deposited on the seabed. In either case, the age of the site is unverifiable.

Criteria

Criterion A: Associated with events that have made a significant contribution to the broad patterns in our history.

Under criterion A, an archaeological site must not only convey chronological association with historic events or trends, but its specific association must be considered important as well (Little et al. 2000:22). Given the wide timeframe in which the site appears to have been formed, and the lack of data on how or when the artifacts were deposited, 45KI1013 cannot be reasonably associated with a specific event, nor an important historical trend. Rather, the site represents general waterfront use over a long time period. Thus, the site cannot be associated with events that have made a significant contribution to the broad patterns in our history.

Criterion B: Associated with the lives of persons significant to our past.

Under criterion B, an archaeological site must be associated with an important person's productive life, must be a property that is most closely associated with that person, and must illustrate that person's important achievements (National Register Bulletin 1995:14–15). Site 45KI1013 lacks the chronological and provenience resolution necessary to associate it with any specific individual, and thus, cannot be associated with the lives of specific persons significant to our past.

Criterion C: Embody the distinctive characteristic of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic value, or that represents a significant and distinguishable entity whose components may lack individual distinction.

As a collection of loose artifacts, 45KI1013 cannot embody the distinctive characteristic of a type, period, or method of construction, nor does it represent the work of a master, possess high artistic value, or represent a significant and distinguishable entity whose components may lack individual distinction.

Criterion D: Have yielded, or may be likely to yield, information important in prehistory or history.

Subsurface testing at 45KI1013 demonstrated that the site has no subsurface component and provided no evidence of discrete episodes of deposition (ESA 2013). Further, there is no spatial patterning indicative of behavior other than opportunistic and casual discard of common, low-value items from the piers, waterfront, or boats. Thus, the site has not yielded, and is not likely to yield, information important in prehistory or history.

Significance Recommendation

Although 45KI1013 contains numerous artifacts greater than 50 years old and is located along a portion of the Seattle waterfront of historic importance, the site itself does not meet any of the NRHP criteria. The site cannot be associated with an event or individual of local or regional significance, and has not yielded information important to prehistory or history. Therefore, the site is recommended not eligible for listing in the NRHP.

Summary of Eligibility Evaluations

Table 6-1 summarizes the eligibility evaluations for 45KI1012 and 45KI1013.

Table 6-1 Summary of Eligibility Evaluations.

NRHP Criteria	45KI1012	45KI1013
Criteria A: Associated with events that have made a significant contribution to the broad patterns in our history.	Not associated with any specific, significant event. It is associated with Northern Pacific and possibly even Yesler's post-1880 dock, but only retains integrity of location.	Not associated with any specific, significant event; represents general waterfront use.
Criterion B: Associated with the lives of persons significant to our past.	Not clearly associated with Yesler, other than by location.	Not associated with any specific person.
Criterion C: Embody the distinctive characteristic of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic value, or that represents a significant and distinguishable entity whose components may lack individual distinction.	Does not embody the distinctive characteristics of a type, period or method of construction. Does not match published descriptions of the type of fill Yesler used. Has been heavily impacted by construction of the seawall, pier demolition and construction, filling with sand, rip rap, and quarry spalls.	Not applicable.
Criterion D: Have yielded, or may be likely to yield, information important in prehistory or history.	No evidence for significant subsurface deposits revealed by archaeological dredge tests or geotechnical coring. The site has not provided information important or significant to history.	There is no subsurface component to the site and no spatial patterning indicative of any behavior or events other than casual discard of common items from the pier or waterfront. The site has not provided information important or significant to history.

Determination of Eligibility

FTA and FHWA determined that 45KI1012 and 45KI1013 were not eligible for listing in the NRHP. DAHP concurred with this determination (Appendix C).

Assessment of Effects

It is recommended that the undertaking would have no adverse effects on historic properties. Within the APE, the Washington Street Boat Landing Pergola is listed in the NRHP, and the Elliott Bay Seawall and Fire Station No. 5 are eligible for listing in the NRHP, but none would be adversely affected by the project. Although a small portion of the locally significant Pioneer Square Preservation District is located in the APE, it would not be affected by the project. The following sections describe why each of these properties would not be adversely affected by the project.

Fire Station No. 5 (ID # 1)

Built in 1963, Fire Station No. 5 is of concrete and steel construction and is located directly adjacent to the area of proposed ground disturbance. WSF assessed potential project construction-related effects from vibration during pile removal on this resource (WSF 2013). The analysts developed a model, based on FTA (Hanson et al. 2006) and California Department of Transportation (Jones & Stokes 2004) guidance, to determine the distance to which vibrations from the various construction activities would spread before dropping below the FTA damage criterion of a peak particle velocity (PPV) of 0.5 inches per second. The model shows that pile-driving vibrations would reduce to below 0.5 PPV at approximately 12 feet (Magnoni 2012). However, it is important to note that the model is based on pile driving, rather than pile removal. Pile removal creates lower vibration levels than pile driving.

Fire Station No. 5 is slightly less than 12 feet from the northeastern corner of the Colman Dock structure. WSF plans to remove the wooden piles in this area by vibrating them out, placing the fire station just within the 12-foot threshold described above. Again, that threshold derives from pile driving vibration and so is inherently conservative.

FTA, FHWA, and WSF will implement best management practices (BMPs) and monitor the building to determine actual vibratory levels and implement appropriate protective measures if vibratory levels exceed the FTA damage threshold. Although some effects could result from vibration during construction, including slight cracks in the exterior façade or “sticky” doors or windows, they would not be considered adverse under Section 106 unless construction diminished one or more aspects of integrity that make the building eligible for listing in the NRHP. These minor effects are not expected to rise to that level. FTA, FHWA, and WSF would repair any minor damage in accordance with the Secretary of Interior’s standards and in consultation with DAHP. Therefore, the building may be affected, but that effect would not be adverse. No other direct or indirect effects are anticipated.

Elliott Bay Seawall (ID # 2)

As indicated previously, the project is anticipated to commence after the Elliott Bay Seawall Project has started. Therefore, although the Elliott Bay Seawall is eligible for listing in the NRHP and is located in the APE, the seawall is anticipated to have been demolished prior to construction of the Seattle Multimodal Terminal at Colman Dock Project. Thus, this historic property would no longer be extant at the time of construction and would no longer be considered a historic property.

Pioneer Square Preservation District (ID # 3)

Although not a historic property, the Pioneer Square Preservation District (PSPD) is a City of Seattle landmark district, and effects from the project are considered as part of this analysis. The locally designated PSPD, as well as the NRHP-listed Pioneer Square-Skid Road Preservation District, were both designated in 1970. A very small portion of the local landmark district is located in the APE (Figure 6-1), but the NRHP-listed district boundary is to the east of the Alaskan Way Viaduct structure, and is not within the APE.

The undertaking would not affect the local PSPD. No physical alteration to any part of the district is anticipated during construction or operation of the project. No significant indirect effects during construction, including significantly increased traffic or closures, are anticipated.

The Washington Street Boat Landing Pergola (ID # 8)

The Washington Street Boat Landing was listed in the NRHP in 1973, and is also within the City of Seattle Pioneer Square Preservation District. The structure will be removed from its current location during construction of the Elliott Bay Seawall project. It is anticipated that the structure will be reinstalled at or near its current location, and will retain integrity of location, design, materials, workmanship, and feeling.

The undertaking would not affect the resource. The project's Draft Noise and Vibration Technical Report (WSF 2013), which documents the noise and vibration analysis, indicates that vibration impacts from construction activities would not extend to the landing. Moreover, the Washington Street Boat Landing is expected to be more structurally sound after it is restored following the Seawall project.

The new Colman Dock will be about 200 feet from the landing, 10 to 20 feet closer than the current dock is to the resource. That slightly reduced distance would not alter any aspect of the structure's integrity. No other direct or indirect effects are anticipated.

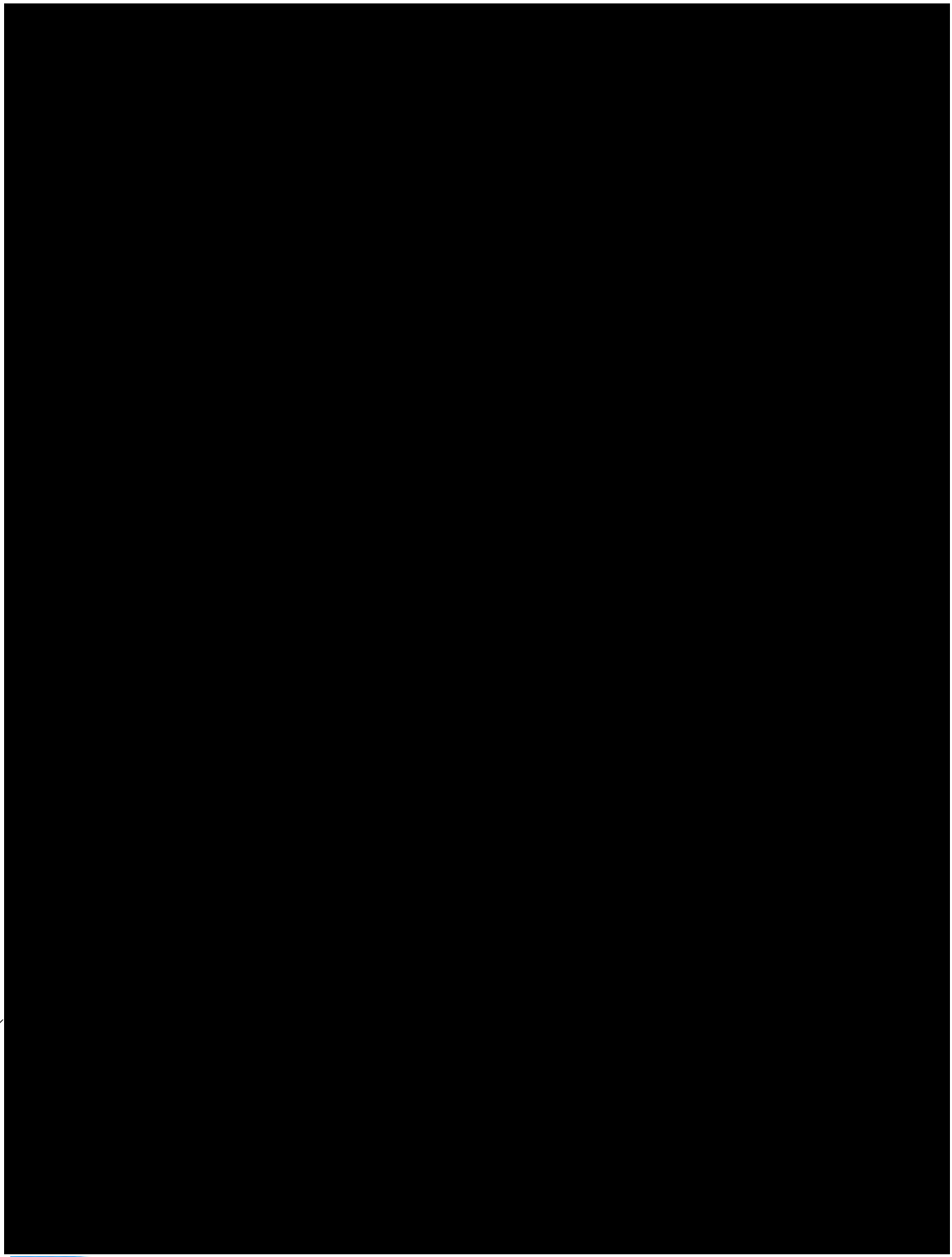

Figure 6-1
Cultural Resource and Proposed Ground Disturbance Areas
Seattle Multimodal Terminal at Colman Dock

Chapter 7
Conclusions and Recommendations

This chapter summarizes the results of the cultural resources discipline report and provides technical recommendations.

Conclusions

An archaeological record search and reconnaissance-level built environment survey identified eight cultural resources in or directly adjacent to the APE. Of these, one is listed in the NRHP (the Washington Street Boat Landing), two were previously determined eligible for listing in the NRHP (Fire Station No. 5 and the Elliott Bay Seawall), one is a Seattle City Landmark (Pioneer Square Historic District), and four were previously determined not eligible for listing in the NRHP. Although Fire Station No. 5, a portion of the Elliott Bay Seawall, the Washington Street Boat Landing, and a portion of the Pioneer Square Historic District are located in the APE, none of these resources would be adversely affected by the project.

Review of the landscape history in the APE indicates that there is limited potential for encountering submerged or buried archaeological deposits in primary depositional context. Certain factors, such as the APE's location over water, as well as repeated episodes of waterfront development and extensive dredging make it unlikely that archaeological deposits would retain integrity, as evidenced by the condition of 45KI1012 and 45KI1013.

Recommendations

Since it is anticipated that no adverse effects would affect the NRHP-eligible resources located in the APE, a finding of no adverse effects to historic properties is recommended for the project under Section 106 of the NHPA.

WSF will develop an Inadvertent Discovery Plan (IDP) for the SMT. An IDP outlines the protocols that will be followed if cultural resources are inadvertently discovered during construction.

FTA, FHWA, and WSF will implement best management practices (BMPs) and monitor Fire Station No. 5 to determine actual vibration levels and implement appropriate protective measures as necessary to prevent damage during Phase IV of construction.

Chapter 8
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Appendix A

APE Correspondence

U.S. Department
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Administration**

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May 7, 2013

Dr. Allyson Brooks, SHPO
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, WA 98504-8343

DAHP Log#: 051911-05-FTA
Re: Seattle Multimodal Terminal Project at Colman Dock
Revised Area of Potential Effects and Request for Comment

Dear Dr. Brooks:

As you know, the Federal Transit Administration (FTA), Federal Highway Administration (FHWA), and Washington State Department of Transportation Ferries Division (WSF) are proposing an undertaking to preserve transportation service at the Seattle Ferry Terminal at Colman Dock (the Seattle Terminal) in Seattle, Washington. In response to comments received by agency partners during the scoping process, including a letter dated January 29, 2013 from your office the agencies have revised the Area of Potential Effects (APE) for the undertaking. FTA, FHWA, and WSF invite you to comment on the revised APE as defined below.

Please provide any comments by June 6, 2013.

Project Description
This project is located in the City of Seattle, within Township 24N, Range 04E, Section 6, Willamette Meridian. FTA, FHWA, and WSF propose to replace the aging and seismically vulnerable components of the Seattle Terminal in order to maintain the facility's role as a regional multimodal transportation hub into the future. The structures replaced by the project are at the end of their service life. The reconfigured facility would preserve the level of vehicle holding available today, enhance safety and operational efficiency, and provide better connections to transit. The new structures would meet current seismic bridge and building code requirements. The project would also address conflicts between vehicles and pedestrian traffic and operational inefficiencies.

FTA, FHWA, and WSF propose to replace the northern timber trestle portion of the Seattle Terminal as well as the main terminal building and auxiliary structures located on the timber trestle. The vehicular transfer span, overhead loading structure, and some marine components of Slips 2 and 3 would also be replaced. The project would also accommodate the in-kind replacement of the existing two-slip passenger-only ferry facility located at Pier 50. The new facility would be connected to the new terminal building and the Marion Street pedestrian bridge by an overhead walkway in order to reduce pedestrian and vehicle conflict.

Definition of the Revised Area of Potential Effects (APE)
The revised APE includes areas with the potential to affect historic properties. Potential effects to archaeological sites are primarily anticipated where ground disturbance will occur during project construction. Potential effects to historic structures are primarily anticipated through vibration associated with construction. Given that the project will replace the existing non-historic terminal facility with a similar non-historic terminal facility, indirect effects related to the setting, feeling, or association of historic properties are highly unlikely. FTA and FHWA consider the revised APE to encapsulate the entire area where there is any potential to affect historic properties.

During the scoping process, FTA, FHWA, and WSF received comments from the City of Seattle in regards to expanding the APE to include Seattle Fire Station No. 5 to the north and the Washington Street Boat Landing to the south. Given the proximity of these historic properties to the project area, the City of Seattle expressed concern that there was a potential for direct construction impacts to affect the integrity of these historic properties. After the federal agencies elected to broaden the APE to include the Fire Station in January 2013, your office suggested that we should reconsider the exclusion of the Washington Street Boat Landing. In response to these comments, FTA and FHWA have now expanded the APE again to include the Washington Street Boat Landing. See Fig. 1.

Tribal Consultation
FTA, FHWA, and WSF will also be requesting comments on the expanded APE from the Muckleshoot Indian Tribe, the Suquamish Tribe, the Snoqualmie Tribe, the Tulalip Tribes, and the Yakama Nation. We look forward to responding to any concerns those parties may identify and will notify you of any such concerns.

Consulting Party Consultation
FTA, FHWA, and WSF will also be requesting comments on the expanded APE from the City of Seattle, the Washington Trust for Historic Preservation, Historic Seattle, and Duwamish Tribal Services. We look forward to responding to any concerns from those parties may identify and will notify you of any such concerns.

Please contact Dan Drais (FTA) (206.220.4465; Daniel.drais@dot.gov), or Kevin M. Bartoy (WSF) (206.440.4525; bartoyk@wsdot.wa.gov) if you need additional information or have any questions.

Thank you for your continued consultation on this project.

Sincerely,

Kenneth Feldman
Deputy Regional Administrator

Enclosure: Seattle Multimodal Terminal Project Area of Potential Effect

cc (by email): Lindsey Handel, FHWA
Matthew Sterner, DAHP

WSDOT Alaskan Way Viaduct Orthophotograph

Seattle Multimodal Terminal Project

Area of Potential Effect (APE)

0 0.01 0.02 0.04 Miles

Washington State Department of Transportation

N

4/24/2013

DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past. Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

May 29, 2013

Mr. Dan Drais
Federal Transit Administration
915 2nd Avenue
Federal Building, Suite 3142
Seattle, WA 98174-1002

In future correspondence please refer to:
Log: 051911-05-FTA
Property: Seattle Multimodal Terminal at Coleman Dock, WSF
Re: Archaeology - APE Revision Concur

Dear Mr. Drais:

We have reviewed the materials forwarded to our office for the Seattle Multimodal Terminal at Coleman Dock project. Thank you for your description of the revised area of potential effect (APE) for the project that now includes the Washington Street Boat Landing. We concur with the definition of the revised APE. We look forward to the results of your cultural resources survey efforts, your consultation with the concerned tribes, and receiving the survey report. We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4) and the survey report when it is available.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Should additional information become available, our assessment may be revised.

Please note that DAHP requires that all historic property inventory and archaeological site forms be provided to our office electronically. Also, please note that DAHP requires that all cultural resource reports be submitted in PDF format on a labeled CD or electronically. For further information please go to http://www.dahp.wa.gov/documents/CR_ReportPDF_Requirement.pdf.

Thank you for the opportunity to review and comment. If you have any questions, please feel free to contact me.

Sincerely,

MAY 31 2013 PM 1:38

Matthew Sterner, M.A.
Transportation Archaeologist
(360) 586-3082
matthew.sterner@dahp.wa.gov

Appendix B

HPI Forms

Historic Register Report

Historic Name: Washington Street Public Boat Landing Facility
(Seattle Harbor Department Shelter)
Address: S. Washington Street, 100' Right of Way, West of Alaskan Way
City: Seattle
County: King

Download nomination form

Historic Use: Transportation
Style: Other - Utilitarian
Built: 1920
Architect: Huntington, Daniel Riggs
Builder:

Smithsonian Number: 45KI00129
Date Listed: 6/10/1974
Listing Status: WHR/NR
Classification: STR
Resource Count: 1
Area of Significance: Architecture
Level of Significance: Local
Listing Criteria: C

Statement of Significance

The Washington Street Public Boat Landing Facility illustrates Seattle's long-running reliance on the waters of Puget Sound and the Pacific Ocean. The earliest European American settlers chose the area in the 1850s partly because of its natural harbor, and since then the city's population has used the water in myriad ways. From its earliest timber products to its most modern computer equipment, Seattle business has sent much of its output by ship. The harbor helped make Seattle America's primary arrival and departure point for the Klondike gold fields, and for years newcomers took their first steps in the city on the docks at which they had arrived. Fishing continues to be an important part of the region's trade, and since the early 1900s, ferries have offered a reliable way to travel Seattle's bays and inlets.

In 1920, the city created a new waterfront landmark when it opened the Washington Street Public Boat Landing Facility. This galvanized iron shelter, supported by 16 decorated steel columns, is very similar in appearance to the earlier Iron Pergola. Over the years this building has fulfilled a number of uses: as a landing for ferries and ocean-going ships, as the headquarters of the Seattle Harbor Patrol and as the U.S. Navy's official shore-leave landing and departure point. Still used daily, the Public Boat Landing Facility remains the gateway to the city from Puget Sound and is the only remaining link from the historic Pioneer Square-Skid Road Historic District to the waterfront that it relied upon.

Photos

Historic Property Inventory Report

Location

Field Site No. H1

DAHP No.

Historic Name: Alaskan Way Seawall

Common Name: Alaskan Way Seawall

Property Address: Alaskan Way, Seattle, WA

Comments:

Tax No./Parcel No.

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T25R04E	31	NW		King	SEATTLE NORTH
T24R04E	06	NE			

Coordinate Reference

Easting: 1187332

Northing: 832216

Projection: Washington State Plane South

Datum: HARN (feet)

Historic Property Inventory Report

Identification

Survey Name: AWV Tunnel

Date Recorded: 09/18/2009

Field Recorder: M. Sheridan

Owner's Name: City of Seattle

Owner Address:

City: State: Zip:

Classification: Structure

Resource Status: Comments:

Within a District? No

Contributing?

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Determined Eligible - SHPO

Determination Date: 9/18/2013

Determination Comments: 051209-10-FHWA determined on 9/18/2013

Description

Historic Use: Other

Current Use: Other

Plan: Stories:

Structural System: Mixed

Changes to Plan:

Changes to Interior:

Changes to Original Cladding:

Changes to Windows:

Changes to Other:

Other (specify):

Style: Cladding: Roof Type: Roof Material:

Foundation: Form/Type:

Narrative

Study Unit	Other
Science and Engineering	
Community Planning/Development	
Commerce	

Date of Construction: 1917 Built Date

Builder: City of Seattle

Engineer: Seattle Engineering Department

Architect:

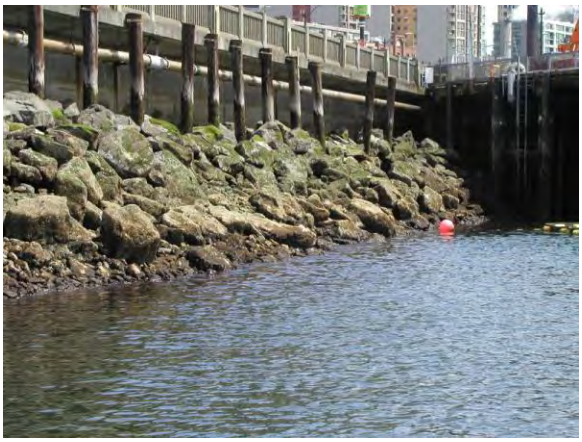
Property appears to meet criteria for the National Register of Historic Places: Yes

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:	The Alaskan Way Seawall is eligible for listing in the National Register under Criterion A for its association with Seattle growth and development. The newer section, between Madison and Broad streets, is eligible under Criterion C for its innovative design and engineering. The Alaskan Way Seawall was constructed in two sections. The present shoreline between South Washington Street and Madison Street was established between 1911 and 1917, with concrete seawalls at the street ends, joined together by a structural sidewalk. Railroad Avenue (Alaskan Way) was gradually back-filled with materials removed in the regrading of Jackson Street. This early seawall was crucial to the growth of the city, allowing waterfront trade to flourish and adjacent development to occur. However, financial problems hindered the continuation of the work. Finally, in 1933, an innovative design for a seawall was developed by the City Engineering Department. The design included retaining a heavy horizontal thrust of 12,000 pounds per linear foot in certain sections and 38,000 pounds in others. Because of the innovative nature of the design, it received considerable publicity, including an article in the Engineering News Record. The design involved an assembly of several components including steel sheet piling, wooden piling, a relieving platform, and three types of pre-cast concrete panels, depending on the expected loading. A distinctive pre-cast concrete railing system was mounted on top of the wall to complete the assembly. Because of these innovations, the city was forced to finance and construct the structure itself, as no one was willing to assume the risk. Construction began in 1934 and was completed in 1936. Over the years, sections of the seawall and railing have been either replaced or obscured by subsequent development. These alterations have been primarily at the Washington State Ferries Terminal (Pier 52), Waterfront Park (Pier 58) and Bell Harbor Marina near Pier 66. Approximately 80 percent of the original 6,100 feet of the 1934-36 seawall remains in place.
Description of Physical Appearance:	The southern portion of the seawall, between S. Washington Street and Madison Street consists of concrete gravity-type seawalls at the street ends of Washington, Yesler, Columbia and Madison streets, with a structural sidewalk supported by piling between the street-end seawalls to allow access to the pier platforms. The northern section, from Madison Street to Bay Street (about 6,100 feet) has three major components: steel sheet piling along the face of the wall; vertical and slanted timber piles behind this steel wall; and precast concrete slabs on the water edge to form the face of the seawall; timber caps tie the slabs to the piles. The specific design varied from one location to another, with the shape of the precast concrete slabs depending on the slope of the beach. A cast concrete railing runs along most of the length of the waterfront.
Major Bibliographic References:	Phelps, Myra. Public Works in Seattle: A Narrative History of the Engineering Department 1875-1975. Seattle: Kingsport Press, 1978.

Photos



Historic Property Inventory Report

Location

Field Site No. DAHP No.

Historic Name: Seattle Steam Heat and Company Saltwater Suction Pipes

Common Name: City of Seattle

Property Address: 801 Alaskan Way , Seattle, WA 98104

Comments:

Tax No./Parcel No.

Plat/Block/Lot

Acreage

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T24R04E	06			King	SEATTLE SOUTH

Coordinate Reference

Easting: 1187210

Northing: 832849

Projection: Washington State Plane South

Datum: HARN (feet)

Historic Property Inventory Report

Identification

Survey Name: WSF-Colman Dock Electrical Upgrade

Date Recorded: 12/08/2010

Field Recorder: Leslie Schwab

Owner's Name: City of Seattle

Owner Address: 700 5th Avenue

City: Seattle

State: WA

Zip: 98104

Classification: Object

Resource Status:

Comments:

Within a District? No

Contributing? No

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Determined Not Eligible - SHPO

Determination Date: 1/26/2011

Determination Comments: 012611-04-WSDOT determined on 1/26/2011

Description

Historic Use: Government - Public Works

Current Use: Vacant/Not in Use

Plan: Irregular

Stories:

Structural System: Other

Changes to Plan: Unknown

Changes to Interior: Not Applicable

Changes to Original Cladding: Not Applicable

Changes to Windows: Not Applicable

Changes to Other: Unknown

Other (specify):

Style:

Cladding:

Roof Type:

Roof Material:

Foundation:

Form/Type:

Utilitarian

Narrative

Study Unit

Other

Date of Construction: 1900 Built Date

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places: No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local): No

Statement of Significance:

The 24-diameter, saltwater intake pipes located under Columbia Avenue, Railroad Avenue -and possibly Colman Dock- are significant for their association with the Post-Fire rebuild of Pioneer Square after the Great Fire of 1889. They are also associated with the Seattle Steam Heat and Power Company, which is listed on the National Register of Historic Places.

THE FIRE

On June 6, 1889 an assistant in the Victor Clairmont woodworking shop on Front Street (now First Avenue) and Madison Avenue was heating glue over a fire. The glue boiled over, caught fire, and poured out onto the floors. The floors, which were covered in wood chips and turpentine, ignited as well. The fire then spread to the neighboring liquor store and saloons, which exploded in an alcohol-induced fireball. The Fire Department was dispatched, however, the water pressure proved inadequate for the task. The existing fire protection system was dependent on a private water supply: The Spring Hill Water Company. As the hydrants were located on every other street, and the wooden pipes were small in diameter, the water pressure dropped as more and more hoses were added to fight the blaze. In addition, subsequent efforts to pump water from Elliott Bay proved difficult as the tide was out. By 4:00 p.m. the fire had spread past Second Avenue and was heading up the hill towards Third Avenue. The fire burned until 3:00 a.m., destroying 120 acres –the equivelant of 25 city blocks. The wharves (including Colman Dock) and mills from Union Street to Jackson Street were destroyed as well. Reconstruction of downtown began almost immediately. (University of Washington)

REBUILDING DOWNTOWN SEATTLE

Mayor Robert Moran proposed rebuilding with brick construction instead of the fire-prone timber construction of the past decades. In addition, Mayor Moran proposed regrading and realigning city streets with a 90-foot-wide right-of-way (on average). Building Ordinance 1147 called for fire-proof construction techniques, including masonry walls with thickness and post-and-beam, heavy timber framing of the upper stories (Link 2005: 47). John G. Scurry was the city engineer in charge of replatting the street grid. In the end, streets ended up being 84 feet wide or 90 feet wide, and, in the case of Railroad Avenue, 120 feet wide.(Warren 1989: 52) Also as a result of these new codes and ordinances, Front Street was raised leaving extant one-story buildings underground. (Warren 1989: 43)

Wharves at the waterfront were completely destroyed in the fire. The Colman Building, located at Colman Dock, was one of the first structures engulfed in flames. Reconstruction of the waterfront began almost immediately following the fire, and the new Colman Dock was nearing completion by the end of June, 1889. (Warren 1989: 50)

SEATTLE'S FIRE BOAT AND THE CITY'S FIRE PROTECTION SYSTEM AFTER THE FIRE

After the fire, speculation by the media offered the opinion that, if the fire department had had an adequate stream of water available to extinguish the flames, the fire would have been contained. (Warren 1989: 59) In 1888, Mayor Moran had proposed a gravity-fed water supply system originating at Cedar River, however, its construction was delayed and the Cedar River water supply didn't exist when the fire started in 1889. At the time of the fire, the Spring Hill Water Company pump was still the main source for water, drawing water from Lake Washington. On July 8, 1889 (one month following the fire) an election to authorize $1 million bond for the construction of the Cedar River water supply system was held. The bond measure passed, however, construction of the Cedar River water system did not commence until 1901. (Link 2005: 47)

While the Cedar River water supply was under construction, an interim solution was necessary to ensure the downtown's protection from fire. The resulting solution included a fireboat and a saltwater supply system to be pumped by steam power. Saltwater suction pipes would be placed under the reconstructed and regarded street system and connected to the Seattle Steam Heat and Power Company's pumps located on Post Avenue.

Fireboat Snoqualmie

The fireboat Snoqualmie could shoot 6,000 gallons of water per minute from a saltwater source. The boat was constructed and placed into service in 1890. Fire insurance rates dropped by twenty percent as a result of its use. The Snoqualmie's slip was located at the foot of Madison Street, next to Fire Station Number Five, and she served Seattle for 37 years. (Dorpat 1984: Section 17)

Steam-Powered Saltwater Suction Pipes

In a letter from T.E. Jones (Councilman of the Fourth Ward, Seattle) to Mayor Moran and the Common Council of Seattle dated May, 1890, Councilman Jones made suggestions to improve the City's fire protection system. Concerned by the fact that the "7,000 gallons-per-minute" of water pressure from the Snoqualmie would be diminished over long distances (to Second or Third avenue), and the fact that the hose would be too heavy to efficiently stretch in a timely manner to a fire some distance from the boat (The Snoqualmie), the councilman suggested "… laying a number of iron force mains at stated distances apart along the harborfront and leading back from the wharves to such distance as might be desireable, through which the fire boat or our steam fire engines might force salt water and from which the fire department could draw water at any point desired, for the utilization of the same in fighting fire." (Jones 1890: 3) The councilman also suggested tying the salt water mains into the fresh water system and regulating it through the use of valves so that if the fresh water system failed, the fire boat could use the salt water mains as a backup. (Jones, 1890: 3)

In September, 1890, a petition from the President of the Underwriter's Association (insurance underwriter) to the Mayor and Common council called for a salt water fire system to serve the business center of Seattle. The Seattle Steam Heat and Power Company was under construction at the time this letter was written, and the author writes "We now have in place in our power-house on Post St., in the rear of the Starr-Boyd Building, two duplex Worthington steam pumps, having a maximum capacity of about four and one-half million gallons per day. These are now connected with our elevator mains which cover district bounded by Yesler Avenue and Columbia St. and Post St. and Second St. The power for these pumps is supplied by a battery of steel boilers, having a capacity of about four hundred horse-power which will soon be increased to six hundred. We shall have an engineer in charge, day and night, so that the head of steam will always be sufficient at any minute to work the pumps.". (Spencer, 1890: 1)

Compared to The Snoqualmie's 7,000 gallons per minute, it is clear that the steam-powered pumps' one-half million gallons per day would greatly enhance the fire protection system to suppress any fire in the future. Spencer goes on to add, "We have at present no connection to salt water, but it is apparent that the chief benefits of our plant must be derived from a salt water supply. If such connection were had, our entire power could be utilized in case of fire to protect the heart of the business portion of the City, without extra cost." (Spencer, 1890: 1)

In response to Spencer's petition, Ordinance Number 1521 was signed by the Mayor and the Seattle Steam Heat and Power Company "…"accepting the proposition of the Seattle Steam Heat and Power Company, by which the City of Seattle agrees to make a suitable and proper connection between the power-house of said Company and Elliott Bay, and to supply the pumps of said Company with salt water and said Company agrees in case of fire to operate its said pumps and devote the full power thereof to supplying salt water to all such hydrants as the said City may connect with the said pumps of said Company, for the term of two years from and after the first day of January, 1891, and authorizing the Mayor and City Clerk of the said city to execute a formal contract with said Company to carry out the terms and conditions of said proposition.". (Prestos, 1890: 1) The salt water pipes were to be constructed by the city, but the Steam Power and Heat Company would have full use of the supply pipes at all times when the city didn't need them for fire protection.

The agreement was for two years, starting in 1891, and the construction of the salt water suction pipes would begin shortly after the ordinance was enacted. In fact, the next day, (October 8th, 1890), an agreement between the City of Seattle and the Steam Power and Heat Company was drawn up and signed: "Whereas the party of the second part has constructed its power-house on Post Street in said city and furnished the same with pumps and other apparatus for pumping water for extinguishing fires, and has made a proposition to said City in accordance with terms and conditions.....Now Therefore the party of the first part [the city] hereby agrees that it will make a suitable and proper connection between the said power-house and Elliott Bay, in order to place within reach of the pumps of the party of the second part a sufficient supply of salt water....". (City of Seattle, 1890: 1). The agreement also stipulated that the Steam Power and Heat Company would have use of the pipes when they were not needed for fire protection, but that the City retained ownership of them once constructed.
The pipes, as depicted on as-builts dated May 20th, 1903, follow a course from the Post Avenue Power Station to the intersection of Columbia Street and Western Avenue, commencing to Railroad Avenue and connecting with Elliott Bay at Colman Dock. The pipes are 24 inches in diameter and constructed of cast iron sections bound together with 4-inch flanges, and secured with rivets. There are two pipes: one for suction of saltwater out of the bay, and the other one for discharge back into Elliott Bay.

Description of Physical Appearance:

The condition and integrity of the extant cast-iron supply pipes is not known at this time, however, they are no longer in use by the Steam Heat and Power Company, or by the City of Seattle according to personnel at the steam company and the City of Seattle. In short, they are 24-inches in diameter, constructed of segments of cast iron pipe riveted together with 4" flanges. The purpose of the saltwater supply pipes was to connect the Steam Heat and Power Company's new Duplex Worthington steam pumps, which had the capacity to pump 4.5 million gallons of water per day. The saltwater mains were to be connected with the steam company's elevator mains which covered a district bounded by Yesler Avenue, Columbia Street, Post Avenue, and Second Avenue. The resulting force would throw thirty-six streams of 7/8" each a distance of one hundred feet. As-built drawings suggest that the pipes originated at the steam plant on Post Alley (619 Post Avenue), ran under Western Avenue, Columbia Avenue, and entered Elliott Bay at Colman Dock.

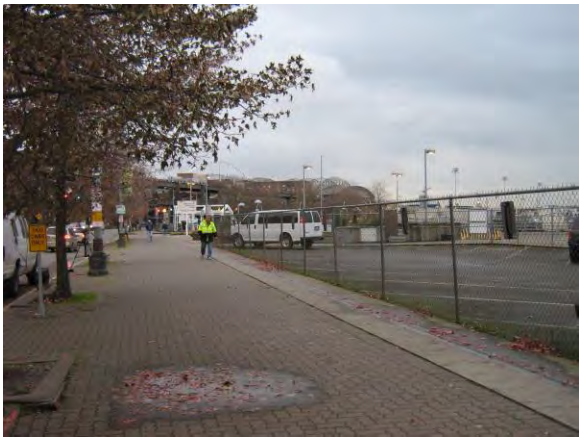
Major Bibliographic References:

City of Seattle. "Agreement between the City of Seattle and The Steam Power and Heat Company." October 8th, 1890.
Dorpat, Paul. Seattle Now and Then. 1984.

http://content.lib.washington.edu/extras/seattle-fire.html -University of Washington Library Digital Collections. Accessed by Leslie Schwab on December 8th, 2010.
Link, Karin. Pioneer Square: Seattle's Oldest Neighborhood. 2005?

Prestos, Albertson & Donworth: Attorneys at Law. "Ordinance Number 1521: An Ordinance Accepting the Proposition of the Seattle Steam Heat and Power Company". October, 1890.
Spencer, D.A. "Petition from the President of the Underwriter's Association to Mayor and Common Council for Salt Water Fire Service Systems in Business Center". September 26, 1890.
Warren, James. The Day Seattle Burned. Seattle: James Warren, 1989.

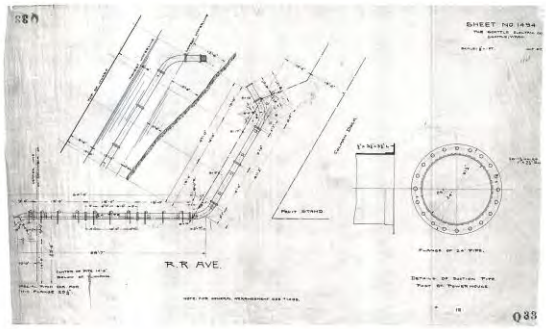
Photos



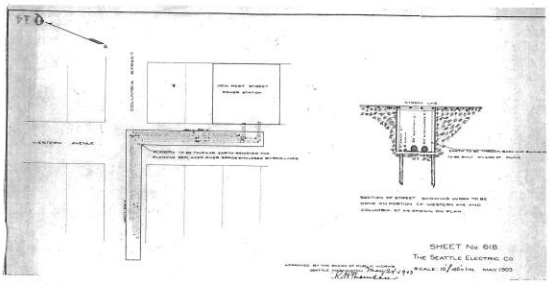
View looking south along Alaskan Way
Alaskan Way Viaduct in front of Washington State Ferry Terminal
2010

View looking east on Columbia Street. The pipes are located under the roadway here.
Intersection of Alaskan Way and Columbia Streets
2010

The saltwater intake pipes penetrate the seawall underneath Colman Dock somewhere, where saltwater was drawn into the pipes for fire protection system.
Washington State Ferry Terminal at Colman Dock
2010



cross section of pipe and locational diagram
2010



cross section of roadway utility location and locational diagram
2010

Historic Property Inventory Report

Location

Field Site No. H122

DAHP No.

Historic Name: Fire Station #5

Common Name: Fire Station #5

Property Address: 925 Alaskan Way, Seattle, WA 98101

Comments:

Tax No./Parcel No. 7666202500

Plat/Block/Lot Seattle Tidelands Bl. 01-376 Bl. 181

Acreage <1

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T25R04E	31	SE		King	SEATTLE SOUTH

Coordinate Reference

Easting: 1186784

Northing: 833380

Projection: Washington State Plane South

Datum: HARN (feet)

Historic Property Inventory Report

Identification

Survey Name: AWV Tunnel

Date Recorded: 09/10/2009

Field Recorder: M. Sheridan

Owner's Name: City of Seattle

Owner Address: PO Box 94689

City: Seattle

State: WA

Zip: 98124

Classification: Building

Resource Status:
Survey/Inventory

Comments:

Within a District? No

Contributing?

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Determined Eligible - SHPO

Determination Date: 2/16/2011

Determination Comments: 051209-10-FHWA determined on 2/16/2011

Description

Historic Use: Government - Fire Station

Current Use: Government - Fire Station

Plan: L-Shape

Stories: 2

Structural System: Concrete - Reinforced Concrete

Changes to Plan: Intact

Changes to Interior: Unknown

Changes to Original Cladding: Intact

Changes to Windows: Intact

Changes to Other:

Other (specify):

Style:	Cladding:	Roof Type:	Roof Material:
Modern	Concrete Veneer - Stucco	Flat with Eaves	Other

Foundation:	Form/Type:
Concrete - Poured	Other

Narrative

Study Unit	Other
Politics/Government/Law Architecture/Landscape Architecture	

Date of Construction: 1963 Built Date

Builder:

Engineer:

Architect: Durham Anderson & Freed

Property appears to meet criteria for the National Register of Historic Places:Yes

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local):

Statement of Significance: This modern fire station appears to be legible for NRHP listing under criterion C as an example of modern architecture applied to a fire station and the work of a prominent local architectural firm, Durham Anderson & freed. It is also eligible under Criterion A for its associations with the development of the Seattle Fire Department and the Central Waterfront.

This 1963 station is the third building on the site. Until the 1930s, much of the development along the Central Waterfront was built on wooden piers and trestles over the water, including the railroad tracks. The Great Seattle Fire of 1889 proved the necessity of a professional fire department as well as the need for a waterfront fire station equipped with a fireboat. In addition to destroying much of the city's commercial district, the fire consumed all of the wooden piers, railroad trestles, and wharves as far north as Union Street. A bucket brigade finally stopped the flames' advance, sparing a few northern piers. The railroad trestles were quickly rebuilt, and the gaps between the two railroad trestles were planked in to create "Railroad Avenue." It was not until 1934 that the city used Depression-era federal funds to build a seawall to contain the fill that would ultimately support a new Alaskan Way. The first waterfront fire station went into service on January 3, 1891 in a small frame building at the foot of Madison Street. With a crew of nine, the company consisted of the new fireboat "Snoqualmie" and a small hose wagon. In 1902, a larger two-story frame building, was constructed on an adjacent lot at 925 Railroad Avenue, now known as Alaskan Way. In 1910, the new fireboat "Duwamish" replaced the "Snoqualmie." In 1916, the wood frame building was demolished and a new two-story brick fire station was completed the following year. This handsome building with Craftsman and Tudor stylistic details remained in service until 1961. During that time, the new fireboat "Alki" was put into service in 1928. By the early 1960s, it was apparent that the 1917 fire station would have to be replaced, as the supporting pier timbers were becoming unsafe. The old building was demolished in early 1961 but the new building was not opened until December of 1963 due to the structural work required to support the new building.

The architecture firm of Durham, Anderson & Freed designed this fire station at the beginning of their second decade in practice together. After a ten-year partnership with noted Seattle architect Bertram Dudley Stuart from 1941 to 1951, Robert Durham had practiced on his own for a brief period before joining with David R. Anderson and Aaron Freed to form their firm. Best known for the design of churches, for which they received considerable local and national attention, the partnership's projects also included schools, banks, residences, and master plans. They also designed public buildings, such as the Southwest Branch of the Seattle Public Library in 1961, Seattle landmark. The Modern design for this building is typical of their work, especially in the integration of the building's form and structure and in the clear legibility between exterior forms and finishes and interior functions.

Description of Physical Appearance:	Completed in 1963, this one and two-story building is situated on the waterfront side of Alaskan Way at the base of Madison Street and extends over the water on pilings. Fireboats are moored from floating docks at the rear. This Modern building's prominent features include an exposed concrete frame, a four-story hose tower, and an overhanging flat roof, which rests on tapered concrete trusses. Exterior finishes include concrete, stucco and exposed aggregate. A one-story engine bay at the southeast corner adjoins a larger two-story block at the rear, creating a structure with an L-plan. The freestanding hose tower is situated near the inner juncture of these two sections. On the principal east elevation of the engine bay, a large offset opening contains two overhead entrance doors separated by a center column. Originally, this opening contained a single large overhead door. Concrete roof trusses overhang the north and south walls of the engine bay. The concrete frame divides the south elevation into six bays, all of which contain a blank panel covered with exposed aggregate. A glass wall with an entrance door covers the north elevation of the engine bay. Concrete roof trusses overhang the east and west walls of the rear two-story portion at both the first and second story levels. The exposed concrete frame divides the longer east and west elevations into twelve bays and the shorter north and south elevations into six bays. Along the upper floor of the principal east elevation, pairs of narrow windows are set below the roofline in nine of the twelve bays. Stuccoed panels fill the remaining three bays. The building's main entrance is tucked behind the hose tower at the ground floor level. The two bays at the northern end of the east elevation contain a driveway to the rear of the site covered by the overhanging second story. An additional entrance is located off the driveway along the north elevation. With the exception of the driveway, the north and south elevations present blank walls covered by exposed aggregate panels under the overhanging eaves. Along the upper floor of the rear west elevation, nine of the twelve bays have large windows set between stuccoed panels above and below. On the ground floor level, a recessed bay near the center and a bay at the southern end have double entrance doors. Three additional bays have windows similar to those found on the second story. The bay adjacent to the driveway at the northern end contains a recessed storage area. Stuccoed panels fill the remaining four bays. Capped by a flared flat roof with a small peak, the hose tower has an exposed concrete frame with window-lined corners at the third and fourth stories. The original corner openings at the first and second story levels have been filled with concrete. The tall narrow panels at the center of each elevation are covered with exposed aggregate. This architecturally distinctive building displays excellent physical integrity.
Major Bibliographic References:	City of Seattle DCLU Microfilm Records. King County Property Record Card (c. 1938-1972), Washington State Archives. Seattle Fire Department, Centennial Commemorative, 1889-1989. Portland, OR: Taylor Pub. Co., c1989. Seattle Department of Neighborhoods Historic Resources Survey.

Photos

east

Identification

Survey Name: Assessors Data Project: King County E

Date Recorded: 07/03/2011

Field Recorder: Artifacts Consulting, Inc.

Owner's Name:

Owner Address:

City:

State:

Zip:

Classification: Building

Resource Status: Survey/Inventory

Comments:

Within a District? No

Contributing?

National Register:

Local District: No

National Register District/Thematic Nomination Name:

Eligibility Status: Determined Eligible - SHPO

Determination Date: 9/18/2013

Determination Comments: 051209-10-FHWA determined on 9/18/2013

Description

Historic Use: Unknown

Current Use: Government - Fire Station

Plan: Unknown

Stories: 2

Structural System: Unknown

Changes to Plan:

Changes to Interior:

Changes to Original Cladding:

Changes to Windows:

Changes to Other:

Other (specify):

Style:	Cladding:	Roof Type:	Roof Material:
Unknown	Unknown	Unknown	Unknown

Foundation:	Form/Type:
Unknown	Other

Narrative

Study Unit

Other

Architecture/Landscape Architecture

Date of Construction: 1963 Built Date

Builder:

Engineer:

Architect:

Property appears to meet criteria for the National Register of Historic Places:Unable to Determine

Property is located in a potential historic district (National and/or local): Unable to Determine

Property potentially contributes to a historic district (National and/or local): Unable to Determine

Statement of Significance:	Data included on this historic property inventory form (HPI) detail stemmed from County Assessor building records imported by the Washington State Department of Archaeology of Historic Preservation (DAHP) into WISAARD in 2011. This upload reduces data entry burden on community volunteers and historical societies participating in the survey and inventory of their communities. The intent of this project is directed specifically to facilitating community and public involvement in stewardship, increasing data accuracy, and providing a versatile planning tool to Certified Local Governments (CLGs). Project methodology entailed use of the University of Washington's State Parcel Database (http://depts.washington.edu/wagis/projects/parcels/development.php) to provide the base parcel layer for CLGs. Filtering of building data collected from each county trimmed out all properties built after 1969, as well as all current, previously inventoried properties. Translation of building data descriptors to match fields in HPI allowed the data upload. Calculation of point locations utilized the center of each parcel. Data on this detail provides a snapshot of building information as of 2011. A detailed project methodology description resides with DAHP. Project team members: Historic Preservation Northwest, GeoEngineers, and Artifacts Consulting, Inc. (project lead).
Description of Physical Appearance:	The building at 929 Alaskan Way, Seattle, is located in King County. According to the county assessor, the structure was built in 1963 and is a fire station. Also according to the county assessor, the structure was remodeled in 1980. The 2-story building has an other form.
Major Bibliographic References:	

Photos

Historic Property Inventory Report

Location

Field Site No.

DAHP No.

Historic Name: Colman Dock

Common Name: Seattle Ferry Terminal Building

Property Address: 801 Alaskan Way S, Seattle, WA

Comments:

Tax No./Parcel No. 7666202620

Plat/Block/Lot Seattle Tidelands BL 01-376

Acreage 3.6

Supplemental Map(s)

Township/Range/EW	Section	1/4 Sec	1/4 1/4 Sec	County	Quadrangle
T24R04E	06	NE		King	SEATTLE SOUTH

Coordinate Reference

Easting: 1186845

Northing: 832967

Projection: Washington State Plane South

Datum: HARN (feet)

Identification

Survey Name: Seattle Multi-Modal Ferry Terminal

Date Recorded: 07/15/2004

Field Recorder: L. Durio

Owner's Name: State of Washington

Owner Address: Toll Bridge Authority

City: Olympia

State: WA

Zip:

Classification: Building

Resource Status: Survey/Inventory

Comments:

Within a District? No

Contributing?

National Register:

Local District:

National Register District/Thematic Nomination Name:

Eligibility Status: Determined Not Eligible - SHPO

Determination Date: 3/29/2005

Determination Comments: 03/29/05 rh

Description

Historic Use: Transportation - Water-Related

Current Use: Transportation - Water-Related

Plan: Rectangle

Stories: 2

Structural System: Steel

Changes to Plan: Moderate

Changes to Interior: Slight

Changes to Original Cladding: Slight

Changes to Windows: Intact

Changes to Other: Unknown

Other (specify):

Style:	Cladding:	Roof Type:	Roof Material:
Modern - Contemporary	Concrete	Other Flat with Eaves	Asphalt / Composition - Built Up

Foundation:	Form/Type:
Other	Other

Narrative

Study Unit	Other
Transportation Architecture/Landscape Architecture	

Date of Construction: 1964 Built Date

Builder: General Construction Company of Seattle

Engineer: Cecil C. Arnold and Associates

Architect: Jones, Lovegren, Helms & Jones

Property appears to meet criteria for the National Register of Historic Places:No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local):

Statement of Significance:

This building is constructed over the site of Colman Dock, which is listed on the Washington State Heritage Register (WSHR) as a historic site only, not as a physical structure.

The original Colman Dock was constructed by James Colman in 1882. Originally a 40 by 60 foot shipping dock, it was rebuilt several times in subsequent years. In 1886, four years after its initial construction, it was rebuilt to provide a larger facility. Unfortunately, in 1889 a great fire destroyed much of Seattle's downtown and its waterfront, including Colman Dock. After the fire, Colman Dock was rebuilt again (in 1890), this time even larger. In 1908 Colman Dock was rebuilt a fourth time, the largest and most ornate one yet, to accommodate the growing ferry trade and provide a waiting room for ferry passengers. It became home to the "Mosquito Fleet," the term given to small wooden-hulled steamer vessels that ferried passengers and goods around Puget Sound, serving island and shoreside communities. The new dock, designed by the Beezer Brothers, featured a domed waiting area and a 72-foot high Italianate clock tower. The tower was unfortunately knocked into the water by the vessel Alameda in 1912. This accident badly damaged the west side of the dock, and it was rebuilt once again with a new west end and a new tower, designed by Daniel Huntington. This time the tower was even larger and more ornate. The tower remained a waterfront landmark until 1935.

The many small operators of the "Mosquito Fleet" had consolidated into two ferry companies by 1929 - Puget Sound Navigation Company (PSNC) and Kitsap County Transportation Company. The Kitsap Company was forced out of business in 1935, leaving PSNC, known as the Black Ball line, to dominate ferry service on Puget Sound. PSNC began as a steamer operation in 1898 by Charles Peabody. Sometime in the 1920s, they purchased Colman Dock.

In 1923, a new ferry slip was added to Colman Dock for handling automobiles. The pressure for car ferries continued - by the late 1930s the Black Ball line was the main auto carrier in the region. In 1936, a portion of the old dock was demolished to build a new terminal to handle the increasing automobile traffic. The tower was demolished and the clock was replaced with a new modern version. The old clock was placed in storage for many years, until it was restored and put on display inside the current Ferry Terminal building. The new Art Deco style terminal building opened in 1937. It also held the Black Ball line offices. The Black Ball line ferry service and most of its fleet was purchased by Washington State in 1951. Initially Colman Dock was one of the terminals that was leased from PSNC, but it was purchased from them before the current ferry terminal was built. Between 1964 and 1965, Colman Dock and the adjacent Grand Trunk Pacific Dock were demolished for construction of the current Washington State Ferry Terminal. Thus, although the current facility is known as Colman Dock, no structure from the actual Colman Dock remains.

Seattle experienced a great influx of visitors for the 1962 World's Fair, and many city leaders were embarrassed over the old 1937 Art Deco ferry terminal, prompting calls for a new, modern terminal to meet the increasing needs and ever larger ferries. More than $3 million were spent to refurbish the terminal with new docking slips, extra automobile traffic lanes, and "an airy and comfortable waiting area, complete with a gift shop and restaurant. The glistening new terminal was a gem on the Seattle waterfront" (Stein 2001). But it had only been in operation for a few days when, on February 21, 1966, at 6:45 a.m., the ferry Kalakala ran into the new terminal on a return run from Bremerton and caused $80,000 worth of damage. No one was injured, but the new south slip had to be completely rebuilt and was out of commission for two months. The Kalakala was repaired for $2,000 and was back in service the next day. Despite this setback the Ferry Terminal building was formally opened and dedicated on May 18, 1966.

The architect of record for the current Ferry Terminal was Lloyd J. Lovegren of Jones, Lovegren, Helms and Jones. In 1964, they designed the current Ferry Terminal and building, with engineers Cecil C. Arnold and Associates. The mechanical engineer was H. Gifford Thompson, and the electrical engineering was done by Beverly A. Travis and Associates. The contractor was General Construction Company. Lloyd Lovegren stamped the architectural plans. Lovegren, born in 1906, received his Washington State architectural license in 1947. Lovegren's early works were as a designer, before he was licensed as an architect. Working under architect R. C. Reamer, he is noted for designing the stylized entrance sign for 1411 Fourth Avenue, circa 1930. One of his greatest accomplishments was the design of the Lacey V. Murrow Floating Bridge (no longer extant), and the concrete entrance to the Mount Baker tunnels on the Seattle end of the bridge. On the bridge he worked with Washington State Highway Department engineers, but is credited as the designer. On the tunnel portal, he paired with artist James FitzGerald for the low relief sculptural work.

In 1956, Lovegren partnered with Vincent Jones, Kenneth Helms, and Gayne Jones to form Jones, Lovegren, Helms and Jones. During this time, he designed the iconic Polynesian-themed Trader Vic's restaurants and lounges in Denver (1954), Chicago (1957), Havana (1958), and New York's Plaza Hotel (1965). On a more conservative note, the firm designed Johnson Hall (1962) and its later addition at the University of Washington. The firm appears to have disbanded in 1965 with the retirement of Victor Jones, and Lovegren then practiced with his own firm, Lovegren and Associates. They continued work for the University of Washington with the design of the Agricultural Sciences building (phases I and II) from 1968 to 1973. Lovegren served as president of the AIA Seattle chapter in 1955, and retired from practice in 1977. He is best known for his work on the Lacey V. Murrow bridge and Mount Baker tunnel portals. Mainly a utilitarian structure, the Seattle Ferry Terminal is not an outstanding example of his work.

The present Ferry Terminal building dates from 1964 - 1966, and will reach 50 years of age in 2016. At that time, it will be eligible for assessment as a historic resource. Due to the long term planning for this project, a determination of eligibility is being made now. The site of Colman Dock is rich in local and regional history, and the current building reflects the continued, uninterrupted use as a passenger ferry terminal from this physical site for the last one hundred twenty years. However, the current building does not convey this sense of history. From an architectural context, the current building does not merit consideration for outstanding architectural design, nor is it representative of the work of a master. While the physical location of the site is rich in history and local significance, the present building and pier do not possess the integrity to convey this significance.

Colman Dock was determined not eligible for the NRHP in the SR 99 Alaskan Way Viaduct Study (Preliminary Draft 2, Appendix L Historic Resources Technical Memorandum). Additional research has not revealed any further evidence to support NRHP eligibility or local landmark listing. Neither the present building nor the pier structure beneath it appear to qualify under criteria A, criteria B, or criteria C. In addition, they do not convey the earlier history or significance of the site. Therefore, the determination of eligibility concludes that the Seattle Ferry Terminal is not eligible for the NRHP.

Description of Physical Appearance:	The current Seattle Ferry Terminal building is a rectangular building constructed 1964-66 on piers over the water. It is two stories with a flat roof, with the main floor on the second level. The second floor features plate glass windows under a substantial eave overhang, supported on exposed steel I-beams. A concrete deck wraps around the building on all four sides, partially shielded by the roof overhang, with a metal railing incorporating oval mesh panels all the way around. On the front façade, the deck bows out slightly. The most visually striking feature of the building is the monitor-type projection in the center of the roof that serves to bring light into the heart of the interior. This rectangular projection has a unique sloping, saddle-shaped roof and the two long sides are mainly glass. The shorter (front and back) sides are solid. It is the stylized roof form on this projection, so indicative of mid-twentieth century modern architecture, that is the most visually appealing part of the structure. The exterior of the building is clad in concrete and concrete stucco with some exposed steel framing. The Seattle Ferry Terminal has been substantially altered since its original construction. The most noticeable change was the addition of a square, two story glass elevator tower to the front façade. This addition has a pyramidal hipped roof of standing seam metal and is placed at an angle to the front façade. It is highly visible due to its location, design, and color scheme, and it is not stylistically sympathetic to the original building. In addition, elevated walkways have been attached, an imposing double-width stairway has been added to the front façade, and the ground level has been altered. For a building whose clean lines and strong horizontality were its major design elements, these alterations result in a significant loss of integrity.

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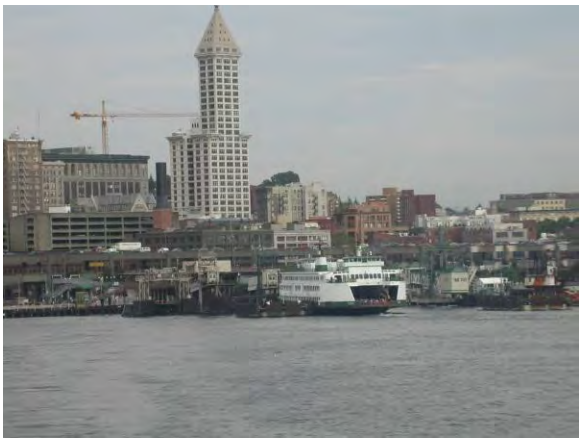
Photos

Shows front façade alterations - stair and elevator tower front (east) façade

Auto entry

north side elevation



ferry terminal from water, west elevation

south elevation, from pier 48

Appendix C

Eligibility Correspondence

U.S. Department
of Transportation
**Federal Transit
Administration**

REGION X
Alaska, Idaho, Oregon,
Washington

915 Second Avenue
Federal Bldg. Suite 3142
Seattle, WA 98174-1002
206-220-7954
206-220-7959 (fax)

February 25, 2013

Dr. Allyson Brooks
State Historic Preservation Officer
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, WA 98504-8343

DAHP Log No.: 051911-05-FTA

**Re: Seattle Multimodal Terminal at Colman Dock Project
Determination of Non-Eligibility (Sites 45KI1012 and 45KI1013)
and Request for Concurrence**

Dear Dr. Brooks:

Pursuant to 36 CFR 800.2(c)(1), the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) are continuing consultation with you in regards to the Washington State Department of Transportation's (WSDOT) proposed Seattle Multimodal Terminal Project. FTA and FHWA respectfully request your concurrence with the agencies' determination that archaeological sites 45KI1012 and 45KI1013 are not eligible for listing in the National Register of Historic Places (NRHP). Attached to this letter, you will find an evaluation of the two archaeological sites carried out by WSDOT's cultural resources consultant for this project. FTA and FHWA concur with the consultant's recommendation and, pursuant to 36CFR800.4(c)(2), have determined that the sites are not eligible for listing in the NRHP.

Please note that United States Army Corps of Engineers (USACE) recently submitted eligibility determinations to your office in relation to the Elliott Bay Seawall Project. USACE deferred determinations for 45KI1012 and 45KI1013, knowing that FTA and FHWA would be submitting the determinations for these sites.

FTA and FHWA respectfully request your concurrence with this determination by **March 1, 2013.**

Should you have any questions, please contact Dan Drais (FTA) (206.220.4465; Daniel.drais@dot.gov) or Kevin M. Bartoy (WSF) (206.440.4525; bartoyk@wsdot.wa.gov).

Thank you for your continued consultation on this project.

Sincerely,

Kenneth Feldman
Deputy Regional Administrator
Federal Transit Administration

Enclosure: NRHP Evaluations for 45K1012 and 45K~~1113~~ 1013 (ICF, Feb. 2013)

cc (by email): Lindsey Handel, FHWA
Matthew Sterner, DAHP
Genevieve Rucki, WSF

DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past, Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

March 25, 2013

Mr. Dan Drais
Federal Transit Administration
915 2nd Avenue
Federal Building, Suite 3142
Seattle, WA 98174-1002

In future correspondence please refer to:
Log: 051911-05-FTA
Property: Seattle Multimodal Terminal at Coleman Dock, WSF
Re: More Information Needed

Dear Mr. Drais:

Thank you for contacting our office and providing a copy of the National Register of Historic Places (NRHP) eligibility report (ICF 2013) for submerged archaeological sites 45KI1012 and 45KI1013, completed by ICF International. I have reviewed the report at length as well as the archaeological survey report (Hudson et al. 2013) completed for the Elliott Bay Seawall (Seawall) project by NWAA/SWCA, submitted to our office by the U.S. Army Corps of Engineers (USACE).

As is undoubtedly clear to you and your consultant, the two cultural resource reports contain widely disparate information, conclusions, recommendations and most importantly, different determinations for both sites' eligibility.

The conflicting consultants' reports also raise numerous additional questions regarding the nature, integrity, and origin of the materials located not only at 45KI1012 and 45KI1013, but at all submerged sites identified in association with the Seawall project.

While this letter is in direct response only to the eligibility recommendations made for 45KI1012 and 45KI1013, the issues raised in this correspondence should be also be posed for eligibility determinations made to all submerged sites associated with the Seawall project.

When viewed in juxtaposition with the Hudson et al. report, the ICF report raises questions that must be addressed prior to Department of Archaeology and Historic Preservation (DAHP) concurrence. These issues (in no particular order) are:

1. The ICF report suggests that the sites represent a surface trash manifestation only, remnants of years of accumulated "sheet trash" that covers most of the submerged near shore along Elliott Bay. These materials are constantly being "subject to regular propeller-driven, high energy water movement," and likely have little integrity to their original deposition. Since the Hudson et al. report makes no mention of site depth, please establish whether these sites have integrity of location. Do these deposits actually have any depth?

2. On the question of site depth, you argue that a Washington State Ferries soil cap was installed in the area of 45KI1012 in 1989 and that, as reported in a 2005 monitoring study of the cap effectiveness (CH2MHill 2005), the cap retains integrity. In light of this, how exactly can we reconcile the artifacts and features (pier piles and linear arrangements of

dimensional lumber) identified in the Hudson et al. report? How can we best address this issue of integrity?

3. The ICF report suggests that artifacts recovered from the two archaeological sites span a wide (date) range of manufacture and subsequent deposit. When reviewing the Hudson et al. report and the site form for each of the sites, there is a strong emphasis on late nineteenth and early twentieth century artifacts, but no discussion of other 'later' materials that may have been recorded or noted in the field. Is there any way to acquire a complete accounting/inventory of artifacts to see if the lists provided in these sources are representative?

4. With the extensive history of wharf burning and sinking, how do we explain the absence of burned materials being identified at the submerged sites? Neither Hudson et al. nor the archaeological site forms mention evidence of burned materials in the form of either soil horizons, lumber (pier piles and dimensional lumber), or artifacts?

5. What are the environmental and physical factors that are compromising site integrity along the Elliott Bay waterfront? The dynamic nature of the underwater environment in combination with the "high energy water movement" associated with ferry propeller wash (especially under Coleman Dock) would certainly argue against the integrity of deposits remaining *in situ* for over 100 years, yet numerous discreet archaeological sites were clearly identified. What is the scholarly documentation that argues either 'for' or 'against' archaeological preservation in these types of highly dynamic environments? Would it be useful to have an independent party specializing in underwater archaeology assess the integrity issue?

These questions represent most of the major concerns I have in assessing your determinations of eligibility for archaeological sites 45KI1012 and 45KI1013, associated with the Coleman Dock project.

Until these issues are addressed, I cannot concur with your determinations of eligibility for these sites. I look forward to further discussions and communications with you regarding these issues.

I would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4) and the survey report when it is available.

These comments are based on the information available at the time of this review and on behalf of the State Historic Preservation Officer pursuant to Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800. Please contact me should you have any specific questions about our request and we look forward to receiving this material.

Thank you for the opportunity to review and comment. If you have any questions, please feel free to contact me.

Sincerely,

Matthew Sterner, M.A.
Transportation Archaeologist
(360) 586-3082
matthew.sterner@dahp.wa.gov

U.S. Department
of Transportation
**Federal Transit
Administration**

REGION X
Alaska, Idaho, Oregon,
Washington

915 Second Avenue
Federal Bldg. Suite 3142
Seattle, WA 98174-1002
206-220-7954
206-220-7959 (fax)

August 9, 2013

Dr. Allyson Brooks, SHPO
Department of Archaeology and Historic Preservation
P.O. Box 48343
Olympia, WA 98504-8343

DAHP Log#: 051911-05-FTA

**Re: Seattle Multimodal Terminal Project at Colman Dock
Request for Concurrence with NRHP Eligibility Determinations for
Sites 45KI1012 and 45KI1013**

Dear Dr. Brooks:

Pursuant to 36 CFR 800.2(c)(1), the Federal Transit Administration (FTA) and the Federal Highway Administration (FHWA) are continuing consultation with you in regard to the Washington State Department of Transportation's (WSDOT) proposed Seattle Multimodal Terminal at Colman Dock Project. FTA and FHWA respectfully request your concurrence with the agencies' determination that archaeological sites 45KI1012 and 45KI1013 are not eligible for listing in the National Register of Historic Places (NRHP).

Attached to this letter, you will find additional information gathered about these two sites during a recent underwater archaeological investigation. This information was gathered in response to the letter from Matthew Sterner dated March 25, 2013 in which your office indicated the need for more information prior to concurrence on the eligibility determination that we provided your office on February 25, 2013.

FTA and FHWA have reviewed the new information and for the reasons described in the report have concluded that it provides additional support for our previous determination of ineligibility for listing.

FTA and FHWA respectfully request your concurrence with this determination by **September 9, 2013**.

If you have any questions or need any additional information, please contact Dan Drais (FTA) at 206.220.4465 or daniel.drais@dot.gov; Lindsey Handel (FHWA) at 360.753.9480 or Lindsey.handel@dot.gov; or, Kevin M. Bartoy (WSDOT) at 206.440.4525, or bartoyk@wsdot.wa.gov.

Thank you for your continued consultation on this project.

Sincerely,

for Amy Changchien
Director, Planning and Program Development Office
Federal Transit Administration

Enclosure: NRHP Eligibility Evaluations for 45KI1012 and 45KI1013

cc (email): Dan Drais (FTA)
Lindsey Handel (FHWA)
Matthew Sterner (DAHP)
Genevieve Rucki (WSDOT)

Washington State Department of Transportation

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September 19, 2013

Matthew Sterner
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DAHP Log No.: 051911-05-FTA; Seattle Ferry Terminal Determination of Eligibility for Sites 45KI1012 and 45KI1013

Dear Matthew:

On behalf of FTA and WSF, I am submitting the enclosed Technical Memorandum prepared by ESA and reviewed by Kevin Bartoy and myself on behalf of WSDOT. The purpose of the document is to provide additional information to support FTA's previous determination of eligibility for archaeological sites 45KI1012 and 45KI1013, as an addendum to the earlier report prepared by ICF.

The initial investigation of the sites conducted by the City of Seattle for the Seawall Replacement Project recommended both sites as eligible for the National Register of Historic Places (NRHP) due to their potential to yield important data (Criterion D), and 45KI1012 also eligible under Criterion A, B, and C, for association with Yesler and his wharf. The follow-up research by ICF, which did not include any additional underwater investigation, determined the sites were not eligible under any NRHP criteria, for a variety of reasons detailed in that study.

To help resolve the two conflicting determinations of eligibility, WSDOT hired ESA to do additional underwater survey work, including test excavations at both sites to determine if stratified deposits were present.

Based on the findings by ESA, including the lack of stratified deposits at either site, the chronologically mixed composition of the site assemblages and their lack of spatial patterning, and the lack of any direct evidence that the structural features at 45KI1012 are related to Yesler's wharf or that deposits related to Yesler's wharf are buried within the structure, we are confirming our determination that neither site is eligible for the NRHP under any criteria, including D. While historic artifacts are present on the surfaces of both sites, these artifacts represent surface scatters lacking spatial or temporal integrity and are mixed with modern debris.

To summarize the relevant points regarding site eligibility and integrity, I have prepared the following table to illustrate why the sites are not eligible for any of the four NRHP criteria:

NRHP Criteria	45KI1012	45KI1013
Criteria A: Associated with events that have made a significant contribution to the broad patterns in our history.	Not associated with any specific, significant event. No evidence for the Great Fire, and it is not the areas of Yesler's first dock. It is associated with NPRR and possibly Yesler's post 1880 dock, but the site does not have retain integrity of design, setting, materials, feeling, or association (all it has is location)	Not associated with any specific, significant event; represents general waterfront use.
Criterion B: Associated with the lives of persons significant to our past.	Not clearly associated with Yesler, other than by location: there is no integrity of design, setting, materials, workmanship, feeling, or association, and it has been heavily impacted and modified by subsequent development (seawall, NPRR pier, pier demo, sediment capping, concrete piles, and erosion); structure does not match historical descriptions of Yesler's construction technigue	Not associated with any specific person.
Criterion C: Embody the distinctive characteristic of a type, period, or method of construction, or that represents the work of a master, or that possesses high artistic value, or that represents a significant and distinguishable entity whose components may lack individual distinction.	Does not embody the distinctive characteristics of a type, period or method of construction; based on location, it may be part of fill Yesler placed under the last phase of dock expansion, but it does not match historical descriptions of the kind of fill Yesler used; by location it does match the NPRR pier and their method of construction/ dredging. As a site it lacks integrity of design, setting, workmanship, feeling, and association, and has been heavily impacted by later pier demolition and construction, plus capping by sand and quarry spalls	No.
Criterion D: Have yielded, or may be likely to yield, information important in prehistory or history.	It is possible there is evidence for earlier phases of construction preserved below one meter (the limit of hand excavation), but there is no evidence for this in the geotechnical cores, and the upper one meter appears to be a single construction event; also, given the extensive number of piles (wooden and concrete) driven into the mound since 1902, it is unlikely there are significant deposits left that would provide any new or important information.	There is no stratigraphic component to the site, and no spatial patterning indicative of any behavior or events other than casual discard of common items from the pier or waterfront. The site has not provided information important or significant to history, and there is no evidence that it will do so.

In conclusion, based on the additional data collected by ESA, we are reaffirming our determination that neither site 45KI1012 nor 45KI1013 is eligible to the National Register of Historic Places. We look forward to your concurrence.

Sincerely,

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DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past, Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

September 26, 2013

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In future correspondence please refer to:
Log: 051911-05-FTA
Property: Seattle Multimodal Terminal at Coleman Dock, WSF
Re: Archaeology – Not Eligible, No Historic Properties

Dear Mr. Drais:

Thank you for contacting our office and providing a copy of the revised cultural resources testing report completed by ESA. We concur that the archaeological testing conducted at archaeological sites 45KI1012 and 45KI1013 supports your determination that the two sites are not eligible for listing in the National Register of Historic Places (NRHP). Based upon the documentation presented in the report, we concur with your finding of no historic properties affected for the project.

We would appreciate receiving any correspondence or comments from concerned tribes or other parties that you receive as you consult under the requirements of 36CFR800.4(a)(4).

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer in conformance with Section 106 of the National Historic Preservation Act and its implementing regulations 36CFR800.

Should additional information become available, our assessment may be revised. In the event that archaeological or historic materials are discovered during project activities, work in the immediate vicinity must stop, the area secured, and this office and the concerned tribes notified.

Thank you for the opportunity to review and comment. If you have any questions, please contact me.

Sincerely,

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Appendix F – Noise and Vibration Discipline Report

Washington State Ferries

Seattle Multimodal Terminal at Colman Dock Project Environmental Assessment

Noise and Vibration Discipline Report

Prepared for

Washington State Department of Transportation
Federal Highway Administration
Federal Transit Administration

Prepared by

Larry J. Magnoni
Washington State Department of Transportation
Air Quality, Noise & Energy Unit

March 2014

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Acronyms and Abbreviations

ADA	Americans with Disability Act
AWV	Alaskan Way Viaduct
dBA	A weighted decibel
DEA	draft environmental assessment
EA	environmental assessment
EDNA	environmental designation for noise abatement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
GP	general purpose
HOV	high-occupancy vehicle
HT	heavy truck vehicle (more than 2 axle 6 wheels)
Leq	equivalent sound pressure level
Ldn	day – night sound level
MMPNV	major public project noise variance
MT	medium truck vehicle (2 axle 6 wheels)
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NVDR	Noise and Vibration Discipline Report
OHL	overhead loading
POF	passenger only ferry
PPV	peak particle velocity
SMC	Seattle Municipal Code
SEPA	State Environmental Policy Act
SR	State Route
TNM	Traffic Noise Model
WAC	Washington Administrative Code
WSBL	Washington Street Boat Landing
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries

Introduction and Project Description

Why are Noise and Vibration considered in the EA?

This document provides the Noise and Vibration Discipline Assessment (NVDR) for the Seattle Multimodal Terminal Project.

The Noise and Vibration Discipline Report addresses the regulations, policies, and procedures for both federal partners: the Federal Highway Administration (FHWA), 23 CFR 772; and the Federal Transit Administration (FTA), 23 CFR 771. The state and federal partners has developed an Environmental Action Team (EAT) paper, issue paper #24, which addresses the resolution of differences between the two federal partner criteria and method requirements. The document also addresses the state's regulations, policies and procedures in Washington State Department of Transportation (WSDOT)'s 2011 Noise Policy and Procedures and in the Washington Administrative Code (WAC) 173-60. This document will also address the City of Seattle's Noise Control Code as outlined in Seattle Municipal Code (SMC) Section 25.08.

Since only FTA has the guidance, modeling tools, and criteria for analyzing the effects from ferry and ferry terminal operations, FTA provides the lead guidance for analyzing much of the operational noise and vibration effects from these project sources. FHWA does provide a much more sophisticated model, however, for analyzing automobile and truck noise, and the FHWA criteria are often more conservative. For analyzing the effect of SR 519 traffic to and from the ferries and the changes to these routes within the project, this report will use FHWA's Traffic Noise Model TNM 2.5.

At the state level, WSDOT 2011 Noise Policy and Procedures provides comprehensive relevant guidance to addressing transportation noise issues. That policy, along with the (EAT) issue paper #24, helps resolve differing directions from noise and vibration guidance from the two federal partners on this project. Traffic on Washington State Highways is exempt from analysis of noise affects when governed by

Washington State Motor vehicle noise performance standards, WAC 173-62.

The Washington State Department of Ecology rules included in WAC 173-60 exempts traffic on state highways when vehicles conform to the motor vehicle noise performance standard WAC 173-62. Construction noise, however, is limited to day time regulation by the state's Department of Ecology. In the City of Seattle, DOE, as it does in many cities and counties, defers regulatory authority to the local officials.

This document discusses in the construction noise section how the City of Seattle's Noise Control Code, SMC 25.08, governs construction noise and its effects on residents and businesses in the City of Seattle and measures that may be taken to reduce those effects. Because the project has neither finished the design nor selected a contractor, this report can only qualitatively address construction noise effects. The project administration, working closely with City of Seattle officials, will ultimately address the final project construction details in light of the construction noise issues.

Recognizing that project noise and vibration may cause effects to the wildlife population both underwater and in air, this technical discipline report only addresses the effects of noise and vibrations to humans through air in the terrestrial environment. The Biological Assessment and Biological Opinions for this project address the noise and vibration effects to both the underwater and the terrestrial wildlife populations.

What are the key points of this report?

Because the existing operations within the ferry terminal facilities are nearly identical with the future build operations, noise and vibration effects do not differ greatly between the build and no build alternatives. The removal of the north trestle and the relocation of the passenger only facility (POF) west of its current location are the two primary physical differences between the facilities in the build and no build alternatives. Both these modifications move the potential sources of noise and vibration further from sensitive areas. Though construction of the build alternative has the potential to produce slightly more vibration effects, the deteriorating wood piles currently

supporting the north trestle will eventually require demolition, presenting a risk similar to the no build alternative.

What is the project area?

The Seattle Multimodal Terminal is located in the City of Seattle, King County, Washington. The terminal is located in Township 24 North, Range 4 East, Section 6, in Elliott Bay. The Seattle Terminal is located at Colman Dock, at Pier 50 and Pier 52, on the Seattle waterfront. Colman Dock at 801 Alaskan Way in Seattle Washington extends west from the Alaskan Way seawall into Elliott Bay of the Puget Sound and is WSDOT right of way. Pier 56, Seattle Fire Department property, frames the north boundary and Pier 48, also WSDOT right of way, frames the south boundary. Colman Dock is administratively a terminus of State Route 519. Exhibit 1 shows the project vicinity and its relationship with other city of Seattle features

Exhibit 1: Project Vicinity Map and Noise Measurement Locations

What are the project alternatives?

What is the Build Alternative?

WSDOT – Ferries Division (WSF) proposes to replace the creosote treated timber trestle portion of the Seattle Terminal at Colman Dock, as well as the main terminal building and auxiliary structures located on the timber trestle. The vehicular transfer span, overhead loading (OHL), and some marine components of Slip 3 will also be replaced. Access and egress to the facility at Marion Street and Yesler Way will remain unchanged.

The structures replaced by the project are at the end of their service life. They are deteriorating and seismically vulnerable. The Slip 3 OHL does not meet the requirements of the Americans with Disability Act (ADA). The reconfigured facility will preserve the level of vehicle holding available today, enhance safety and operational efficiency and provide better connections to transit. The new structures will be designed to meet the latest seismic bridge and building code requirements.

Trestle

The existing timber trestle is an over water structure approximately 140,000 square feet in size. The trestle includes the timber piles, the deck and the deck's structural supports. It extends from the south edge of the terminal building to the north edge of the facility, adjacent to the fire station. The trestle was originally constructed in 1936 and rebuilt in 1964 using many of the original timber piles. As part of the

1964 pier reconstruction, WSF also constructed the main terminal building. WSF added the southern, concrete half of the dock in 1990 (approximately 150,000 square feet).

The proposed project will replace the timber trestle up to Marion Street. The area north of Marion will not be reconstructed, the equivalent holding capacity being replaced on the south edge of the facility. This reconfiguration of the dock will enhance safety by reducing pedestrian and vehicle conflicts and provide increased operational efficiency, while opening approximately180 linear feet of waterfront and near shore habitat. Total overwater coverage for the facility will remain approximately constant.

Ferry Slips

The vehicle transfer span and the passenger OHL structures of Slip 3 will be reconstructed as part of the project. The new OHL will be wider, allowing faster movement of walk-on passengers. It will be ADA accessible. Two timber berthing structures in Slip 2 and 3 will be replaced.

Access and Egress

Access and egress points to the facility will remain unchanged for vehicle, bicycle, and pedestrian traffic.

Multimodal Connections

Existing connections to transit service along Alaskan Way will be maintained. WSF will integrate its efforts with the City of Seattle and King County Metro to assure that ferry passenger connections to local transit service are maintained or enhanced as local transit routes or service are revised.

Terminal Building

The existing terminal building will be demolished and a new building will be constructed as part of the project. The main level of the existing terminal building includes 36,000 square feet of enclosed space. The main level now accommodates passenger waiting and processing areas, as well as staff and vendor spaces. The new terminal building will provide 22,000 square feet of passenger, staff and vendor spaces. The design of the new building will provide the flexibility to add additional vendor spaces in a future phase of the project.

What is the No Build Alternative?

Existing state law requires the state ferry system to maintain existing facilities. With the "no build" alternative, WSF or its agents would not perform any of the preservation or improvement tasks proposed in the build alternative above. The state law then requires WSF to perform the maintenance and preservation tasks necessary to keep the terminal operational. These tasks would include such actions as emergency repair and replacement of structures, and structure systems that may fail due to seismic or other catastrophic events. The "no build" alternative would include actions that would maintain and repair the current level of multimodal services until structural systems, such as the slip 3 vehicle transfer span and overhead loading, reached a point in their lifespan when annual maintenance and repair costs exceeded annual capital costs, forcing operations to reduce or close the services. The most likely predicted Washington State Legislature action at this point would be to appropriate funds to replace deteriorated structures and systems as needed to maintain the current level of ferry service.

Affected Environment

What are the existing Noise and Vibration characteristics of the study area?

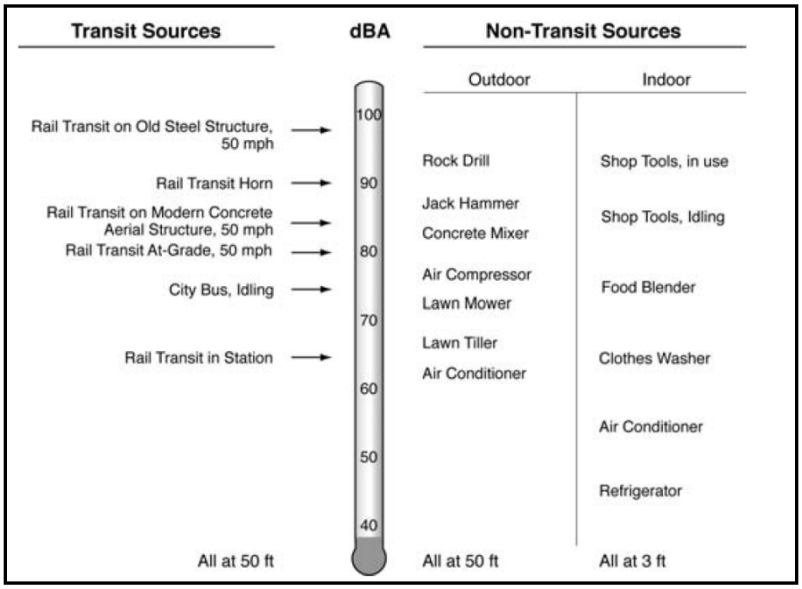
The project area consists primarily of commercial and transit oriented uses. Traffic on the Alaskan Way Viaduct (AWV) is a predominant source of noise in the project area. Existing sources of noise near the Colman Dock come mainly from road traffic, with some localized industry as well as aircraft over flights. The noise environment consists of routes of relatively heavy or fast automobile and truck traffic along the AWV and SR519 / Alaskan Way. Natural noises such as leaves rustling, modest wave action, and bird vocalizations are limited. Retail, office, transportation, public services (fire) and recreational uses dominate on the west side of Alaskan Way, where natural noises can be limited during peak commute times.

The discussion below describes the characteristics considered important by each of the two federal agencies in their guidance and regulation, as well as that addressing local and state law. For sound and vibration, the affected environment is evaluated base on how humans perceive these sounds and vibrations, the amount of sound and vibration already present in the environment, and how federal, state, and local entities regulate them.

How do we perceive sound?

Vibrating objects, such as vocal cords or hammers on steel bells create sound by causing variations in the surrounding atmospheric pressure. We usually call this sound pressure. The human ear's response to sound is based on the magnitude of a sound as a function of its frequency and time pattern (U.S. Environmental Protection Agency [EPA] 1974). Magnitude measures the physical sound energy in the air. The human ear detects variations in pressure as small as 20-micropascal (µPa [10-6 pascal]). Sound pressure greater than about 100 pascal (Pa) is painfully loud. This range of magnitude, from the faintest to the loudest sound the ear can hear, is so large that sound pressure levels are expressed on a logarithmic scale in units called decibels (dB) that quantify the energy contained in the sound

pressure. A sound pressure of 20 µPa is defined as 0 dB (the threshold of hearing for a healthy ear); while a sound pressure of 100 Pa is about 130 dB (the approximate threshold for pain).



Using the logarithmic dB scale, a doubling of the sound sources would result in an increase in decibels of only about 3 dB. A tenfold increase in the number of sources will add a 10 dB increase to the original sound. For example, two 60 dB sources will measure only 63 dB and 10 of these sources will only measure 70 dB.

Humans also respond to a sound's frequency or pitch. The human ear can typically perceive sound frequencies between approximately 20 and 20,000 hertz (Hz, or cycles per second), but we hear sounds best between approximately 1,000 and 5,000 Hz. Environmental sounds are composed of many frequencies, each occurring simultaneously at its own sound pressure level. Frequency weighting, which is applied mathematically by the sound level meter, combines the overall sound frequency into one sound level that simulates how an average person hears sounds. The most commonly used frequency weighting for environmental studies is A-weighting, which is a curve of frequencies based on how most humans perceive sounds of low to moderate magnitude. Meters then express the measurements using A-weighting in dBA.

Sound levels also decrease as the distance from the sound source increases. For a line source, such as a row of cars moving on a roadway, sound levels drop 3 dBA over hard ground (concrete or pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor (individual hearing the noise). For a point source, such as a piece of construction or ventilation equipment, sound levels decrease between 6 and 7.5 dBA for every doubling of distance from the source.

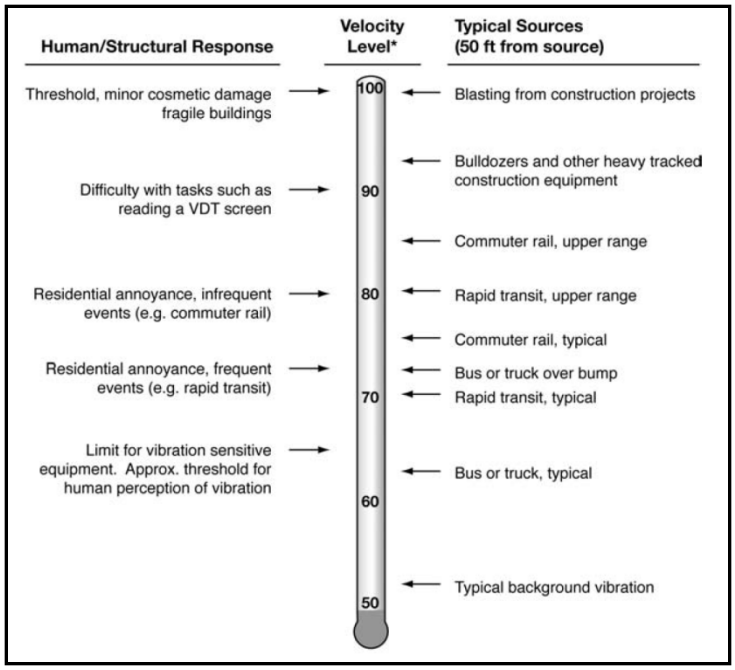
Terrain can greatly affect propagation of sound. Level ground is the simplest case. Noise travels in a straight line-of-sight path between the source and the receiver. The addition of a berm or other area of high terrain reduces the sound energy arriving at the receiver. Breaking the line of sight between the receiver and the sound source can result in a sound level reduction of approximately 5 dBA.

Sound levels from traffic sources depend on the number or volume of vehicles, their speed, and the type of vehicles. In general, an increase in volume, speed, or vehicle size increases the traffic noise level generated by that source. Vehicular noise is a combination of noises from the engine, exhaust, and mostly tires on automobiles. On the larger trucks, however, the engine and exhaust may have a greater influence. Other conditions affecting traffic noise include such things as steep grades, terrain, vegetation, distance from the roadway, and shielding by barriers and buildings.

How do we perceive vibrations?

Unlike sound, there is relatively little research done to determine human response to vibration, in particular, human annoyance with building vibration. In contrast to airborne sound, ground-borne vibration is not a phenomenon that most people experience every day.

Vibration consists of rapidly fluctuating motions above and below a zero or normal point. Several descriptors can be used to quantify vibration amplitude. The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak of the vibration signal. PPV is often used in monitoring of blasting, pile driving and other construction activities that produce high level of vibrations. Although peak particle velocity is appropriate for evaluating the potential of building damage, it is not suitable for evaluating human response. It takes some time for the human body to respond to vibration signals.



In a sense, the human body responds to average vibration amplitude. Because the net average of a vibration signal is zero, the root mean square (rms) amplitude is used to describe the "smoothed" vibration amplitude. The PPV and rms velocity are normally described in inches per second in the USA and meters per second in the rest of the world. Although it is not universally accepted, decibel notation is in common use for vibration. Vibration levels in this report are referenced to $1x10^{-6}$ in. /sec. Although not a universally accepted notation, the abbreviation "VdB" is used in this document for vibration decibels to reduce the potential for confusion with sound decibels.

The background-vibration velocity level in residential areas is usually 50 VdB or lower, well below the threshold of perception for humans, which is around 65 VdB. Most perceptible indoor vibration is caused by sources within buildings, such as operation of mechanical equipment, movement of people, or slamming of doors. Typical outdoor sources of perceptible ground-borne vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. Pile driving is a common source of vibration. The vibration from traffic is rarely perceptible if the roadway is smooth. The range of interest is typically from about 50 to 100 VdB.

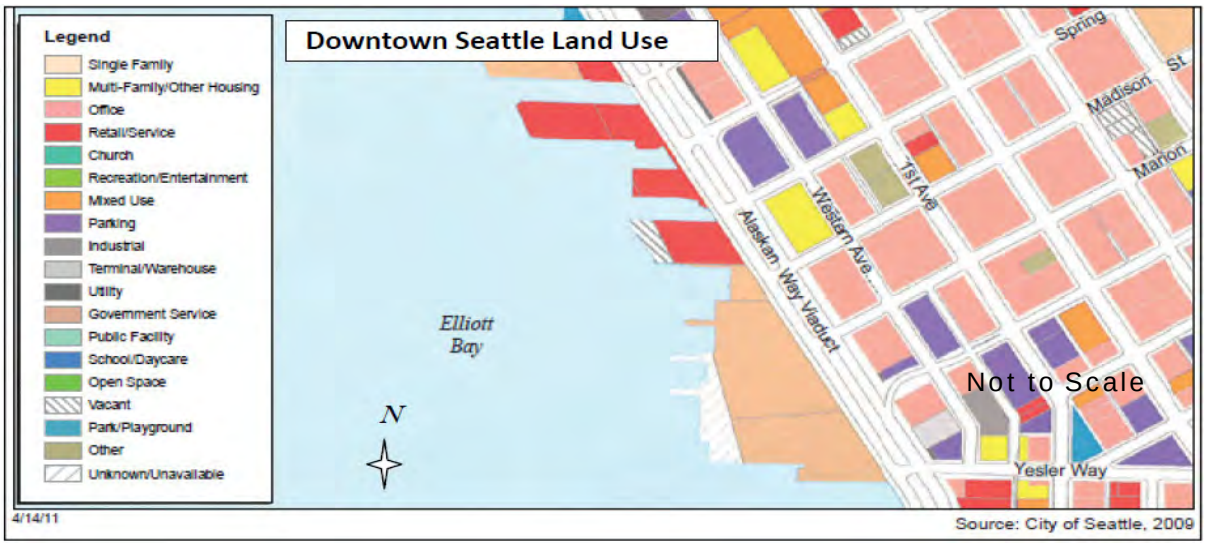
Although the perceptibility threshold is about 65 VdB, human response to vibration is not usually significant unless the vibration exceeds 70 VdB. Rapid transit or light rail systems typically generate vibration levels of 70 VdB or more near their tracks. On the other hand, buses and trucks rarely create vibration that exceeds 70 VdB unless there are bumps in the road. Because of the heavy locomotives on diesel commuter rail systems, the vibration levels average about 5 to 10 decibels higher than rail transit vehicles. If there is unusually rough road or track, wheel flats, geologic conditions that promote efficient propagation of vibration, or vehicles with very stiff suspension systems, the vibration levels from any source can be 10 decibels higher than typical. Hence, at 50 feet, the upper range for rapid transit vibration is around 80 VdB and the high range for commuter rail vibration is 85 VdB. If the vibration level in a residence reaches 85 VdB, most people will be strongly annoyed by the vibration.

What type of environment will the project's noise and vibration affect?

The study area evaluated for noise and vibration effects includes areas likely to be affected by changes in traffic or ferry terminal facility operations and by project construction noise. This study evaluates noise and vibration for each alternative and areas likely to be affected by construction and operation noise or vibration. Potential noise- and vibration-sensitive uses near project limits include a 20 unit condominium building located northeast of the project site, Fire Station # 5 immediately north of the project site, and the Washington Street Boat Landing south of the site. The Seattle downtown core land use map, Exhibit 2 below, shows the land uses that project operations and construction may affect.

Two historic structures discussed within this document include Fire Station #5 adjacent to and immediately north of the Colman Dock, and the Washington Street Boat Landing (WSBL), located just over 200 feet south of Colman Dock's south egress roadway. The WSBL is listed on the National Register of Historic Places (NRHP), and is within the Seattle-designated Pioneer Square Preservation District. The fire station, though not listed, is eligible for listing in the NRHP. Therefore it is necessary to determine the project vibration and noise effects to these facilities.

Exhibit 2: Downtown Seattle Land Use



The two federal co-lead agencies, FHWA and FTA, analyze the operational noise and vibrations within their project limits differently. These two federal entities, however, take similar

approaches for analyzing effects caused by construction noise. Only FTA considers and analyzes the effects of project-related vibrations.

How was the sound and vibration information collected?

The roadway vehicle volumes, speeds, and types modeled came from traffic studies performed for this project. The subsections below describe the sound level measurements taken to support this analysis. The Alaskan Way Viaduct (AWV) project noise study and the Seattle Seawall Noise and Vibration Analysis also provided some of the data needed to produce this study.

Sound Level Measurements

Sound levels from transportation sources tend to vary with time. For example, noise levels increase when a car approaches, then reach a peak as it passes, and decrease as the car moves farther away. To account for the variation in loudness over time, sound level professionals use a common noise measure, the equivalent sound pressure level (Leq). The Leq is defined as the average sound level, in A-weighted decibels, dBA, for a specific time period. This report uses the Leq metric to describe the traffic noise modeled and analyzed.

Exhibit 3: Sound Level Meter

Another unit that noise engineers frequently use in transportation noise studies is the day-night sound level, or Ldn. This unit includes cumulative sound exposure from all events over a 24-hour period, with sound levels monitored between 10 PM and 7 AM increased by 10 dBA to account for greater nighttime sensitivity to noise. The Ldn unit is applied in the modeling and analysis of noise levels in the local area to determine affects to sleeping spaces, such as in the fire station or the condominiums.

The analyst used Larson Davis LXT Type I sound level meters and microphones to measure sound levels as prescribed by Measurement of Highway Related Noise (FHWA 1996). These measurements were taken to establish both the FTA 24-hour Ldn and the FHWA peak 1 Hour Leq that occurs on a regular basis. The AWV and Seattle Seawall project measurements and levels were used to supplement and support sound levels measured for this project.

The analysis of the noise environment for this project included three sound level measurement sites to provide the foundation of this analysis. The location of these measurements can be seen on the aerial shown in Exhibit 4. Exhibit 5 summarizes the measurement taken at these sites.

Exhibit 4: Sound level measurement locations.

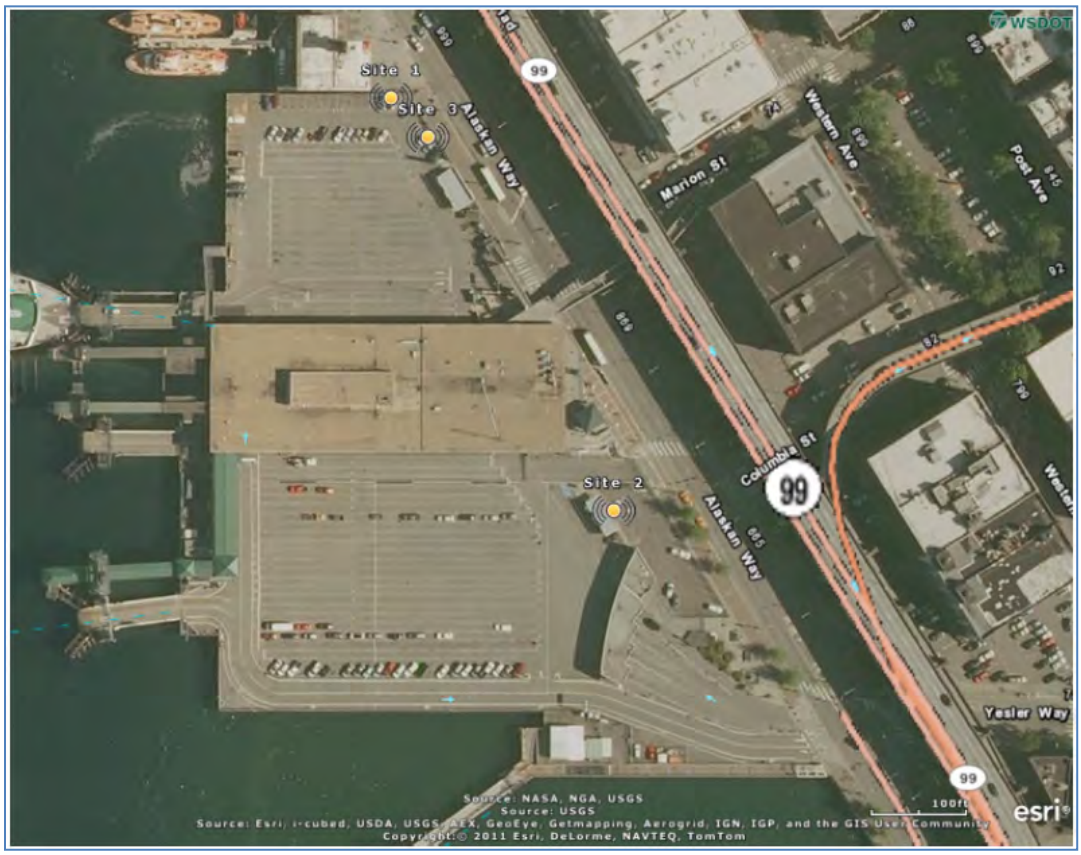


Exhibit 5: Sound Level Measurements.

Site No.	Location	Time Period	Measurement Date / Time	FHWA 15 min. Leq (dBA)	FTA Ldn (dBA)	Day / Night Range (Ldn) (dBA)
Site 1	North side of Colman Dock Near Fire Station #5	24 hr.	8-9 Aug. 2012	NA	76.3	68 - 85
Site 2	South side of Colman Dock Near Toll Booths	24 hr.	8-9 Aug. 2012	NA	72.7	64.8 – 81.1
Site 3	North side of Colman Dock 28 feet from SR519.	15 min.	8 Aug. 2012 2:10 PM	73.9	NA	NA

FHWA Highway Traffic Sound Measurements

The US Department of Transportation provides guidance in its Measurement of Highway Related Noise (1996) for sound level measurements collected to provide validation for the FHWA TNM 2.5 traffic noise model. The analyst counts traffic while measuring sound levels and incorporate this into a model constructed from existing sound level measurements. The model constructed with the counted traffic must validate to within 2 dB of the measured values. One 15-minute Leq sound level measurement was collected to validate a TNM 2.5 model to represent traffic sound level emissions for traffic on Alaskan Way and on the roadways to and from the ferry decks.

Sound level measurements from traffic composed of mostly autos, the wind rustling the leaves in trees nearby, construction work and traffic on the Alaskan Way Viaduct and conversations from pedestrians on the sidewalks produced 15-minute measurements of 74 dBA Leq (Exhibit 5). Due to the overwhelming levels from the other sources, the model would not validate.

FTA Existing Environmental Sound Measurements

The FTA uses sound level measurements to establish the existing sound level from all sources. Sound level meters set to measure hourly Leq's for 24-hour periods establish this existing level for residential land uses. For the Seattle Multimodal Terminal project two 24-hour measurements were made with meters placed just north, south and east of the current Colman Dock facility, to establish an Ldn background for the project. Due to AWV construction work, these measurements may contain sound from sources not characteristic of the site's normal sound environment. Review of AWV project noise files provides preconstruction measurement details showing project sound levels with and without traffic on the viaduct. The measurements taken for this project are consistent with measurements in the AWV project noise files. Measurements with traffic on the viaduct show a sound level 7 dB higher than that with the viaduct closed for this area of the project.

Potential Effects of the Project

The discussion below addresses the characteristics considered important by each of the two federal agencies in their guidance and regulation, as well as addressing local and state law.

What methods were used to evaluate the potential effects?

This analysis considers noise and vibration effects based on the criteria used by FTA and FHWA. The primary criterion comes from FTA guidance, and varies depending on the existing sound level exposure with and without the project and existing land use. The FHWA, on the other hand, compares existing sound levels with the future, usually 20 years out, with and without project. The discussion below describes the differences between these two agency criteria and the metrics used in this report.

FTA Noise Assessment Guidelines

The FTA manual, Transit Noise and Vibration Impact Assessment (May 2006), provides detailed requirements for analysis of noise and vibration for a transit project. The manual distinguishes between sources that can be characterized as a fixed "point source," such as a transit center or ferry terminal, and those that can be characterized as a "line source," such as a roadway and rail lines. The point sources are also referred to as "stationary" noise sources.

The FTA manual groups the land uses surrounding a project into three categories, shown in Exhibit 6. The criteria used in the analysis of operational effects depend on the land use category of the properties near the noise source. To describe the criteria sound level, FTA uses the A-weighted hourly Leq which describes a receiver's cumulative noise exposure from all events over an hour's time. In residential areas where night time sound levels are a concern, an Ldn is used. This descriptor cumulatively averages 24 hourly Leq's but provides added sensitivity to the night time hours by increasing sound levels between 10 pm and 7 am by 10 dBA. Commercial and industrial land uses are not included in the land use categories and are excluded from the analysis process

because the activities within these buildings are compatible with higher sound levels.

Exhibit 6: FTA Land Use Categories

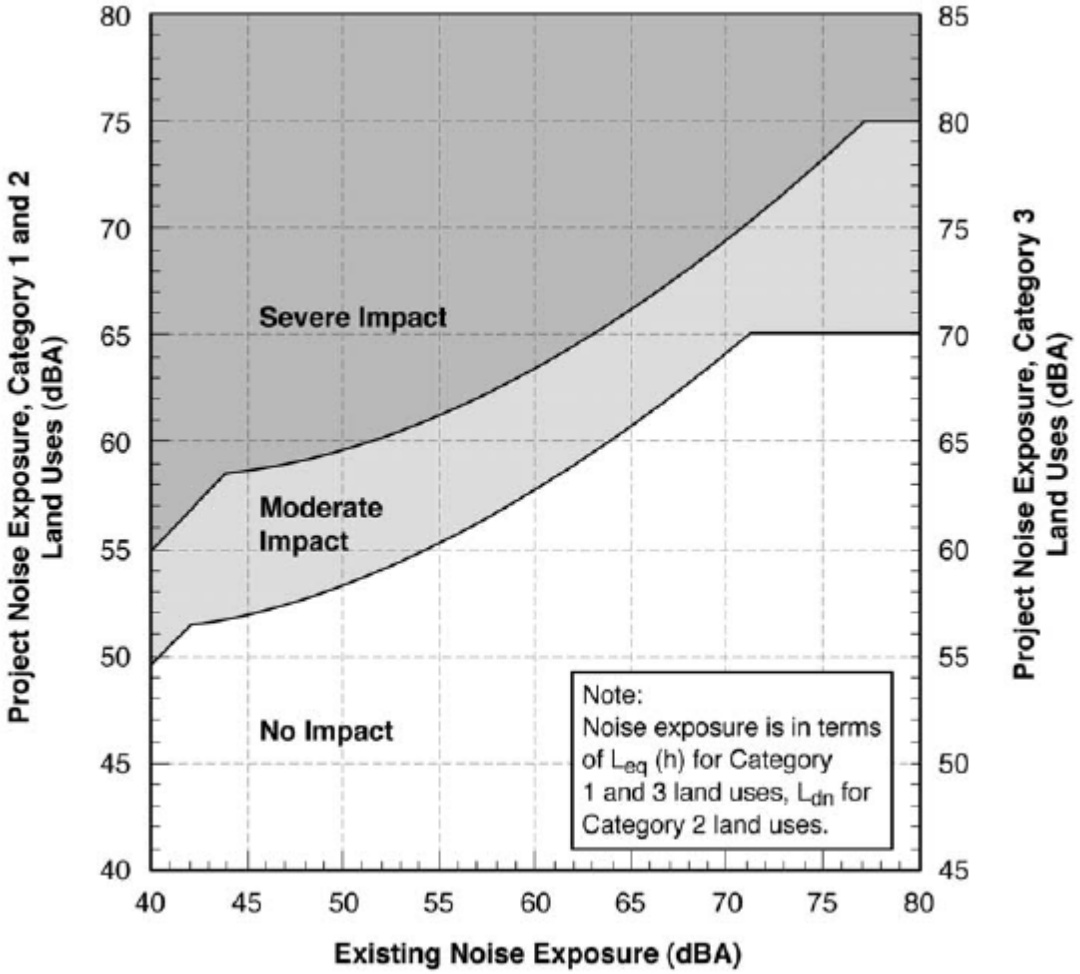
Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(h)*	Tracts of land where quiet are an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor L_{eq}(h)*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

* L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity.

In the FTA guidance, the general processes for both noise and vibration analysis are similar, although they differ in the detailed applications. Each assessment begins with a Screening Procedure. They are followed by a General and then a Detailed Assessment where FTA criteria are applied depending upon the seriousness of affect to the existing environment.

The noise impact criteria shown in Exhibit 7 are based on comparison of the existing outdoor noise levels and the future outdoor noise levels from the proposed project. They incorporate both absolute criteria, which consider activity interference caused by the transit project alone, and relative criteria, which consider annoyance due to the change in the noise environment caused by the transit project.

Exhibit 7: Noise Impact Criteria for Transit Projects



FTA Vibration Assessment Guidelines

FTA guidelines require a vibration assessment as part of FTA Noise Assessments. For many of FTA projects which typically include a fixed rail component, vibration from these rail sources has a potential to cause annoyance and needs to be addressed. It is unlikely that this type of vibration impact would occur from a ferry terminal operation. However, during construction similar vibration events, though only temporary in nature, will occur and FTA provides guidance to address them.

Two phenomena affect people's perception of vibration: ground-borne noise and ground-borne vibrations. The relationship between ground-borne vibration and ground-borne noise depends on the frequency content of the vibration and the acoustical absorption of the receiving room. Vibrations are seldom annoying to people outside a building. The more acoustical absorption in the room, the

lower will be the noise level. For a room with average acoustical absorption, the unweighted sound pressure level is approximately equal to the average vibration velocity level of the room surfaces. Hence, the A-weighted level of ground-borne noise can be estimated by applying A-weighting to the vibration velocity spectrum. The criteria for acceptable ground-borne vibration are expressed in terms of rms velocity levels in decibels (VdB). The criteria for acceptable ground-borne noise are expressed in terms of A-weighted sound levels. The limits are specified for the three land-use categories in Exhibit 8 below:

Exhibit 8: Ground-Borne Vibration (GBV) and Ground-Borne Noise (GBN) Impact Criteria

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch /sec)			GBN Impact Levels (dB re 20 micro Pascal)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibration would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

Notes:

1. "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

2. “Occasional Events” is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

3. "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

4. This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

Source: FTA 2006

This analysis considers three specific factors in determining if there is potential vibration impact from projects that involve rubber-tire vehicles:

- Will there be expansion joints, speed bumps, or other design features that result in unevenness in the road surface near

vibration-sensitive buildings? Such irregularities can result in perceptible ground-borne vibration at distances up to 75 feet away.

- Will buses, trucks or other heavy vehicles be operating close to a sensitive building? Research using electron microscopes and manufacturing of computer chips are examples of vibration-sensitive activities.
- Does the project include operation of vehicles inside or directly underneath buildings that are vibration-sensitive? Special considerations are often required for shared-use facilities such as a bus station located inside an office building complex.

The majority of smaller FTA-assisted projects, such as this ferry terminal and park-and-ride lots, will be eliminated from further consideration of ground-borne vibration impact in the first step above. While the project will not operate vehicles inside or underneath the Washington Street Boat Landing or Fire Station # 5, those structures have been considered in this analysis. Each of these structures will be located outside the screening distances shown in Exhibit 9 for vibration from operations. (Construction vibration impacts are discussed separately below.)

Exhibit 9: Screening Distances for Vibration Assessment

Type of Project	Critical Distance for Land Use Categories* Distance from Right-of-Way or Property Line		
	Cat. 1	Cat. 2	Cat. 3
Conventional Commuter Railroad	600	200	120
Rail Rapid Transit	600	200	120
Light Rail Transit	450	150	100
Intermediate Capacity Transit	200	100	50
Rubber tired vehicle projects (if not previously screened out)	100	50	--

* The land-use categories are defined in Exhibit 5. Some vibration-sensitive land uses are not included in these categories. Examples are: concert halls and TV studios which, for the screening procedure, should be evaluated as Category 1; and theaters and auditoriums which should be evaluated as Category 2.
Source: FTA 2006

Results from consideration of these steps indicate little or no potential for vibration impacts as a result of current operations in the project area. Analysis of the operations of project alternatives determines if any vibration-sensitive land uses are within the screening zones. The two vibration-sensitive land uses near the project include the Washington Street Boat Landing, a category 3 land use like most of the property surround the terminal, and the condominiums and Fire Station #5, category 2, which must consider where people sleep. Vibration screening distances for the project operations are based on effects to these two sensitive uses.

Vibrations during the construction phase of the project have also been assessed. Construction activities such as pile driving and operation of heavy earth-moving equipment commonly cause vibration that people find annoying, and may cause damage to nearby sensitive buildings. The effects of ground vibration include perceptible movement of the building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Building damage is not normally a factor for construction projects, with the occasional exception of blasting, pile driving, and demolition of structures.

FHWA Noise Regulations and Criteria

The FHWA traffic noise criteria defined in 23 CFR 772 identified in WSDOT Traffic Noise Analysis and Abatement Policy and Procedures (WSDOT, 2011), are compared to the predicted project traffic-noise levels for the project design year. The criteria, called Noise Abatement Criteria (NAC), are considered to be at impact if it exceeds or approaches the active Leq (h) noise level identified in Exhibit 10.

Exhibit 10: Noise Abatement Criteria (NAC)

Activity Category	Activity Leq(h)[1]	Evaluation location	Activity description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential.
C[3]	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F			Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G			Undeveloped lands that are not permitted.

1 Hour A-Weighted Sound Level decibels (dB(A)).

WSDOT defines approach to mean 1 dBA below the NAC. For example, for a residential receiver, category B, a noise impact would occur if the predicted exterior Leq (noise level) is 66 dBA or higher. An impact applicable for other developed lands such as commercial and industrial uses, category E, occurs when a noise level approaches or exceeds 72 dBA criteria, which is 71 dBA or higher. FHWA also considers a traffic noise impact to occur if future noise levels are projected to result in a "substantial increase" or a 10 dBA increase over existing noise levels. There are no criteria for undeveloped lands or construction noise. FHWA NAC are shown in Exhibit 10

Joint FTA / FHWA Noise Assessment Methods and Criteria

All Transit facilities analyzed for this project are anticipated to be rubber tired line noise sources except where the buses are stationary at the route stop and ferry traffic into the slips. WSDOT, Sound Transit, FTA, and FHWA agreed on February 1 2001 that this type of noise would be analyzed using FHWA criteria and methodology in WSDOT / Sound Transit Re-Alignment Issue Paper #24. Using this paper analysts are guided to which parts of the project's noise is considered using FHWA criteria and methods and which parts will use FTA

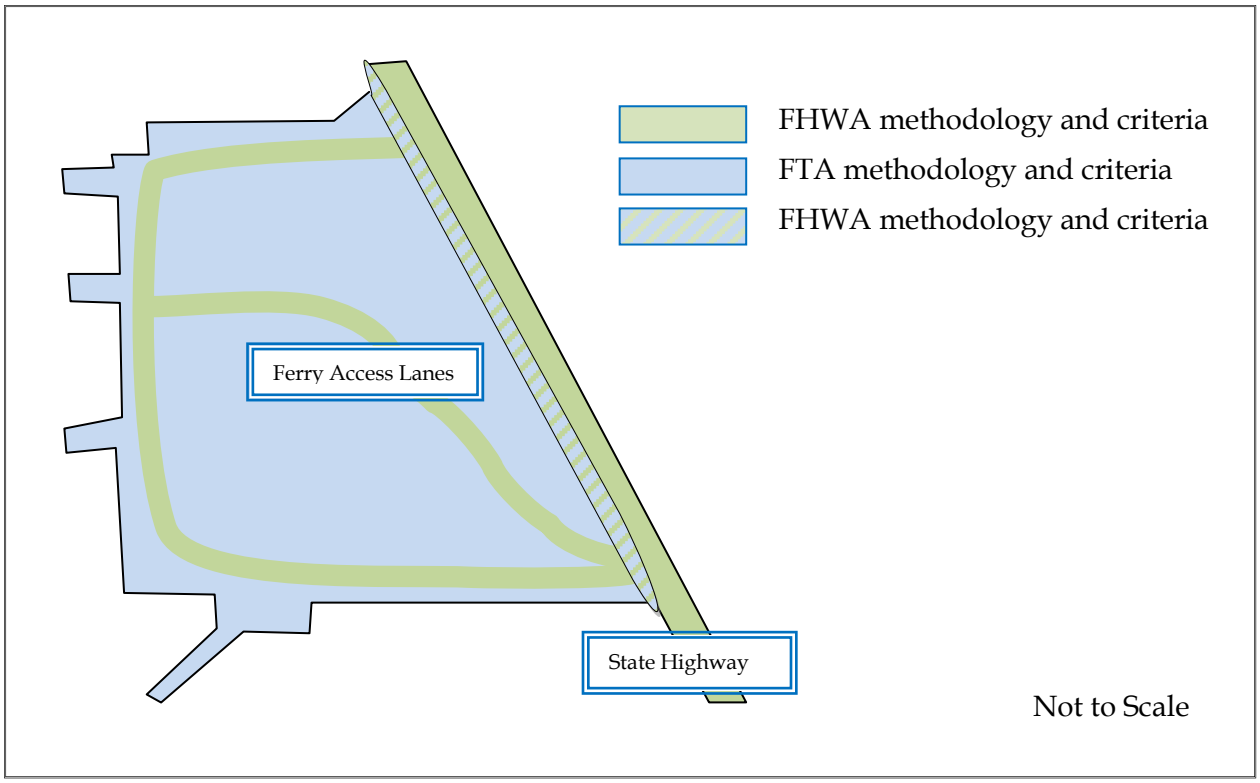
criteria and methods. Exhibit 11 and Exhibit 12 that follow show how the method and criteria is determined.

Exhibit 11: FTA / FHWA Decision Matrix

	Co-lead		FTA-Only		FHWA-Only	
	Method	Criteria	Method	Criteria	Method	Criteria
Point Source e.g. Park & Ride Transit Center	FTA	FTA	FTA	FTA	FTA	FTA
Line Source	FHWA	FHWA	FHWA	FHWA	FHWA	FHWA

FHWA methodology and criteria (line source) will be used for the roadways to the intersection with the physical boundary of the point source (e.g. curb line of a park and ride lot). For the point source, use FTA methodology and criteria contained in FTA's Transit Noise and Vibration Assessment. In areas where the line source analysis area and point source analysis area overlap, the FHWA line source methodology and criteria will be used.

Exhibit 12: FHWA / FTA Example Source Diagram



Local Property Line Criteria

The City of Seattle's noise ordinance (SMC 25.08) limits noise levels at the property lines of neighboring properties. The maximum permissible sound level depends on the land uses of both the noise source and the receiving property (Exhibit 13).

For construction, the maximum permissible sound levels apply only at night (between 10:00 p.m. and 7:00 a.m. on weekdays, or 10:00 p.m. and 9:00 a.m. on weekends and legal holidays). Construction activities during nighttime hours that would exceed these levels require a noise variance from the City.

Exhibit 13: City of Seattle Maximum Permissible Sound Levels

District of Noise Source	District of Receiving Property			
	Residential [1] (dBA)		Commercial (dBA)	Industrial (dBA)
	Day	Night		
Residential	55	45	57	60
Commercial	57	47	60	65
Industrial	60	50	65	70

[1] The maximum permissible sound level is reduced by 10 dBA for residential receiving properties between 10:00 p.m. and 7:00 a.m. where the receiving property lies within a residential district of Seattle.
Source: SMC 25.08.410

During the daytime (7:00 a.m. to 10:00 p.m. on weekdays, and 9:00 a.m. to 10:00 p.m. on weekends and legal holidays), construction is allowed to exceed the property line standards per the following limits, measured at 50 feet or the property line, whichever is farther (SMC 25.08.425):

- Earth-moving or other equipment on construction sites may exceed the applicable property line noise limit by 25 dBA.
- Portable powered equipment in temporary locations in support of construction may exceed the limit by 20 dBA.
- Impact equipment, such as jackhammers, may not exceed an Leq (h) of 90 dBA continuously or an Leq (7.5 minutes) of 99 dBA and may be used only from 8:00 a.m. to 5:00 p.m. weekdays and from 9:00 a.m. to 5:00 p.m. on weekends and legal holidays, unless otherwise allowed by a noise variance.

How would construction noise and vibration affect the project area?

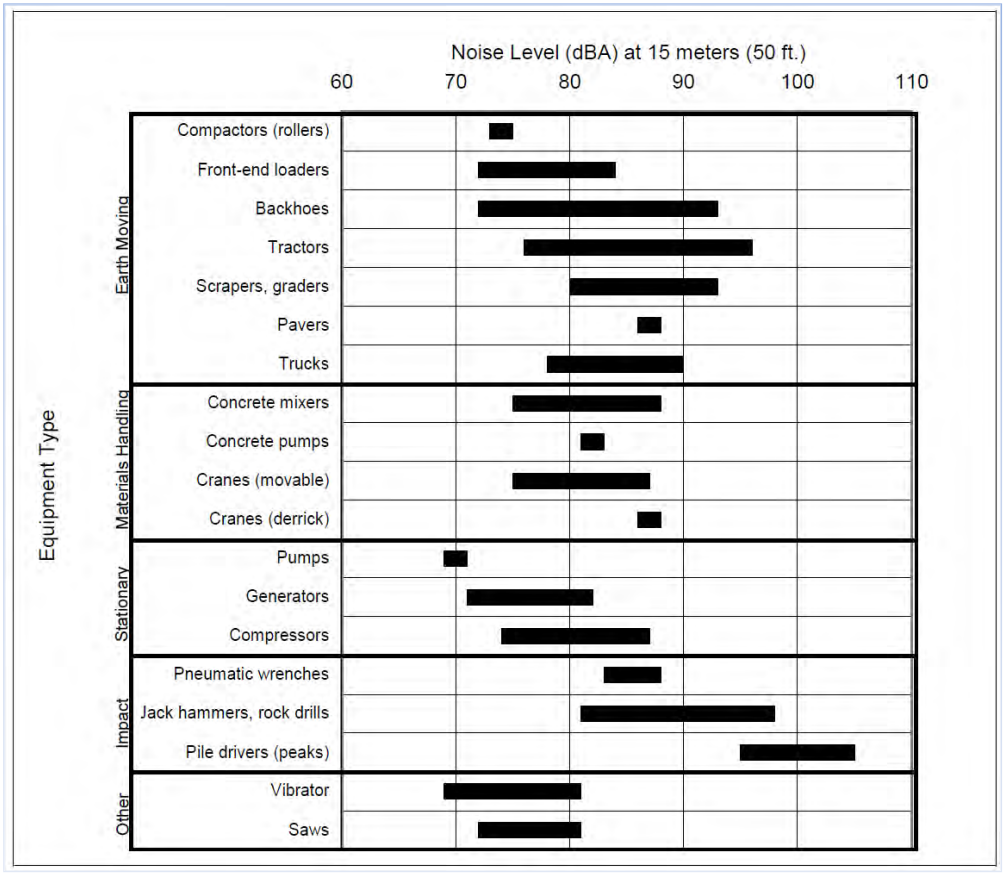
This section provides the result of screening and general assessments on construction noise and vibration performed using the FTA / FHWA guidance. The sub headed sections below describe in greater detail the result of these analyses. Construction noise and vibration would require monitoring when vibratory removal of piles within 12 feet of the fire station north of the north trestle is necessary.

Noise

The most prevalent noise source at construction sites would be internal combustion engines. Earth-moving equipment, material-handling equipment, and stationary equipment are all engine-powered. Mobile equipment operates in a cyclic fashion, but stationary equipment (e.g., pumps, generators, and compressors) generates sound levels that are fairly constant. Because trucks would be present during most construction stages and not confined to construction staging areas, noise from trucks could affect more receptors. Other noise sources would include impact equipment and tools such as pile drivers. Impact tools could be pneumatically powered, hydraulic, or electric.

Construction noise would be intermittent, occurring at different times at various locations in the project area. Construction staging areas could also be located outside the project area. Construction noise levels would depend on the type, amount, and location of construction activities. The type of construction methods determines the maximum noise levels produced by the construction equipment used. The amount of construction activity would quantify how often construction noise would occur throughout the day. The location of the construction equipment relative to adjacent properties would determine any effects of distance in reducing the levels of construction noise. The maximum noise levels of construction equipment under each build alternative would be similar to the typical maximum noise levels from construction equipment presented in Exhibit 14.

Exhibit 14: Typical Noise Levels from Construction Equipment



Source: EPA 1971.

As shown in Exhibit 14, maximum noise levels from construction equipment would range from 69 to 106 dBA Lmax at 50 feet. Construction noise at locations farther away would decrease at a rate of 6 to 8 dBA per doubling of distance from the source. Vibratory pile-driving generates noise levels of 101 dBA at 50 feet. At an attenuation rate of 6 dBA per doubling of distance, noise levels at the condominium building, which is about 260 feet from the closest corner of the Colman Dock site, would be 87 dBA during vibratory pile-driving.

Because various pieces of equipment would be off, idling, or operating at less than full power at any given time, and because construction machinery is typically used to complete short-term tasks at any given location, average Leq daytime noise levels would be less than the maximum noise levels.

Within the Seattle city limits, construction noise levels may not exceed a maximum Leq (7.5 minutes) of 99 dBA at 50 feet or the nearest property line, whichever is farther (SMC 25.08.425). Construction noise is allowed to exceed the City property line noise limits by 15 to 25 dBA

during the day (7:00 a.m. to 10:00 p.m. on weekdays and 9:00 a.m. to 10:00 p.m. on weekends and legal holidays). Impact equipment such as jackhammers may not exceed an Leq (h) of 90 dBA or an Leq (7.5 minutes) of 99 dBA and may be operated only from 8:00 a.m. to 5:00 p.m. on weekdays and from 9:00 a.m. to 5:00 p.m. on weekends and legal holidays, unless otherwise allowed by a noise variance.

Vibration

Construction activities that would result in the highest levels of ground vibration are demolition of the existing structures and impact and vibratory pile driving. For demolition and removal of the existing structures, the highest vibration levels would result from various methods of concrete, asphalt, and deck removal (including saw cutting and lifting segments out of place); using concrete pulverizers and shears mounted on excavators; or using jackhammers, hoe rams, or core drilling to break up material. The use of jackhammers and hoe rams and vibratory pile drivers to install piles would result in the highest levels of vibration during the demolition activities shown in Exhibit 15. Extraction of piles generates less vibration than installation.

Except for the pile driving, screening distances of demolition activities conducted 100 feet or more from existing structures would not result in vibration levels that exceed the damage risk criterion for most buildings. Structures in the project area that may be fragile include Washington Street Boat Landing and the Fire Station #5. The expected PPV of ground vibration levels at 25 feet from the demolition activities is anticipated to be in the range of 0.035 to 0.734 inch per second.

Exhibit 15: Vibration Source Levels for Construction Equipment (from measured data)

Equipment		PPV at 25 ft. (in/sec)
Pile Driver (impact)	upper range	1.518
	typical	0.644
Pile Driver (sonic)	upper range	0.734
	typical	0.170
Clam shovel drop (slurry wall)		0.202
Hydromill (slurry wall)	in soil	0.008
	in rock	0.017
Vibratory Roller		0.210
Hoe Ram		0.089
Large Bulldozer		0.089
Caisson Drilling		0.089
Loaded Trucks		0.076
Jackhammer		0.035
Small Bulldozer		0.003

Source: FTA, 2006

For impact pile driving, the PPV of ground vibration levels at 25 feet is expected to vary between 0.644 to 1.518 inches per second, depending on the size of and force exerted by the pile driver. These levels could exceed the damage risk criteria of 0.12 inch per second for extremely fragile buildings such as the Washington Street Boat Landing. The damage threshold criteria for Fire Station #5, a concrete and steel structure, is 0.5 inch per second PPV; vibrations could approach the damage threshold for this structure as well. Damage criteria expressed in inches per second PPV are shown in Exhibit 16 for different building categories.

Exhibit 16: Construction Vibration Damage Criteria

Construction Vibration Damage Criteria	
Building Category	**PPV (in/sec)**
• Reinforced-concrete, steel or timber (no plaster)	0.5
• Engineered concrete and masonary (no plaster)	0.3
• Non-engineered timber and masonary buildings	0.2
• Buildings extremely susceptible to vibration damage	0.12

Source: FTA, 2006

Analysis of vibration effects was adjusted for soil type. For most piles driven in Puget Sound, developers could reasonably anticipate encountering wet sandy and muddy soil. Exhibit 18 applies the "n"

exponent, based on soil type, model (Caltrans, 2004) as an effective approach for producing a reasonable vibration assessment for differing soil types. The value of "n" of 1.4 shown in Exhibit 17 is used to calculate the distances shown in Exhibit 18

Exhibit 17: Suggested "n" Values Based on Soil Class

Soil Class	Description of Material	Value of "n" measured by Woods and Jedele (1985)	Suggested Value of "n"
I	Weak or soft soils: loose soils, dry or partially saturated peat and muck, mud, loose beach sand, and dune sand, recently plowed ground, soft spongy forest or jungle floor, organic soils, top soil (shovel penetrates easily)	Data not available	1.4
II	Competent soils: most sands, sandy clays, silty clays, gravel, silts, weathered rock (can dig with shovel)	1.5	1.3
III	Hard Soils: dense compacted sand, dry consolidated clay, consolidated glacial till, some exposed rock. (cannot dig with shovel, need pick to break up)	1.1	1.1
IV	Hard competent rock: bedrock, freshly exposed hard rock. (difficult to break with hammer)	Data not available	1.0

Source: Caltrans 2004

No-Build

Existing state law requires the state ferry system to maintain existing facilities. With the "no-build" alternative, WSF or its agents would not perform any of the preservation or improvement tasks proposed in the build alternative above. The state law then requires WSF to perform the maintenance and preservation tasks necessary to keep the terminal operational. These tasks would include such tasks as emergency repair and replacement of structures, and structure systems that may fail due to seismic or other catastrophic events. The "no-build" alternative would include actions that would maintain and repair the current level of multimodal services until structural systems fail.

Construction activities to maintain the current level of service would be similar in nature to construction of the build alternative. In the absence of the improvements planned for the build alternative, these maintenance activities would be slightly shorter in duration. Construction noise and vibrations would be just as disruptive for this shorter time period, and equipment to maintain and replace

deteriorating structures and piles would be similar in level and annoyance. To maintain the north trestle would mean more frequent noise and vibration affects to Fire Station #5, and the firemen residing there. Due to the existing pier's proximity to the Fire Station, replacing the piles under this trestle to maintain its structural integrity would result in more serious vibration and noise impact from this maintenance construction task than would occur when removing the piles in the build alternative. Constructing the build alternative provides a buffer zone between the terminal and the fire station resulting in lower noise and vibration levels

Build Alternative

Construction noise and vibration is likely to be bothersome to some nearby residents and businesses. Construction workers would also be subjected to noise while working on the site. Project construction is currently planned to occur in four phases over approximately six years (69-72 months).

Phase I Construction Noise and Vibration

Beginning in 2015, Phase I will last approximately 1 year. Phase I constructs a temporary platform for Passenger Only Ferry (POF) use. The POF trestle and walkway and a new southern trestle will be constructed. This phase will also construct the slip 3 transfer span, supported by steel piles. Drilled shafts constructed in this phase will support the new overhead loading structures, and the two dogleg dolphins between slips 2 and 3 will be replaced with steel pile dolphins as well as a temporary dolphin.

The equipment anticipated for much of this work will include but would not be limited to large barges with large cranes to support both vibratory and impact type pile drivers. Equipment such as augers, back hoes, hoe rams, forklifts, jackhammers, and front loaders, trucks of various types, as well as air compressors, generators and various hand tools will also be used in this phase.

The greatest construction noise impacts for this phase are anticipated to be from the number of impact pile driving events required. The City of Seattle will likely require a variance from its noise code for the loudest work, pile driving. Sound levels between 72 and 105 dBA measured at 50 feet are likely.

Pile driving will also cause vibrations during this phase of the project. Project construction, especially pile driving, will be closest to the

vibration-sensitive Washington Street Boat Landing during this phase. Colman Dock will be built 10 to 20 feet closer to the WSBL, reducing the distance between the landing and Colman Dock to approximately 200 feet. At this distance, however, the boat landing is beyond the distance considered affected for buildings extremely susceptible to vibrations from 0.12 in/sec. structural criteria. Fire Station #5 may experience some vibrations from the pile driving activities of this phase. However, due to the concrete and steel construction of the fire station, the PPV criteria level for this structure is 0.5 in. /sec. The fire station is over 200 feet from the nearest construction activity that may cause PPV to exceed 0.5 in/sec criteria that may cause damage to this structure. The distance to vibration damage from various pile driving operations is shown in Exhibit 18. This exhibit shows that neither the Washington Street Boat Landing nor Fire Station #5 would be affected by vibration impacts during this phase.

Exhibit 18: Distance to Damage Criteria from Construction Vibrations

Distance to Damage Criteria from Construction Vibrations					
Category & Vibration Sensitive Building		Equipment Type	Estimated PPV @ 25 feet (in./sec.)	Criteria PPV @25 feet (in./sec.)	Distance to Criteria (Feet)
I	Fire Station #5	Typical Impact Pile Driver	0.644	0.5	29.95
I	Fire Station #5	Upper Range Impact Pile Driver	1.518	0.5	55.26
I	Fire Station #5	Typical Sonic Pile Driver	0.170	0.5	11.57
I	Fire Station #5	Upper Range Sonic Pile Driver	0.734	0.5	32.89
IV	Washington St. Boat Landing	Typical Impact Pile Driver	0.644	0.12	83.02
IV	Washington St. Boat Landing	Upper Range Impact Pile Driver	1.518	0.12	153.16
IV	Washington St. Boat Landing	Typical Sonic Pile Driver	0.170	0.12	32.06
IV	Washington St. Boat Landing	Upper Range Sonic Pile Driver	0.734	0.12	91.15

Phase II Construction Noise and Vibration

This portion of the project will take approximately 22 months. In Phase II, the Slip 1 walkway will be removed, as well as a portion of the south (concrete) trestle and piles underneath the new terminal building. The pile foundation will be installed for the new terminal, and southern third of the new terminal building will be constructed with an elevated walkway connecting to the POF platform. The removed section of trestle will be replaced with a concrete trestle supported by steel piles

filled with reinforced concrete. Steel piles will be installed with a vibratory hammer and then impacted to the required depth. The Slip 1 walkway will be reinstalled. A barge will be anchored south of Slip 2 to support construction equipment necessary for the work.

Since the operation in phase II is similar to that of the previous phase, equipment and construction sound and vibration levels are anticipated to be similar as well. As in the previous phase, the highest construction noise and vibration sources will come from pile driving activities. A slight reduction in vibration levels may be experience by most due to an increased distance between activities and the sensitive land uses.

Phase III Construction Noise and Vibration

During this phase of the project, the Slip 2 transfer span and overhead loading will be temporarily removed and the vehicle attendant crew building under the Slip 2 OHL will be demolished. The entire terminal building and a strip of the north (timber) trestle approximately 100 ft wide immediately north of the existing concrete trestle will be demolished and replaced with a new concrete trestle supported by concrete-filled steel piles. Two temporary vehicle bridges will span the 100-ft strip during construction. The center third of the terminal building will be reconstructed and the Slip 2 vehicle and OHL spans reinstalled. Temporary pedestrian bridges will link the Marion Street overpass and Slip 3 to the new terminal building. A derrick and barge will be anchored south of the slip for this portion of the work, which will last about 21-24 months, with Phase IV overlapping and beginning after 13 months.

As with the previous two phases the highest noise impacts will result from the pile driving activities and construction sound and vibration levels are anticipated to be the same as in Phase I.

Phase IV Construction Noise and Vibration

Phase IV will begin 13 months after start of Phase III. The remaining portion of the north (timber) trestle will be demolished. A section of fill beneath the trestle contained behind a sheet pile bulkhead will be removed and the area restored to match the bathymetry on either side, then the bulkhead will be removed.

Demolition will take approximately 3 months. The remainder of the new trestle will be reconstructed using steel piles filled with reinforced concrete. The final third of the new terminal building will be constructed, and temporary pedestrian bridges replaced with

permanent structures. This portion of the project will last approximately 22-25 months.

Pile driving would generate the greatest construction noise impacts during this phase. Peak noise from vibratory pile driving would be 101 dBA at 50 feet. Noise from vibratory pile extraction would be somewhat lower than for pile driving. Clam shovels, which would be used to excavate fill, would generate noise levels in the 80-90 dBA range. Noise levels at the corner of the nearest residence, a 20-unit condominium building, would be no more than 87 dBA during the project's noisiest activities, due to its distance from the project site, and that would diminish as the work moved to the south and west. The Post Apartments, a second residential building located at the corner of Marion Street and Western Avenue, is about 100 feet further from the project site than the 20-unit condominium building, and an intervening building partially screens the apartments. Without the intervening building, noise levels at the Post Apartments would be at 80 dBA, and the building in line-of-sight to the project site would reduce those levels further. These estimates are considered conservative; actual noise levels would be expected to be lower, as pile driving for the new trestle will be at least 165 feet further away from the northeast corner of the site. Only pile extraction, at lower noise levels, will occur at the northeast corner of the site.

Pile driving and clam shell operation for fill removal will also cause the greatest vibratory effects to Fire Station #5. Work to remove the piles and demolish the north trestle and return the bathymetry to that of the surrounding sea floor could see vibration levels near the fire station approach the 0.5 in/sec PPV damage threshold identified in Exhibit 18, resulting in potential vibration impact. For the vibratory removal of piles within 35 feet of Fire Station #5, piles would be cut at the mudline rather than vibrated out, avoiding the potential impact. Mitigation would also include vibration monitoring when pile removal is within 50 feet of the fire station; if vibration levels approach the 0.5 PPV damage threshold, extraction will be halted and piles will be cut at the mudline instead.

The estimated distances in this study for potential vibration damage to the fire station or the Washington Street Boat Landing are conservative, because they are based on pile driving rather than pile extraction, which causes less vibration. At the fire station, existing timber piles within 165 feet would be removed but no pile driving would be

required; the area between the fire station and the new north concrete trestle would be left as open water.

How would operation noise and vibrations affect the project area?

Using the methods outlined in the Potential Effects section of this report, WSF considers the operation noise and vibration effects from the project. The analysis of noise and vibration effects considers both Build and no-build alternatives in the discussions below. Due to the minimal changes to the operation of the Ferry Terminal facility and the low noise and vibration characteristics of both projects build and no-build alternatives, no project operation related noise or vibration impacts are anticipated.

No-Build

Existing state law requires the state ferry system to maintain existing facilities. These tasks would include emergency repair and replacement of structures and structure systems that may fail due to seismic or other catastrophic events. The "no-build" alternative would include actions that would maintain and repair the current level of multimodal services until structural systems, such as the slip 3 vehicle transfer span and overhead loading, reached a point in their lifespan when annual maintenance and repair costs exceeded annual capital costs, forcing operations to reduce or close the services. The current traffic patterns, ferry slip locations, or operation schedules would not change except as needed to accommodate maintenance tasks. The current terminal building would remain the same as well.

FHWA traffic noise levels were modeled using the volume of traffic vehicles, the speed of the vehicles, and the type of vehicles. The numbers of ferries limit the amount of traffic, and neither the speed nor the types of vehicles are anticipated to change for the no-build alternative. Therefore, it is not anticipated that the noise from ferry operations will increase from that reported for the existing and measured sound level. Measured levels shown in Exhibit 5 are above impact thresholds from all sources. Using FHWA's TNM traffic noise model, an analysis of traffic noise from the ferry access lanes indicates sound drops to below the 66 dBA abatement criteria by the time it has traveled 50 feet. This means none of the impacts from this source are likely to spread beyond the current facilities. Impacts identified are a combination of sound from all sources. With traffic volume limited by

ferry capacity, and speed limited to the posted 10 mph, ferry access lane traffic would not produce sufficient noise to contribute to the measurement shown in Exhibit 5. Exhibit 19 on page 35 shows the only potentially affected area would be Fire Station #5 for considering operational impacts from the no-build alternative. Since the access lanes in this area are used primarily to access employee parking spaces and are not used to access the ferries themselves the 50 foot screening distance would reduce to far less than 50 feet in this area. Therefore no further impacts would need to be considered for this site.

Using the FTA Criteria for determining noise impacts from the ferry and terminal operations, FTA screens out all ferry facilities operations within 250 feet of the ferry slips. Exhibit 19 shows that nothing is within the screening distance of the ferry slips to cause noise impacts. Vibration impacts as discussed in the methodology section are rare from rubber tired vehicles on well-maintained pavements. No operations noise or vibration impacts from the no-build alternative are identified using FTA guidance and criteria.

Build Alternative

The build alternative analysis considers a similar configuration of traffic patterns and because the volumes are limited by ferry capacity, future volumes are not anticipated to change. Both FHWA TNM noise modeling as well as FTA screening apply to the build alternative. No impacts would be identified from the build alternative either as a result of the FHWA modeling or from FTA analyses for noise or vibration. See Exhibit 20 for the proposed FTA and FHWA screening limits.

Exhibit 19: No Build FTA & FHWA Screening Limits

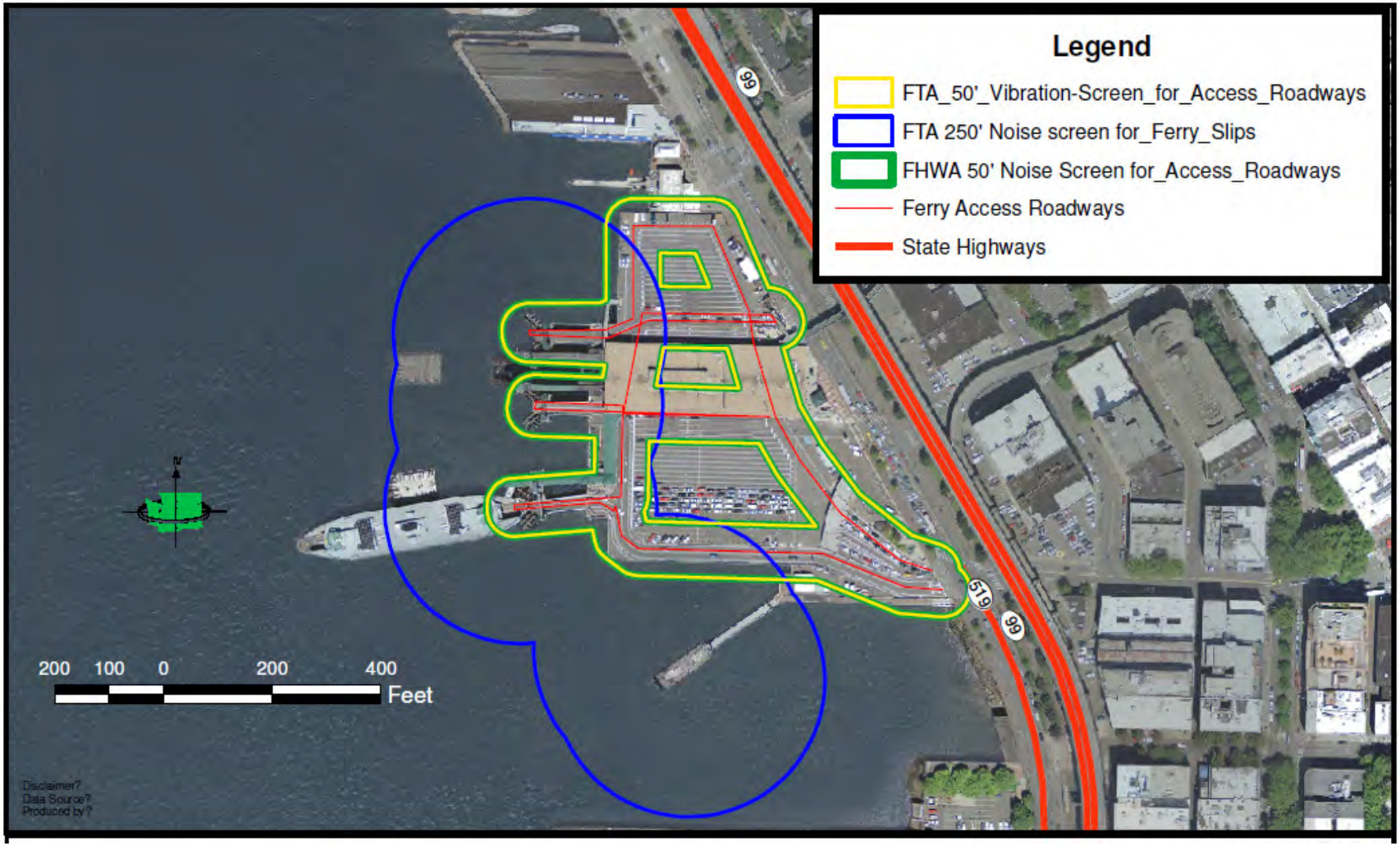
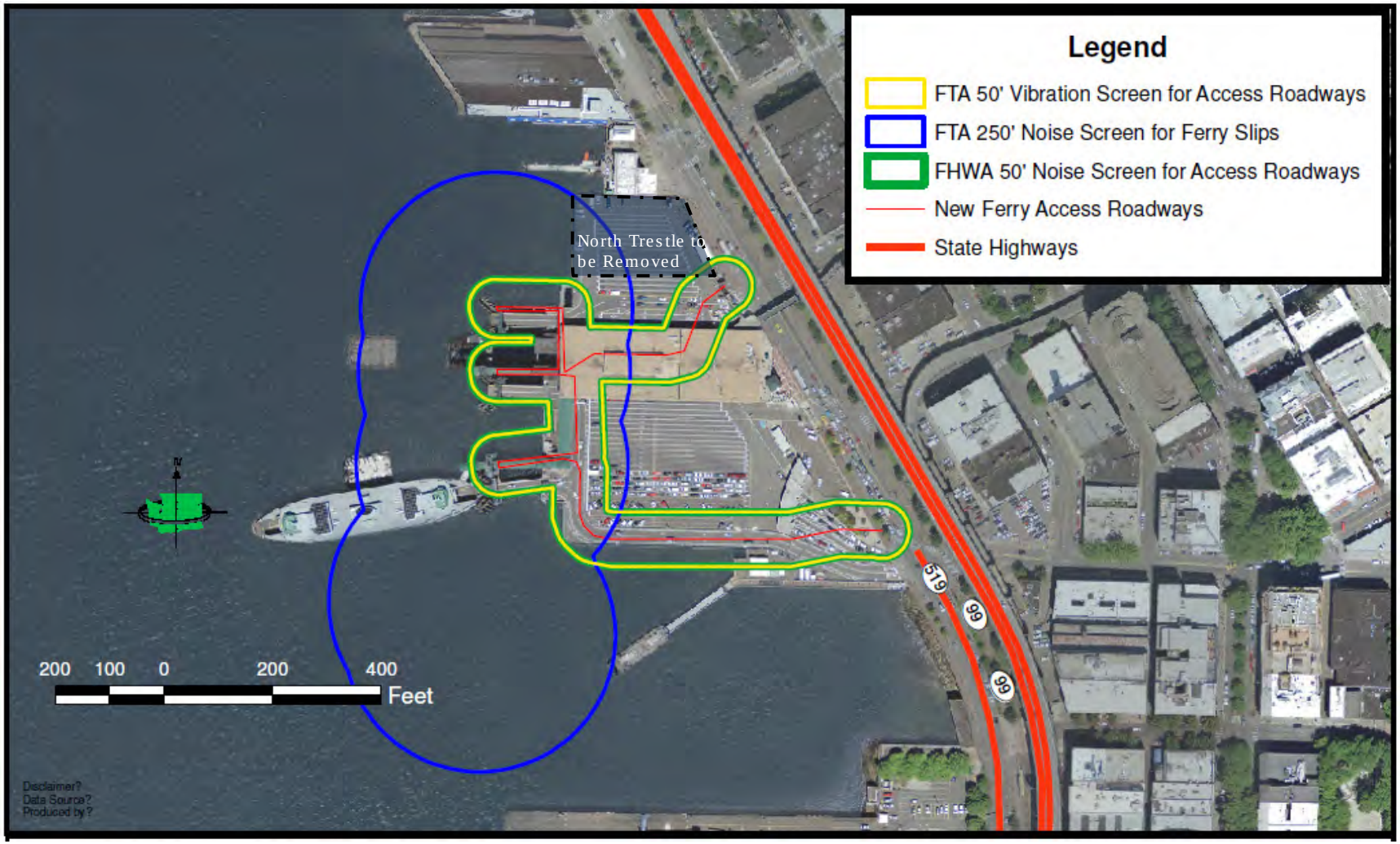


Exhibit 20: Build FTA & FHWA Screening Limits



How do the alternatives differ in their effects on Noise and Vibration?

Because the operations within the ferry terminal facilities are nearly identical, noise and vibration effects do not differ greatly between the two alternatives. The removal of the north trestle and the relocation of the POF west of its current location are the two primary physical differences between the two alternatives. Both of these modifications move the potential sources of noise and vibration further from areas that may be sensitive. Though construction of the build alternative has the potential to produce slightly higher noise and vibration effects, eventually the deteriorating wood piles currently supporting the north trestle will require demolition, presenting a risk similar to the build alternative.

How would operation of the project affect noise and vibrations in the current or reasonably foreseeable future?

Indirect and Secondary Effects

Indirect effects are caused by the actions that are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate. Because this project does not increase capacity to any of the current facilities, no indirect or secondary effects are likely to be reasonably foreseeable for the current alternatives proposed.

Cumulative Effects

The noise modeling and analysis presented earlier considers the long-term cumulative effects of noise from existing noise sources and all traffic forecast to operate within the study area. This includes traffic from future development proposals such as the removal and replacement of the Alaskan Way Viaduct, and both residential and commercial development along the downtown waterfront area.

Noise and vibration effects are such that it takes a doubling of the sources to cause a 3 dB increase, which is considered barely noticeable.

Because the project does not increase current capacity to any of the facilities within the project limits, no noise or vibration cumulative impacts are anticipated.

Abatement

Abatement measures for the construction effects are based on the site information and standard design and construction procedures in use at the time this discipline report was prepared, and apply to all alternatives.

What has been done to avoid or minimize negative effects?

No operation impacts or negative effects were found in either the build or no build alternative. The build alternative places more open space between the terminal facilities and the passenger only ferry slips and potentially sensitive areas, but neither alternative would cause negative effects compared to current operations.

Construction will cause vibration close to Fire Station #5. To avoid potential impacts, piles within 35 feet of the fire station will be cut at the mudline rather than removed using vibratory extraction. Mitigation will include monitoring of vibration levels for pile removal within 50 feet of the fire station; if vibration levels approach the 0.5 PPV damage threshold, extraction will be halted and piles will be cut at the mudline. Other construction noise and vibration avoidance techniques and abatement measures are discussed in the section that follows.

How could the project compensate for unavoidable adverse effects?

No noise or vibration impacts were identified from the operation of either the build or no-build alternatives. No abatement or compensation would be necessary as a result of operating the facilities.

Both construction noise and vibrations will likely cause adverse effects. While both the build and no-build alternatives would exhibit similar adverse noise and vibration effects, the no-build would likely spread the effects over a longer time frame as facilities deteriorated and eventually required repairs and replacement. Methods to address construction noise and vibration adverse effects are discussed below.

Construction Noise Abatement Techniques

Construction of the project may require substantial nighttime construction activities as well as exceed City of Seattle daytime limits; therefore, a noise variance will likely be required.

Because of its construction duration, this project may be considered by the City of Seattle for a Major Public Project Noise Variance (MPPNV). Consultation with the City on whether this project would qualify under a MPPNV is recommended well in advance of construction. Abatement requirements for construction noise would be developed and specified in the MPPNV in coordination with the City. To reduce construction noise at nearby receptors, abatement measures such as the following could be incorporated into construction plans, specifications, and variance requirements:

- Crush and recycle concrete off site, away from noise-sensitive uses, to decrease construction noise effects. If recycled on site, an operations plan would be required to define the locations and hours of operation.
- Construct temporary noise barriers or curtains around stationary equipment and long-term work areas located close to residences to decrease noise levels at nearby sensitive receptors. This could reduce equipment noise by 5 to 10 dBA.
- Limit the noisiest construction activities to daytime hours of between 7:00 a.m. and 10:00 p.m. on weekdays and between 9:00 a.m. and 10:00 p.m. on weekends and legal holidays reducing construction noise levels during sensitive nighttime hours. A noise variance would be required from the City for construction between 10:00 p.m. and 7:00 a.m. on weekdays and between 10:00 p.m. and 9:00 a.m. on weekends and legal holidays.
- Limit use of impact equipment to between 8:00 a.m. and 5:00 p.m. on weekdays and between 9:00 a.m. and 5:00 p.m. on weekends and legal holidays. A noise variance from the City would also be required for impact equipment used for construction between 5:00 p.m. and 8:00 a.m. on weekdays and between 5:00 p.m. and 9:00 a.m. on weekends and legal holidays.

- Use generators and compressors between 10:00 p.m. and 7:00 a.m. Monday through Friday and between 10:00 p.m. and 9:00 a.m. Saturday, Sunday, and legal holidays, provided that WSDOT-approved noise mitigation shields are used during this type of work. Specifications for this measure may by modified or changed at the request of the Seattle Department of Planning and Development, depending on specific location and duration.
- Equip construction equipment engines with adequate mufflers, intake silencers, and engine enclosures, which could reduce noise by 5 to 10 dBA. Out-of-specification mufflers can increase equipment noise by 10 to 20 dBA.
- Use the quietest equipment available, which could reduce noise by 5 to 10 dBA.
- Turn off construction equipment during prolonged periods of non-use, which could eliminate noise from construction equipment during those periods.
- Require maintaining all equipment and training of equipment operators, which could reduce noise levels and increase operational efficiency.
- Where possible, locate stationary equipment away from sensitive receiving properties.
- Provide a 24-hour noise complaint line.
- Notify nearby residents and businesses prior to periods of intense nighttime construction.
- Use broadband, ambient-sensitive, or strobe backup warning devices or use backup observers in lieu of backup warning devices for all equipment except dump trucks in compliance with Washington Administrative Code (WAC) Sections 296-155-610 and 296-155-615 (WAC 296-155-610 and 296-155-615). Backup observers and broadband or strobe backup warning devices must also be used for dump trucks between 10:00 p.m. and 7:00 a.m. Monday through Friday, and between 10:00 p.m. and 9:00 a.m. on Saturday, Sunday, and legal holidays (WAC 296-155-610). The use of pure tone backup warning devices is prohibited after 10:00 p.m. and before 7:00 a.m. on weekdays, or 9:00 a.m. on weekends.

- Trucks performing export hauling must use rubber bed liners between 10:00 p.m. and 7:00 a.m. Sunday night through Friday, and between 10:00 p.m. and 9:00 a.m. from Friday night through Sunday morning.
- During pavement removal, material spilled on the roadway could be removed by hand or by sweeping, avoiding the use of scraping equipment.

Construction Vibration Abatement Techniques

Impact pile driving could be the most prominent source of vibration for this project. The following measures to reduce vibration from impact pile driving could be useful, when appropriate for specific site conditions:

- Some vibratory pile work involves vibration to remove rather than installing piles near historic structures. As discussed above, piles within 35 foot of the fire station will be cut off at the mudline, and monitoring will be performed for pile removal within 50 feet of the fire station. If monitoring indicates that vibration levels are approaching the 0.5 PPV level, piles will be cut at the mudline instead of removed by vibration.
- Alternative nonimpact drivers – Several types of proprietary pile-driving systems have been designed specifically to reduce the impact-induced vibration by using torque and down-pressure or hydraulic static loading. These methods would be expected to reduce substantially adverse vibration effects of pile placement.

Vibration from other construction activities can be reduced by either restricting their operation to predetermined distances from historic structures or other sensitive receivers (such as sensitive utilities), or using alternative equipment or construction methods. An example would be the use of saws or rotary rock cutting heads to cut bridge decks or concrete slabs, instead of a hoe ram.

The WSBL is listed on the NRHP and is within the Seattle designated Pioneer Square Preservation District. The fire station, though not listed, is eligible for listing in the NRHP, as is the existing seawall. Vibration monitoring will be required at the fire station and other sensitive receivers (such as sensitive utilities) within 200 feet of construction activities. The monitoring data will be compared to the project's

vibration criteria to ensure that ground vibration levels do not exceed the damage thresholds for historic and non-historic buildings and sensitive utilities.

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FHWA (U.S. Department of Transportation, Federal Highway Administration). 2010. Construction Noise Handbook. Available at: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/ handbook09.cfm.

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May 2006. Transit Noise and Vibration Impact Assessment, Hanson, C.E., Towers, D.A., and Meister, L.D., FTA-VA-90-1003-06, National Technical Information Service, Springfield, VA www.ntis.gov.

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Alaskan Way Viaduct Replacement Project Final EIS Noise Discipline Report, appendix F, and

Land Use Discipline Report, appendix G, Parsons Brinckerhoff, December 2010 http://data.wsdot.wa.gov/publications/viaduct/AWVFEIS-AppendixF.pdf and http://data.wsdot.wa.gov/publications/viaduct/AWVFEIS-AppendixG.pdf

CalTrans (California Department of Transportation). Transportation and Construction Induced Vibration Guidance Manual, June, 2004

Appendix G – Hazardous Materials Discipline Report

Washington State Ferries

Seattle Multimodal Terminal at Colman Dock Project Environmental Assessment

Hazardous Materials Discipline Report

Prepared for

Washington State Department of Transportation
Federal Highway Administration
Federal Transit Administration

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February 2014

Note:
Some pages in this document have been purposely skipped or blank pages inserted so that this document will copy correctly when duplexed.

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Attachments

1 Applicable Federal and State Regulations

2 Hazardous Materials Site Screening Process

3 Sediment Analysis Report for the Seattle Multimodal Terminal at Colman Dock Project

4 Standard Hazardous Materials Impacts and Mitigation Methods (tailored to the site)

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Executive Summary

This Hazardous Materials Discipline Report is one of the technical documents developed to support the Environmental Assessment for the Seattle Multimodal Terminal at Colman Dock project.

The Washington State Department of Transportation, Ferries Division (WSF) proposes to replace the aging and seismically vulnerable components of the Seattle Ferry Terminal at Colman Dock in order to maintain ferry service in the future. The Federal Transit Administration and the Federal Highway Administration are the federal co-lead agencies responsible for reviewing the proposal for compliance with the National Environmental Policy Act.

The purpose of the project is to preserve the role of the Seattle Ferry Terminal as a regional multimodal transportation hub, providing safe, reliable, and effective service for transit, general and commercial purpose transportation, high occupancy vehicles (vanpools/carpools), pedestrians, and bicyclists.

The purpose of the Hazardous Materials Discipline Report is to identify and evaluate known or potentially contaminated sites that may 1) affect the environment, 2) create significant construction impacts, and/or 3) incur cleanup liability to Washington State Ferries. Release of contaminants or disturbance of existing contamination may affect environmental health, which includes both human and ecological components.

Findings

The project is not at risk of receiving contamination from offsite sources. Existing on-site contamination may require remediation during construction. There is a risk that hazardous materials could be released during construction and operation of the facility, although that risk can be minimized by implementing best management practices.

Existing Conditions

The Seattle Terminal is located at Colman Dock, at Pier 50 and Pier 52, on the Seattle waterfront. Colman Dock extends west from the Elliott Bay Seawall into Puget Sound. The property is framed to the north by Pier 56 (Seattle Fire Department property), Pier 48 (Washington

Department of Transportation right of way) to the south, and Alaskan Way South to the east.

Colman Dock was constructed entirely above water, with the Elliott Bay Seawall running adjacent along the shoreline beneath Alaskan Way. When first constructed, Alaskan Way was known as Railroad Avenue, supporting multiple sets of tracks running above the area backfilled behind the seawall.

Parts of the existing Colman Dock timber trestle were built in 1938 and reconstructed in 1964 using many of the original timber piles, and then expanded in 1971 and 1990. A retaining wall extends west from the seawall in the northeast corner of the property that was backfilled with soil of unknown origin.

Much of the Colman Dock trestle components are composed of wood treated with creosote. Sediment beneath the trestle has been contaminated by the creosote piles and other chemicals discharged to the environment over the years, potentially from onsite and offsite sources. A sediment cap was installed to cover contaminated sediment on the south half of the site prior to trestle expansion in 1990.

Two samples from backfill behind the retaining structure at the northeast corner of the property indicate some contamination is present.

Asbestos abatement has been conducted during renovation of the terminal building over the years, when required. Some asbestos remains onsite.

Project Impacts

Approximately 7,400 tons of creosote-treated wood would be removed from the site, including approximately 1,446 piles removed from the sediment, as well as over-water structures.

Casings driven to install piles and installation of stormwater vaults would result in the removal of approximately 3,500 cubic yards of sediment.

Approximately 7,700 cubic yards of contaminated fill situated behind the retaining wall at the northeast corner of the site would be removed.

A small amount of asbestos associated with the terminal building would be removed by a certified abatement contractor.

Direct-discharge surface drains would be replaced with below-deck vaults that provide basic treatment with oil control.

Project Mitigation Measures

Mitigation would be provided by using standard measures developed either as best management practices, Washington Department of Transportation standard specifications, or regulatory requirements.

Pile removal would adhere to Washington State Ferries Standard Construction Minimization Measures for impacts on marine habitat that include best management practices developed by the Washington State Department of Natural Resources and U.S. Environmental Protection Agency. These measures are implemented on all WSF projects that require consultation under the Endangered Species Act.

Creosote-treated wood, contaminated sediment, contaminated fill, and asbestos would be disposed of at approved disposal facilities.

Replacing surface drains would provide basic treatment with oil control.

Acronyms and Abbreviations

BMP	best management practices
BTEX	benzene, toluene, ethylbenzene, xylenes
cy	cubic yard
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EDR	Environmental Data Resources
EPA	U.S. Environmental Protection Agency
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	polychlorinated ethylene
WSDOT	Washington Department of Transportation
WSF	Washington State Ferries
SVOC	semi-volatile organic compound

Introduction

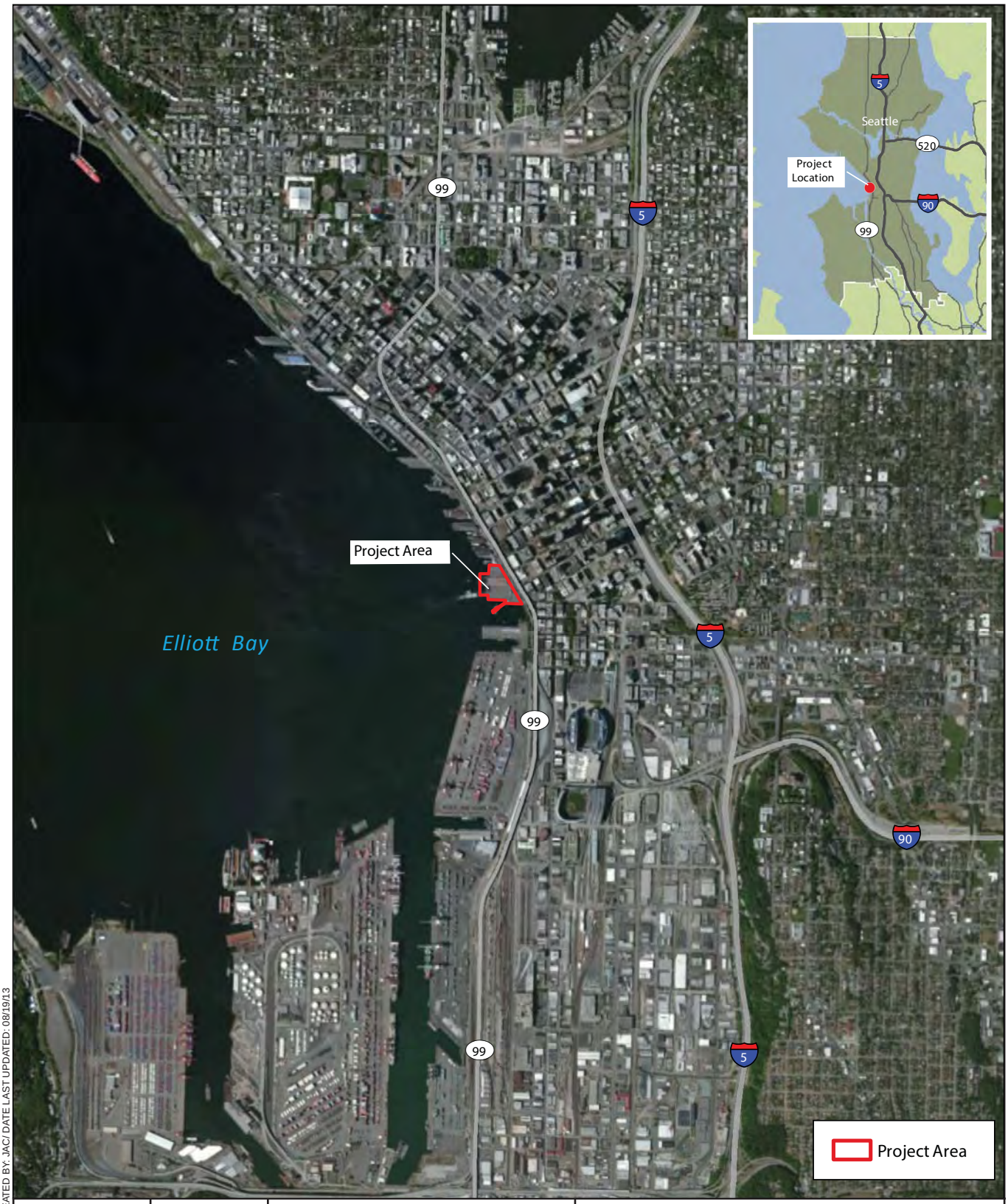
The Seattle Ferry Terminal Project is located at Colman Dock along the central waterfront of downtown Seattle, Washington. The site is owned by WSDOT, and is part of the State Highway System. The terminal is the western terminus of SR 519 and the eastern terminus of SR 305. The Elliott Bay Seawall and Alaskan Way border the site on the east. Immediately north of the site is the Seattle Fire Station No. 5 at Pier 53, while just south of the site are the Washington Street Boat Landing and Pier 48, owned by WSDOT. The project site includes Piers 50 and 52 in the numbering system used along the Seattle waterfront. The site and vicinity are shown in Exhibit 1.

The northern portion of Colman Dock is a timber structure that has deteriorated over time and is both seismically vulnerable and at the end of its service life. Initially constructed in 1938 and rebuilt in 1964, it still uses many of the timber piles, caps, and stringers installed in 1938. Its degraded condition requires regular maintenance, which can cause lane closures and disrupt operations.

Key elements of the Seattle Ferry Terminal Project include:

- Replacing and re-configuring the timber trestle portion of the dock.
- Replacing the main terminal building.
- Reconfiguring the dock layout to provide safer and more efficient operations.
- Replacing the vehicle transfer span and the overhead loading structures of Slip 3.
- Maintaining a connection to the Marion Street pedestrian overpass.
- Replacing the passenger-only ferry (POF) facility on the southern edge of Colman Dock.

Much of the area where the northern trestle would be removed would be left as open water after construction, increasing nearshore habitat and narrowing the facility's frontage along Alaskan Way by 150 feet. The total over-water coverage for the reconfigured terminal, including the POF facility, would increase by about 5,200 square feet. Mitigation for the increased overwater coverage would include removal of an



Washington State Ferries

N

0 0.5
Miles

Washington State Department of Transportation

SOURCE: Google Earth, 2011; WSDOT, 2011

Exhibit 1

Project Vicinity Map

Seattle Terminal Project

Seattle, Washington

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equivalent area of overwater coverage in Elliott Bay or elsewhere in Puget Sound.

When WSF constructed the south trestle of the Seattle Ferry Terminal in 1990, a clean sediment cap was placed over the contaminated sediments in the construction area. The current proposal would also place a clean sediment cap in the new construction areas, to contain contamination in the underlying sediment and prevent leaching into the marine environment. Details for the design, location, and extent of the new cap will be developed in cooperation with the Washington Department of Ecology, during the final design and permitting process.

The project incorporates stormwater vaults below the deck that will provide water quality treatment for all new and replaced areas of the terminal. The vaults will collect and hold runoff, allowing suspended solids to settle, and periodic maintenance will clean the vaults and remove the solids.

Construction would be phased to minimize disruption to ferry service. The phasing would maintain holding lane capacity on the dock to allow ferry loading during construction, and WSF anticipates that current ferry schedules would be maintained. The construction would last for six years, from 2015 through 2021.

For additional details, including a full description of the project, please see Chapter 3 of the project's Environmental Assessment.

Why are hazardous materials considered for this Project?

The purpose of the Hazardous Materials Discipline Report is to identify and evaluate known or potentially contaminated sites that may 1) affect the environment, 2) create significant construction impacts, and/or 3) incur cleanup liability to WSF. The objective of the Hazardous Materials Discipline Report is to provide an appropriate level of documentation and analysis necessary to understand the potential impacts of this project as they relate to hazardous materials; it also provides a reference for permitting and development of design and construction plans.

What is a hazardous material?

A hazardous material is a substance that may harm human health or the environment because of its physical or chemical characteristics. The handling and disposal of hazardous materials and the remediation of media contaminated with hazardous materials are governed by numerous laws, regulations, guidance documents, and policies. Attachment 1 to this Chapter identifies the most relevant laws and regulations.

Hazardous materials may be encountered during pile installation, demolition, and excavation activities associated with construction. Hazardous materials will also be used and could be spilled during

project construction and operation. Such encounters, uses, and spills could harm project workers, the public, and the environment; subject WSF to liability for hazardous materials remediation; delay project construction; temporarily shut down project operation; and increase project costs. Identification of hazardous materials that could be encountered, used, or spilled allows WSF to engage in investigations and planning to reduce the potential impacts of such materials.

What will this Report discuss?

This Hazardous Materials Discipline Report will discuss, in three parts, the hazardous materials impacts of the project. The first part describes the existing conditions that are relevant for hazardous materials impacts analysis. The second part identifies the project's potential hazardous materials impacts. The third part proposes measures to mitigate impacts associated with hazardous materials.

How was this Report developed?

This Hazardous Materials Discipline Report was completed in two steps: step 1 evaluated the affected environment (i.e., existing conditions), standard impacts, and standard mitigation measures; step 2 evaluated project-specific impacts and mitigation measures and determined appropriate cost estimates. The approach relies on a standard process for evaluating the Hazardous Materials study area, based on the American Society for Testing and Materials [ASTM] 1527 standard for conducting Phase I Environmental Site Assessments (Attachment 2, Hazardous Materials Site Screening Process). This process identifies known or potentially contaminated sites that may 1) affect the environment during construction, 2) create significant construction impacts, and 3) incur cleanup liability to the department based on research, screening, and risk criteria.

Research identifies sites of potential concern by evaluating regulatory and historical use information. This may prompt additional research to determine whether there is a concern with respect to construction activities and/or cleanup liability.

Screening of potential sites is then conducted to narrow the list to a subset of sites that warrant further investigation. Sites are screened based on:

- Groundwater flow direction

- Type of construction planned in the area (excavation, demolition, etc.)
- Impacted media on the site of concern (soil, groundwater, surface water, sediment)
- Chemicals of concern (e.g., petroleum products, solvents, metals).

Potential risk to the project associated with environmental impacts, the construction process, and cleanup liability is then evaluated for each site. The risk analysis prioritizes sites to determine the need for avoidance and mitigation, while taking associated costs and liability into consideration. The following risk levels were assigned:

- **Low Impact:** either the likelihood for the site to impact the project is low or the contamination was previously remediated
- **Moderate Impact:** the site is likely to impact the project, but sufficient evidence is not available
- **High Impact:** contamination is known and extensive and/or the site will likely impact the project. In general, high impact sites are properties that possess a potential for substantial soil, groundwater, or sediment contamination, or the information necessary to predict remedial costs is lacking. The site may be contaminated over a large area by a single contaminant or over a smaller area by multiple contaminants. High impact sites typically are large, have large volumes of contaminated materials, or have a long history of industrial or commercial use.

Complexity of impact also factors into the risk level based on whether contamination issues are straightforward or complex:

- **Straightforward:** typically small to medium site size and the potential contaminants are not extremely toxic or difficult to treat. Examples of straightforward sites are gas stations, auto repair shops, tank sites, and buildings with asbestos or materials that contain lead-based paint.
- **Complicated:** widespread contamination or potential contaminants are difficult to treat. Complicated sites will typically involve additional research, investigation, and possibly regulator involvement. Examples of complicated sites are dry cleaners, wood treating operations, metal plating facilities, or other operations associated with large amounts of hazardous materials.

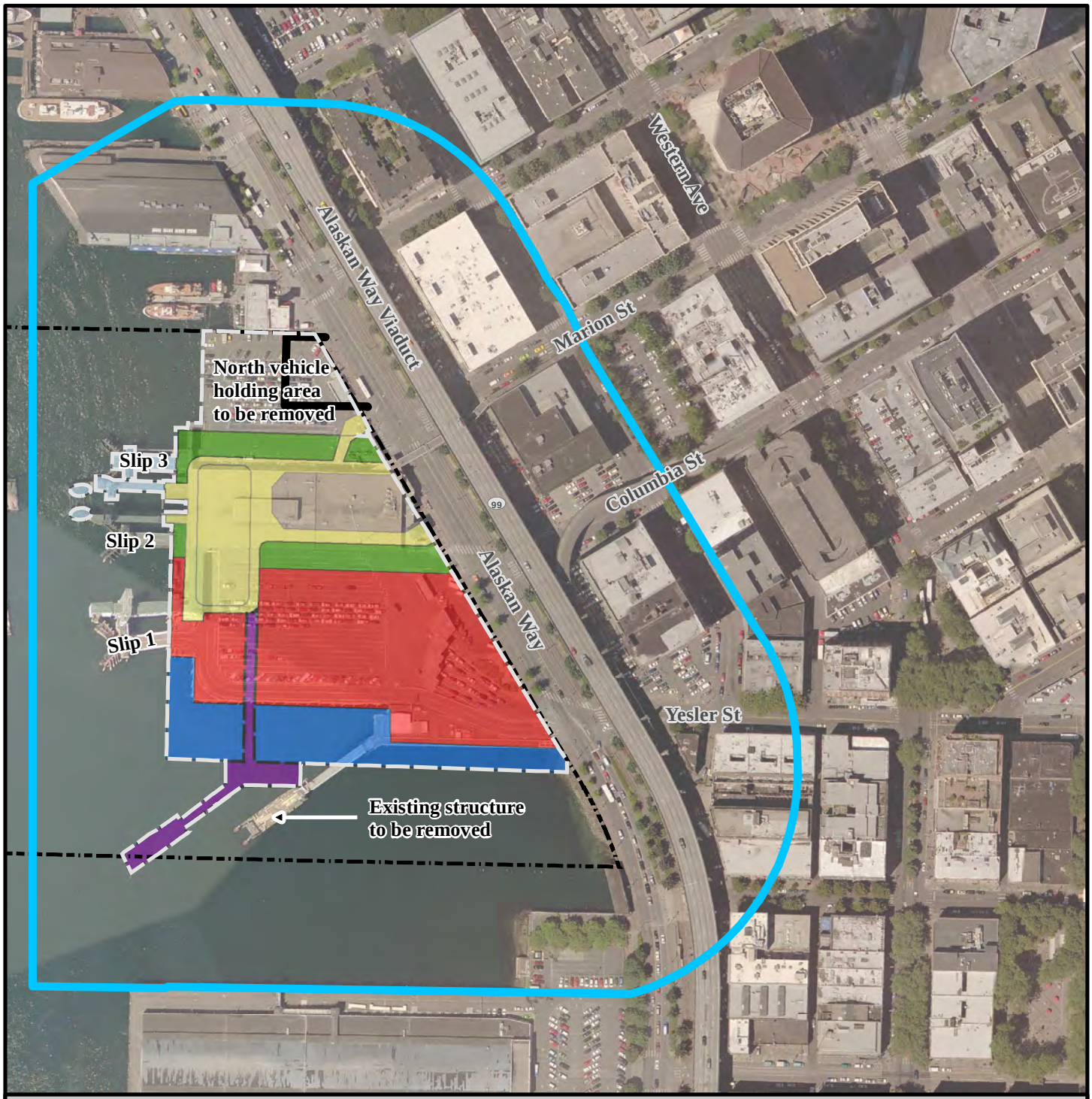
What is the project area?

The Seattle Multimodal Terminal at Colman Dock Project area comprises the Colman Dock at 801 Alaskan Way Pier 52 in Seattle Washington. Pier 52, and adjacent Pier 50, extend west from the Elliott Bay Seawall into Elliott Bay of the Puget Sound and are WSDOT right of way. Pier 56, Seattle Fire Department property, frames the north boundary and Pier 48, also WSDOT right of way, frames the south boundary. Pier 52 is administratively a terminus of State Route 519 (see Exhibit 2). The Hazardous Materials study area extends 400 feet east of Colman Dock, the distance judged to encompass areas from which contamination could reasonably be expected to migrate in groundwater from upland sources to the project footprint.

The seawall adjacent to Colman Dock was originally constructed in the 1910s to support rail and road access to piers extending into Elliott Bay. The piers were constructed offshore to provide deep-water mooring, with trestles constructed to connect with the existing shore. The seawall consisted of unreinforced-concrete gravity walls supported by timber pilings, with a pile-supported sidewalk. The area between the seawall and shoreline was backfilled over time. When first constructed, Alaskan Way was known as Railroad Avenue, supporting multiple sets of tracks running above this backfilled area.

Colman Dock has been constructed entirely above water; parts of the existing timber trestle were built in 1936, reconstructed in 1964 using many of the original timber piles, and expanded in 1971. The south trestle was reconstructed and expanded in 1990, with a concrete deck and piling system. A retaining wall extends west from the seawall in the northeast corner of the property, enclosing approximately 17,500 square feet that was backfilled with fill and soil material and covered by decking in 1971.

The terminal building, built as part of the 1964 reconstruction, is supported by columns approximately 20 feet above the trestle, allowing vehicles to park beneath it. An elevator was added at the east end of the building in 1996.



Legend

- Future Passenger-only Facility
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Upper Level Terminal Structures
- New Slip 2 and 3 Structures
- Study Area
- Colman Dock
- Property boundary
- Retaining Wall

Exhibit 2. Hazardous Materials Study Area, Seattle Multimodal Terminal at Colman Dock Project, Seattle, Washington.

N

0 125 250 500 Feet

HERRERA

Aerial: King County 2007

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What are the project area subsurface conditions?

The following upland information summarizes the Physical Environment section from the Alaskan Way Viaduct Replacement Project Hazardous Materials Discipline Report, addressing subsurface soil and groundwater conditions adjacent to the Project Area (WSDOT 2011). Sediment information is summarized from a recent geotechnical characterization (Landau Associates 2011) and a previous sediment quality assessment (Hart-Crowser 1994).

The Seattle Multimodal Terminal at Colman Dock Project area is situated in the Seattle Basin, filled with over 1,500 feet of glacial and nonglacial sediments overlying bedrock. These sediments were subsequently overridden by glaciers and compacted by the weight of overriding glacial ice. Repeated glaciations strongly influenced the present-day topography, geology, and groundwater conditions.

The upland area along the waterfront is underlain by 40 to 80 feet of recent deposits of sand and silt, including fill up to 30 feet thick. The fill contains substantial amounts of wood debris, such as sawdust and creosote-treated piles. Fill adjacent to Colman Dock includes wood debris layers up to 20 feet thick. The glacially-overridden deposits underlying recent deposits in this area consist primarily of very dense till and till-like sand and gravel.

Groundwater is encountered within the fill at about 8 to 12 feet below ground surface, with flow predominantly toward Elliott Bay.

Marine deposits at Colman Dock include an unconsolidated mixture of very soft organic silt fill and recently deposited sediments consisting of silt and clay, with occasional interbeds of silty sand. Marine sediments become more consolidated with depth, ranging to approximately 30 feet in thickness. Glacial deposits underlie the marine deposits, consisting of very dense slightly gravelly, silty sand and layers of hard clay. The fill layer increases in thickness to approximately 30 feet near the seawall.

What are the project alternatives?

Two alternatives are being considered for this analysis, the Build and No Build Alternatives. The Build Alternative would construct the project as described below. The project would not be constructed under

the No-Build Alternative but repair and replacement of failing structures would still take place as necessary for continued operation of the facility as required by state mandate.

What is the Build Alternative?

The Build Alternative would replace the creosote-treated timber trestle sections (i.e., piles and structural cross members) of Colman Dock up to Marion Street, as well as the main terminal building and auxiliary structures located on the timber trestle. Originally constructed in 1936 and rebuilt in 1964, the trestle uses many of the original timber piles. Planned reconfiguration of the trestle would allow for enhanced safety by reducing pedestrian and vehicle conflicts and provide for increased operational efficiency of holding lanes and vessel loading and unloading. A section of fill contained behind a bulkhead underneath the north trestle also would be removed.

With construction of the new concrete trestle, the existing layer of clean sediment, placed in 1990 to abate suspension of contaminated sediments during construction of the existing concrete trestle, would be extended north in the area where wooden trestle and creosote pilings are to be removed. Areas of the existing sediment cap disturbed during construction of the new south trestle would be repaired.

The Build Alternative includes in-kind replacement of the existing two-slip passenger-only ferry facility, known as Pier 50, which would be located further west on the south edge of the trestle.

The existing terminal building would be demolished and a new building constructed. The main level of the existing terminal building includes 36,000 square feet of enclosed space, and accommodates passenger waiting and processing areas, as well as staff and vendor spaces. The new terminal building would provide 22,000 square feet of passenger, staff, and minimal vendor spaces.

The vehicle transfer span and the passenger overhead loading structures of Slip 3 would be reconstructed to meet Americans with Disabilities Act standards. Replacement of two timber berthing structures at slips 2 and 3 with concrete piles would also be accomplished.

Project construction would occur in four phases over approximately 6 years (69 to72 months), with four seasons of in-water work. In-water work would only occur during the in-water work window for Elliott

Bay (August 1 – February 15). The project would require complex phasing and extended project duration to maintain ferry operations, while minimizing effects to the environment.

What is the No Build Alternative?

The No Build Alternative continues to preserve the function of the existing terminal as a regional multimodal facility. This would include maintenance and repair of the existing facility until structural systems, such as the Slip 3 vehicle transfer span and overhead loading, reach a point in their lifespan where the cost of maintenance and repair activities exceeds the annualized cost of replacing them. At that point, service would be reduced or eliminated.

With the No Build Alternative, the dock would continue operating in its current configuration to the extent possible. Portions of the terminal would face weight restrictions and possible closure because of structural deficiencies. The No Build Alternative would not maintain operational reliability and connections to other transit modes as exist today at Colman Dock. In accordance with the programmed WSF maintenance projects, the timber berthing structures and transfer span for Slip 2 would be replaced. Individual wooden, creosote-treated piles would be replaced with wooden ammoniacal copper zinc arsenate treated piles when a failure occurs. Continued deterioration of the vehicle transfer span and overhead loading at Slip 3 would increase the risk of closure, due to weight restrictions.

The passenger-only facility at Pier 50 would remain in the current location, with the current configuration and size.

Affected Environment

How was the information collected?

Facilities or properties that have released hazardous material or waste to the environment, or that manage hazardous material or waste in significant quantities, are required to report these activities and register with either the Washington State Department of Ecology (Ecology) or the U.S. Environmental Protection Agency (EPA). These facilities and sites are tracked on agency databases available to the public for review. Facilities and sites located within the project footprint and its immediate vicinity that have documented releases or potential releases of hazardous materials to the environment were identified through a search of these federal and state regulatory databases.

Other historical sources were also reviewed, including aerial photographs, parcel and topographic maps, city directories, Sanborn fire and insurance maps, and previous site investigation reports (Attachment 3). Sites with documented or potential hazardous material releases were then evaluated further by reviewing state and local regulatory records and by conducting a visual reconnaissance of the Hazardous Materials study area to determine the project's potential to affect public health and the environment. Sites of interest were limited to those located within approximately 400 feet of Colman Dock, the distance judged to encompass areas from which contamination could reasonably be expected to migrate to the project footprint.

What are the existing hazardous materials characteristics of the Hazardous Materials study area?

Exhibit 3 summarizes information gathered from review of regulatory databases, evaluation of historical documents, review of Ecology site files, and visual reconnaissance of the Colman Dock facility and surrounding area (Environmental Data Resources [EDR] provided a summary of regulatory databases and other historical information used in the review, assigning their own site identification numbers). A potential project impact rating (i.e., low, medium, or high) is assigned for each site identified. Exhibit 4 provides locations of each site of potential concern.

Exhibit 3. Hazardous Materials Sites of Potential Concern.

Site No. (EDR ID)	Site Name and Address (Site Ownership Information)	Site Location Relative to the Project Area	Site Information Sources[1]	Relevant Site Use(s), Hazardous Materials of Concern, Site Conditions of Concern, Compliance History, and Affected Media and Remediation History	Impact Rating
1 (A1 through A16)	Colman Dock/Pier 52 801 Alaskan Way	Subject Property	ERNS, RCRA-NonGen, CSCSL,	Contaminated sediments (see Attachment 3)	**High Impact** Work in the over water project area would disturb sediments contaminated with creosote- and stormwater-related contaminants.
2 (B17, B18)	Seattle Fire Dept 925 Alaskan Way	Adjacent North	RCRA-NonGen	No violations found or reported.	**No impact.** No documented release.
3 (C19, C20, C21, C22, C23, C25, C26)	Commuter Center Parking /Turner & Pease Co UST /Colman Building Garage 801- 815 Western Avenue	180 feet East	ICR, CSCSL NFA, UST, LUST, RCRA-NonGen, Historical Auto Stations	Automobile repair, gasoline service station, parking garage from 1930 to 1960. Gasoline station from 1975 to 1990. As many as 11 USTs either removed or closed in place through the 1990s that stores fuel and waste oil. Release to soil, petroleum contaminated soil removed from site – Petroleum may have migrated offsite.	**Low to moderate impact.** Documented release.
4 (C24)	Colman Building Garage 812 Western Avenue	180 feet East	Historical Auto Stations	Automobile repair, service station, parking garage from 1925 to 1955 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.
5 (C28)	Western Avenue Cleaners 820 Western Avenue	300 feet East	Historical Cleaners	Historical Dry Cleaners 1935 to 1944 – Solvents may have migrated offsite	**Low to moderate impact.** No documented release.
6 (D30)	Marine Cleaners 72 Marion Street	300 feet East	Historical Cleaners	Historical Dry Cleaners 1930 to 1940 – Solvents may have migrated offsite	**Low to moderate impact.** No documented release.
7 (31)	Seattle Port Term 48 101 Alaskan Way S	Adjacent South	RCRA-NonGen, CSCSL	Contaminated sediments may have migrated and mixed with Colman Dock sediments.	**Low to moderate impact.** Documented release.
8 (D32, D33)	Maritime Building/ Maritime Assoc. 911 Western Avenue	200 feet East	RCRA-NonGen, CSCSL NFA	Ecology has issued a NFA for the site.	**No impact.** Documented release; site reported cleaned up.

Exhibit 3 (continued). Hazardous Materials Sites of Potential Concern.

Site No. (EDR ID)	Site Name and Address (Site Ownership Information)	Site Location Relative to the Project Area	Site Information Sources[1]	Relevant Site Use(s), Hazardous Materials of Concern, Site Conditions of Concern, Compliance History, and Affected Media and Remediation History	Impact Rating
9 (34)	Seafood Enterprises Inc. Pier 54	150 feet North	UST	Two USTs reported closed in place in 1996 – Petroleum may have migrated offsite.	**No impact.** No documented release. Cross gradient from Colman Dock.
10 (35)	Stevenson Tire Co 85 Marion Street	400 feet East	Historical Auto Stations	Automobile repair and supplies 1920 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.
11 (E36)	Ace Novelty Seattle 621-625 Western Avenue	350 feet East	UST	Two USTs removed in 1996 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.
12 (F37)	Maritime Cleaners 73 Madison Street	300 feet Northeast	Historical Cleaners	Historical Dry Cleaners 1951 to 1955 – Solvents may have migrated offsite.	**Low to moderate impact.** No documented release.
13 (F38, F39)	Waterfront Place 1011 Western Avenue	400 feet Northeast	ICR, CSCSL NFA, VCP	Release to soil and groundwater – Petroleum may have migrated offsite.	**No impact.** Documented release, but cross gradient from Colman Dock.
14 (E40)	Western Automotive Service 72 Yesler Way	300 feet East	Historical Auto Stations	Historical gasoline service station 1940 to 1966 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.
15 (H48, H52, H53)	Seattle Steam Co 700 Post Avenue	450 feet East	CSCSL, HSL, UST, RCRA-NonGen,	55,000-gallon Bunker C UST, soil (petroleum, metals, and PCBs) and groundwater (petroleum) releases – Petroleum may have migrated offsite.	**Low to moderate impact.** Documented release.
16 (I50,I51)	Truck Tire Co Baranof Dye Works/ 67 Yesler Way	300 feet East	Historical Auto Stations Historical Cleaners	Historical auto repairs and supplies – Petroleum may have migrated offsite Historical dry cleaners 1930 to 1951 – Solvents may have migrated offsite.	**Low to moderate impact.** No documented release.
17 (I56)	Peterson and Turnbull 69 Yesler Way	300 feet East	Historical Auto Stations	Automobile repairs and supplies in 1920 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.

Exhibit 3 (continued). Hazardous Materials Sites of Potential Concern.

Site No. (EDR ID)	Site Name and Address (Site Ownership Information)	Site Location Relative to the Project Area	Site Information Sources[1]	Relevant Site Use(s), Hazardous Materials of Concern, Site Conditions of Concern, Compliance History, and Affected Media and Remediation History	Impact Rating
18 (I61)	Yesler Tire Shop 71 Yesler Way	300 feet East	Historical Auto Stations	Automobile repairs and supplies in 1920 – Petroleum may have migrated offsite.	**Low to moderate impact.** No documented release.
19 (I69)	Lorraine EDW 81 Yesler Way	350 feet East	Historical Cleaners	Historical dry cleaners in 1935 – Solvents may have migrated offsite	**Low to moderate impact.** No documented release.
20 (I73)	Northwest Cleaners 87 Yesler Way	450 feet East	Historical Cleaners	Historical dry cleaners 1951 to 1966 – Solvents may have migrated offsite	**Low to moderate impact.** No documented release.
21	Alaskan Way South	Adjacent to the East	Sanborn Maps	Railroad tracks – Spills involving petroleum products (fuel and lubricants) and transported materials may have occurred.	**Low to moderate impact.** No documented release.
22	Manson Constr & Eng Co 821 Alaskan Way	Subject Property	City Directories	General contractor (1940-1951) – potential fuels, solvents	**Low to moderate impact.** No documented release.
23	Western Enterprise Engine 913 Western Avenue	300 feet East	City Directories	Engine shop (1930-1951) – potential fuels, solvents	**Low to moderate impact.** No documented release.
24	Hall Scott Motor Car Co 907 Western	300 feet East	City Directories	Auto sales (1940) – potential fuels	**Low to moderate impact.** No documented release.
25	Power Machine & Tool Co 822 Western Avenue		City Directories	Machine shop (1940-1956) – potential fuels, solvents	**Low to moderate impact.** No documented release.
26	Seattle Wood Finishing Co 814 Western Avenue	300 feet East	City Directories	Paint manufacturing (1935-1955) – potential solvents	**Low to moderate impact.** No documented release.
27	SEATTLE Marine Equipment Co 64 Marion Street	300 feet East	City Directories	Machine shop (1930-1944) – potential fuels, solvents	**Low to moderate impact.** No documented release.

[1] See Attachment 2 for descriptions of regulatory database contents and associated acronyms.

Four sites were determined to pose no potential for impact based on location relative to Colman Dock, the fact that the site had been cleaned up, or there was no report of a hazardous material release. Twenty-two of the Hazardous Materials Sites that are, or may be, contaminated with hazardous materials received a "Low-Moderate Impact" rating (Site Numbers 3, 4, 5, 6, 7, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27). These sites were or are currently used as gasoline stations, automobile repair shops, and dry cleaning facilities; a number of facilities stored petroleum products in USTs. Only Colman Dock (Site Number 1) was identified with a "High Impact" rating, based on documented sediment contamination.

Contamination exists in onsite sediments beneath much of the Colman Dock structure, as described in the Sediment Analysis Report for the Seattle Multimodal Terminal at Colman Dock Project (Attachment 3). Sediments are contaminated with metals, light and heavy polynuclear aromatic hydrocarbons (PAHs) typically associated with creosote, and semivolatile organic compounds (SVOCs) typical of stormwater runoff. Limited sampling results for polychlorinated biphenyls (PCBs) indicate the possible presence of PCBs across the project site, although no samples collected exceeded Sediment Management Standards criteria. Contaminated sediments beneath the southern portion of Colman Dock are covered by a cap consisting of approximately 1½ feet of clean, commercially obtained sand (placed in 1989 after pier demolition and prior to driving piles for the southerly expansion of Pier 52). A 2004 study indicated that the cap was intact and covered by 4 to 8 inches of more recent sediment.

Why are Project-Area sediments contaminated with creosote?
Creosote is created by high temperature treatment of coal, certain woods, or the resin of the creosote bush. It is a mixture of chemicals that includes polynuclear aromatic hydrocarbons (PAHs), phenol, and cresols. Creosote is commonly used as a wood preservative for railroad ties, telephone poles, and marine pilings. At least some creosote contamination found in sediments within and in the vicinity of the Project Area is likely due to the leaching of creosote from the timber pilings used to support docks and other structures associated with past and present uses of the waterfront.

The soil and groundwater contaminants that may exist on nearby upland sites, based on historical property use, include petroleum hydrocarbons such as gasoline, diesel, waste oil; gasoline components such as benzene, toluene, ethylbenzene and xylene (BTEX); heavy metals such as cadmium, chromium, copper, lead, mercury, and zinc; and dry cleaning solvents such as Stoddard Solvent and perchloroethylene (PCE).

As a part of investigations conducted to support viaduct replacement design, geotechnical borings were advanced along the waterfront and environmental samples collected at select locations (WSDOT 2010). Eighteen borings were installed on either side of the existing viaduct structure across from Colman Dock; soil samples were collected from

Legend

- ① Site of Potential Concern
- Retaining Wall
- Colman Dock
- Study Area
- Parcel

Exhibit 4. Map of Hazardous Materials Sites of Potential Concern, Seattle Multimodal Terminal at Colman Dock Project Seattle, Washington.

N

0 125 250 500 Feet

HERRERA

Aerial: King County 2007

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all 18 borings and groundwater was collected from 11 borings; not all contaminants of concern were analyzed at each location. Contaminant types by location numbers were identified as summarized in Exhibit 5.

Exhibit 5. Soil and Groundwater Sampling Location Results Along Viaduct.

	Soil Sampling Locations			Groundwater Sampling Locations		
Contaminant of Concern	Detected	Greater than Cleanup Level	Non-detected	Detected	Greater than Cleanup Level	Non-detected
Metals	18	4	0	11	5	0
PAHs	9	3	3	0	0	0
VOCs	2	0	13	5	0	1
Petroleum	8	2	7	2	1	7

Groundwater contaminated with metals was identified at three locations along the west side of the viaduct, approximately 75 feet from Colman Dock. VOCs were identified at five locations, with none exceeding cleanup levels. One of four tested samples found petroleum above the cleanup level on the east side of the viaduct; one of five tested samples found petroleum below the cleanup level on the west side of the viaduct, nearer to Colman Dock, with no petroleum detected at the other four locations. There appears to be little chance of significant contamination moving from upland sources onto the Colman Dock property (high total lead concentrations were found along a 150-foot line beneath the viaduct in probe samples; no dissolved data are available).

Three geotechnical borings were advanced along the seawall adjacent to Colman Dock (WSDOT 2011). Soil samples collected near the south side of the ferry building identified carcinogenic PAHs exceeding the Model Toxics Cleanup Act (MTCA) method A cleanup level at 40 feet below ground surface; samples collected near the north end of the Colman Dock property identified PAHs exceeding the MTCA method A cleanup level at 43 and 53 feet below ground surface. Mercury also exceeded the MTCA method A cleanup level at 43 feet below ground surface near the north end of the property.

There is a low likelihood that contaminants from upland sites would migrate to the Colman Dock facility through groundwater and affect sediments based on travel distances and substantiated by sampling

along the viaduct. Any contaminants migrating to Colman Dock would be found in sediments, since the terminal has been constructed entirely above water. Sediment samples have not been analyzed for petroleum products or dry cleaning solvents, so no analytical data for these constituents were identified for review.

One boring was advanced in material held behind the retaining structure at the northeast corner of the Colman Dock property (Landau Associates 2012). It is estimated that 49 feet of fill and sandy soil sit on top of native sediment; of this, the top 14 feet are planned for removal, amounting to an estimated 7,700 cubic yards. Three composite samples were collected representing 0 to 10 foot, 10 to 20 foot, and 20 to 30 foot depth increments (half in fill and half in underlying sediment). Samples were analyzed for metals, semivolatile organic compounds (including PAHs), and PCBs. Arsenic and benzo(a)pyrene (one of the PAHs) exceeded MTCA cleanup levels in samples representing the 0 to 10 foot (fill) and 20 to 30 foot (sediment) depth intervals; lead exceeded the MTCA cleanup level in the 20 to 30 foot (sediment) interval. Further analysis of lead by the Toxicity Characteristic Leachate Procedure determined that the sediment did not qualify as a hazardous waste. Lead and mercury exceeded Sediment Management Standards (both Sediment Quality and Cleanup Screening Levels) in the 20- to 30-foot interval.

Sanborn maps from 1884, 1888, 1893, 1904, 1905, 1916, 1949, 1950, and 1969 indicate light manufacturing and services (e.g., lumber mills, machine shops, electrical shops, tin shops, canvas sail lofts, printing, box manufacturing) on Colman Dock and to the east across Alaskan Way. The northeast corner of the property was identified as “filled ground” as early as 1949. Alaskan Way was originally known as Railroad Avenue, consisting of up to nine sets of tracks; most tracks adjacent to Colman Dock were removed between 1916 and 1949, based on available maps.

City directory information collected on approximate 5-year intervals from 1920 through 2005 was reviewed to identify the presence of nearby businesses with a potential for hazardous materials use. A number of business addresses matched sites already identified from regulatory databases. An additional six addresses are provided at the end of Exhibit 3.

Aerial photographs and historical topographic maps for the area were of such poor spatial resolution that no discernable features related to hazardous materials use could be distinguished.

A site visit was conducted to evaluate the current layout and operations relative to hazardous materials management; a site representative was interviewed at that time to gain perspective on current and historical practices. The following information was observed and discussed:

- Stormwater drains exist across the entire dock, more than 25 of which are fitted with simple oil/water separators (water discharges through a pipe with a downturned elbow that provides a sump within each drainage structure). Separators are cleaned out based on visual assessments (typically on an annual basis). Water from all drains is discharged to Elliott Bay.
- A hazardous materials storage building (temporary metal shed) and a metal flammables locker are located at the west edge of the south parking area, just south of the main terminal building. Eight 55-gallon drums of oil used on vessels were stored in the building and a few gallons of gasoline were stored in the locker. Both areas were well organized and no evidence of spills was apparent.
- A small hydraulic unit used to lift a dumpster adjacent to the hazardous materials building also was observed. This unit has leaked in the past, with flow directed to a nearby catch basin fitted with an oil/water separator; however, leaks have primarily been addressed using absorptive materials on the pavement surface.
- Hydraulic hoists used to vertically adjust vehicle loading spans were observed at the three loading locations, positioned directly above the water.
- The elevator at the east end of the terminal building uses hydraulic fluid. Small leaks have been retained by a sump and have been cleaned out by a vendor service in the past.
- Three dry-type transformers are located beneath the Agent's Office at the southwest corner of the terminal building and another dry-type transformer is located beneath the east-central portion of the terminal building. It is unknown whether previous transformers contained PCBs. All transformers onsite have been owned by WSF.
- Asbestos-containing materials have been removed from the terminal building as part of renovations in the past and some

material remains. Survey and abatement reports are available at the Eagle Harbor Insulation Shop. At least some of the remaining asbestos has been labeled beneath the terminal building.

- No permanent emergency generators (and associated fuel tanks) are maintained on the property.
- A septic tank situated near the Agent's Office collects waste from the break room, which is routed to the city sewer system; all other wastewater is piped directly to the sewer system.

Potential Effects of the Project

A project has the potential to pose direct, indirect, and cumulative effects on the environment.

Direct impacts are caused during implementation of a project, at the same time and place. Examples include disturbing existing contaminated media (e.g., soil, sediment, groundwater) and releasing hazardous materials during construction or operations (e.g., spills, poor containment practices).

Indirect impacts, also known as secondary impacts, are caused by a project that occur later in time or are farther removed in distance, but are still reasonably foreseeable. This would relate to vehicle accident spills and long-term ongoing vehicular use and decking maintenance that may contaminate surface water.

What does "reasonably foreseeable" mean?
Reasonably foreseeable events, although still uncertain, must be probable; those effects considered possible, but not probable, may be excluded from analysis.

Cumulative impacts are impacts on the environment that result from incremental impact of a project when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions and can result from individually minor, but collectively significant, actions taking place over a period of time.

What methods were used to evaluate the potential effects?

Evaluation of the types and distribution of hazardous materials likely to be encountered within the proposed project footprints is based on data and information gathered during the site screening process. Potential effects are determined by superimposing the proposed project layout over existing features and areas of identified environmental concern. Project effects on contaminated soil, groundwater, sediment, and other media can be determined based on experience with similar hazardous material sites as a guideline.

General use of hazardous materials both during the course of construction and maintenance of WSF facilities has been evaluated over many years of conducting similar projects. Standard approaches have been developed to identify and address the potential effects posed by these activities.

How would construction of the Project affect environmental health and directly impact the environment?

Construction of the project would involve replacing pilings and support structures, replacing decking, and replacing existing above-decking structures. This will disturb contaminated sediment and require abatement of hazardous building materials. Release of contaminants or disturbance of existing contamination may affect environmental health, which includes both human and ecological components.

No Build

Under the No Build Alternative, construction activities would be limited to replacing failing structures as necessary. The creosote-treated timber trestle and piles would be replaced when failure is anticipated. Contaminated sediments would not be capped, so pile installation and removal would temporarily degrade water quality on a piecemeal basis across the entire facility as it incrementally loses structural integrity. Fill at the north end of the terminal would not be removed. No stormwater treatment would be provided under this alternative, and most stormwater runoff from the trestle would continue to discharge untreated to Elliott Bay.

Build Alternative

Approximately 1,446 existing creosote-treated wood piles would be removed from the site. The removal process would disturb contaminated sediment, suspending it into the water column, with a potential for settling on the surface. Portions of piles may remain buried in sediment when broken during the removal process.

Concrete, steel, concrete-reinforced steel, and drilled shafts would replace existing creosote-treated wood piles based on structural requirements across the project site. Concrete and concrete-reinforced steel piles would be installed with an impact hammer. Steel piles would be vibrated as deep as possible and then driven with an impact hammer to the necessary depth. Steel casings for the drilled shafts would be vibrated into place. Approximately 3,500 cubic yards of contaminated sediment would be removed from the hollow steel casing interiors as they are driven. This sediment would initially be staged on a barge to allow dewatering and then would be transferred either directly to

trucks or to a stockpile prior to transport from the site to a permitted disposal facility (see Attachment 3 for an analysis of disposal options).

Approximately 7,400 tons of creosote-treated wood would be removed from the site, including piles and over-water structures. This wood would be stockpiled on barges prior to transport from the site.

Approximately 7,700 cubic yards of contaminated fill situated behind the retaining wall at the northeast corner of the site would be removed using a backhoe. This soil would either be loaded directly into trucks for immediate transport or would be stockpiled prior to transport to a permitted disposal facility.

The small amount of remaining hazardous building materials (primarily asbestos) would be removed from the terminal building by a certified abatement contractor. This material would be stored in bags in a segregated area prior to transport from the site to a permitted disposal facility.

The existing sediment cap would be expanded, covering any piles that break at or beneath the mudline during removal. Cap expansion would also prevent direct contact by benthic organisms to the currently exposed contaminated sediment.

The proposed cap design considered propeller wash-induced scour associated with ferry operations. Two types of upper armor layer material were identified, based on proximity to propeller action, and a bedding layer of fine- to medium-sand was stipulated for beneath the armor layer to minimize mixing of the coarser layer with finer underlying silts. Minimum 6-inch thick armor and bedding layers each were indicated, with a 1-foot total over-placement allowance. The coarser armor layer would cover approximately 1.5 acre and the less coarse armor layer would cover approximately 0.9 acre.

Management of sediment removed from the casings would require some dewatering prior to transport to an upland facility. Water removed from the sediment by gravity drainage would entrain contaminants. Some treatment would be required prior to discharge to Elliott Bay (e.g., filtration, adsorption) or the sewer system (e.g., settling). Water discharged to Elliott Bay must meet Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC) plus other criteria for pollutants of concern determined by Ecology; water discharged to the sanitary sewer must meet King County Industrial Wastewater acceptance criteria, determined on a

case-by-case basis. An estimated total of 950,000 gallons of water would be generated over the four construction seasons; treatment options are presented in Attachment 3.

Exhibit 6 provides a summary of estimated hazardous materials management and capping costs associated with the Build Alternative. Cost estimates for water treatment range widely, depending on the specific contaminants that must be addressed, from $22,000 for a simple settling tank to $445,000 for a dual sand- and activated carbon-filter system.

Exhibit 6. Estimated Hazardous Materials Management and Capping Costs Related to Construction.

	Transport and Dispose			Cap	
	Treated Wood (ton)	Sediment/Soil (ton)	Asbestos (ton)	Thin Sand Open Water (cubic yard)	Thin Sand Under Pier (cubic yard)
Unit Cost	$106	$50	$130	$30-$90*	$75-$180*
Quantity	7,400	16,800	1	4,000	4,000
Total Cost	$784,400	$840,000	$130	$120,000-$360,000	$300,000-$720,000

* Depends on many factors, such as availability and distance from cap material source, cap application approach, mobilization requirements, monitoring requirements.

Contaminated sediment, soil, wood, and building materials would be disturbed during the construction process, resulting in potential short-term negative impacts to the environment associated with spills, leaks, and other accidental releases. These impacts are expected to be localized to within the work zone water column and possibly a small area adjacent to Alaskan Way used for contaminated soil stockpiling and truck loading. When construction is completed, the removal of creosote-treated wood and the removal of contaminated soil (from behind the retaining wall) and sediment (from piling installations), and the capping of contaminated sediment left in place, would provide for an overall, long-term environmental benefit.

How would operation of the Project affect environmental health?

Operation of the project would require use of those hazardous materials needed to 1) operate and maintain facility buildings, the dock structure, pavement, and mechanical systems; 2) operate vehicles owned or contracted by WSF used in project building and pavement maintenance

work; 3) operate vehicles owned by the public using the Ferry Terminal; and 4) change-out of lubricating oil during vessel operation. Hazardous materials associated with these activities include gasoline, diesel fuel, motor oil, transmission fluid, radiator coolant, brake fluid, metals (associated with tires), hydraulic oil, paint, asphalt tar, paving oils, and tack. In addition to being used in vehicles and on project infrastructure, these hazardous materials would also be temporarily stored in one or more locations across the Project Area.

No Build

The number of vehicles boarding the ferries would remain the same for the No Build Alternative, because the project would not increase ferry service. The direct discharge surface drains would remain in place and no improvements to stormwater discharge would result. The frequency and degree of leaks and spills are expected to remain unchanged from current operations. Continued maintenance would require replacement of timber piles to meet structural needs. This process would accelerate as existing piles age.

Build Alternative

Maintenance required by new infrastructure built as part of the project would be less than that required by the existing trestle, buildings, and paved areas (except for stormwater drains). This would result in an appreciable difference in maintenance-related hazardous materials leaks and spills. Replacing direct-discharge surface drains with below-deck vaults that provide basic treatment with oil control would improve the quality of stormwater discharged to the Sound. These vaults would increase maintenance required for periodic cleaning.

The sediment cap would effectively protect marine organisms from direct contact with existing contaminated sediments, providing a long-term benefit. Operations would not involve further actions associated with the cap (i.e., monitoring, assessment, maintenance), which would be conducted as a separate project in the future.

Potential effect of ferry boats churning up sediments will not change, since the same boats would operate under either alternative.

Although the number of vehicles using the terminal would remain approximately the same, the Build Alternative would improve traffic flow. This is expected to reduce vehicle accidents at the terminal, reduce the time some vehicles remain on terminal property, and reduce

or result in no appreciable difference in the amount of hazardous materials leaked from those vehicles and spilled during vehicle accidents at the terminal.

How would operation of the Project affect environmental health in the reasonably foreseeable future?

Cumulative impacts are the summation of impacts on a resource resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

As defined earlier in this report, hazardous materials impacted by the project include 1) creosote-treated timber that would be removed from within and above the sediment, 2) contaminated sediment and soil that would be removed from the site, and 3) hazardous building materials (primarily asbestos) that would be removed from the site.

Contaminated sediment across the north portion of the site would be capped to limit direct contact by benthic organisms. Installation of stormwater wet vaults with oil/water separators would reduce the amount of oily matter discharged to Puget Sound from the trestle surface.

The old and deteriorating state of the trestle support structure requires increased maintenance (replacement) as time goes on. Previous efforts have replaced treated wood with concrete piles on the south side of the facility. This project would continue to replace contaminated structural materials with concrete and steel to the north, requiring less maintenance over time. By removing the trestle as part of construction, the sediment cap already in place beneath the southern portion of the terminal can be extended across the north portion of the property.

The project includes disturbing contaminated sediment during pile removal; generating contaminated wood, sediment, soil, and asbestos waste requiring offsite transport and disposal; and capping exposed contaminated sediment. Localized, short-term negative impacts would be associated with each of these construction activities, due to limited releases of contaminated materials to the environment. Implementation of the project, however, would result in beneficial long-term impacts on the environment by removing contaminated sediment, soil, and

wood and containing contaminated sediment left in place. Additional operational controls would be implemented providing enhanced collection and treatment of stormwater prior to discharge to the Sound.

Similar projects take place on a regular basis across Seattle that result in generation of contaminated wood, sediment, and soil. Ongoing Alaskan Way Surface Street Improvements, the Elliott Bay Seawall Project, and the SR99 New Bored Tunnel are adjacent projects planned for construction during the same time-frame as Colman Dock. Given the long construction period of each project, the generation of contaminated waste by all four combined, as well as that of other projects across the City, would not adversely impact disposal facility capacities. Short-term coordination between adjacent projects would be conducted, as required, to address staging of waste materials prior to transport, based on the limited available upland space. Construction efforts at Colman Dock would use barges to help alleviate space constraints.

As contaminated media are uncovered and cleaned up during this project and other reasonably foreseeable future actions, there would be an improvement in environmental quality. This would lead to an overall beneficial cumulative effect to the area.

Mitigation Measures

Mitigation measures are actions taken prior to and during construction to avoid or reduce the hazardous material impact. These measures prevent or reduce environmental health impacts, minimize construction costs, and avoid or reduce future long-term cleanup costs associated with managing, remediation, and monitoring work.

How will the potential hazardous materials impacts posed by the Project be mitigated?

It does not appear that offsite sources of contamination would impact the Colman Dock project, so any mitigation would be associated with existing property conditions or releases associated with construction. Mitigation would be provided by using standard measures developed either as BMPs, WSDOT specifications, or regulatory requirements, which would be included in the construction contracts.

Standard impacts and mitigation measures developed by WSDOT for transportation projects applicable to this project are summarized in Attachment 4. Standard construction management activities include:

- Developing hazardous materials management plans
- Controlling spills of hazardous materials (i.e., petroleum products)
- Covering stockpiles to prevent erosion and runoff
- Monitoring water quality when activities could impact receiving waters and implementing additional protective measures if monitoring shows an adverse impact to receiving waters
- Properly disposing of contaminated soil, sediment, and hazardous building materials

Standard facility operations activities include controlling spills associated with vehicles and ferry terminal maintenance.

Project-specific impacts and mitigation measures include a wider array of issues, primarily focusing on removal of creosote piles, managing water quality, and protection of biological resources. Project-specific BMPs are provided in Attachment 3.

Proposed capping of contaminated sediments would be addressed through two regulatory avenues: 1) the Clean Water Act and 2) the Sediment Management Standards (see Attachment 1). The Clean Water Act requires issuance of permits for discharge of dredged or fill material into navigable waters (i.e., capping). Water quality restrictions and monitoring requirements would be imposed through the permit. Sediment Management Standards define requirements for addressing contaminated sediment (see Attachment 3).

Recommendations

What actions regarding hazardous materials should be taken as part of the Project?

The project would be beneficial for the environment – contaminated timbers, contaminated soil and sediment, and asbestos would be removed and disposed of in controlled facilities; contaminated sediment left on the site would be capped in place, providing protection to benthic communities. BMPs would be implemented to mitigate disturbance of these materials during the removal process.

Clean Water Act permitting and Sediment Management Standards compliance may require substantial administrative processes. Schedule and budget considerations for these efforts should be coordinated with the overall plans for project development.

Previous sampling and analysis has determined the presence of area-wide sediment contamination, as well as contamination of fill behind the retaining wall at the northeast corner of the property (currently defined by two vertically composited samples over 10-foot intervals). Additional targeted sediment sampling would better define limits of sediment contamination, determining cap limits required to the north (sampling details are provided in Attachment 3). Additional soil sampling behind the retaining wall would determine that portion of fill that should be considered to be contaminated, requiring disposal at a controlled facility.

Estimated costs for additional soil sampling would be $6,000 to $12,000 and for proposed sediment sampling $12,000 to $24,000, depending on the amount of documentation required.

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Washington State Ferries

Attachment 1

Applicable Federal and State Regulations

Attachment 1 Applicable Federal and State Regulations

Numerous federal, state, and local regulations and policies govern decisions concerning hazardous materials issues. A standard list of federal and state regulations that apply to majority of WSDOT projects is provided below. This is not an all-inclusive list of regulations, and further evaluation of applicable local regulations must be conducted for each project.

Federal Regulations

Federal law and regulations relating to hazardous materials and wastes that affect the project include the following:

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and All Appropriate Inquiries (AAI) (40 CFR Part 312)

Section 101(35)(B)(ii) and (iii) of CERCLA and the Superfund Amendments and Reauthorization Act (SARA) define liability for hazardous waste contamination and require liable parties to take responsibility for cleanup. 40 CFR Part 312, Standards and Practices for All Appropriate Inquiries, establishes specific regulatory requirements and standards for conducting AAI provisions necessary to qualify for certain landowner liability protections under CERCLA. The purpose of Hazardous Materials Discipline Reports is, in part, to address liability issues relating to identification of, and acquisition of previously contaminated property.

Resource Conservation and Recovery Act (RCRA)

RCRA provides requirements for handling, transportation, treatment, storage, and disposal of hazardous materials and wastes. It includes provisions for identifying and classifying hazardous materials and wastes, and through the Hazardous and Solid Waste Amendments (HSWA), creates treatment standards for specific wastes. HSWA also establishes requirements for ownership, operation, maintenance, and closure of underground storage tanks. Any removal, treatment, or

transportation of contaminated soils as part of the proposed project would need to be conducted in compliance with RCRA.

Occupational Safety and Health Act (OSHA)

OSHA establishes requirements for site safety procedures, worker training, and worker safety and health standards for employees engaged in work related to hazardous materials. All work relating to the handling of, and potential exposure to, hazardous substances by workers while conducting activities associated with the project must be in compliance with the relevant sections of OSHA.

Rivers and Harbors Act

The Rivers and Harbors Act address projects and activities in navigable waters and harbor and river improvements. The Acts make it a misdemeanor to discharge refuse matter of any kind into navigable waters of the United States without a permit. Section 10 of the Act (33 U.S.C. 403) prohibits the unauthorized obstruction or alteration of any navigable water of the United States. It provides that construction of any structure in or over navigable water, or any other work affecting the course, location, condition, or physical capacity of navigable waters, is unlawful unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army.

Clean Water Act (CWA)

The Clean Water Act (CWA) provides for comprehensive federal regulation of all sources of water pollution. Section 404 of the CWA allows for issuance of permits for the discharge of dredged or fill material into navigable waters. Applicants receiving a Section 404 Permit are required to obtain a Section 401 Water Quality Certification from the Department of Ecology (Ecology). Issuance of a certification means that Ecology anticipates that the applicant's project will comply with state water quality standards and other requirements of state law.

Pollution of state waters is controlled by two administrative regulations that implement Chapter 90.48 RCW, Water Pollution Control Act; Chapter 173-201A WAC, Water Quality Standards for Surface Waters of the State of Washington; and Chapter 173-200 WAC, Water Quality Standards for Groundwater of the State of Washington. Both state standards are discussed under State Regulations, below.

National Environmental Policy Act (NEPA)

NEPA requires that all actions sponsored, funded, permitted, or approved by federal agencies undergo planning to ensure that environmental considerations are given due weight in project decision-making. If the proposed project is partially funded by the FHWA, NEPA compliance is likely to be required. One of the major elements addressed in a NEPA assessment is environmental health. Assessment of impacts associated with hazardous materials and waste is a component of the environmental health evaluation.

Endangered Species Act (ESA)

ESA regulates a wide range of activities affecting plants and animals designated as "endangered" or "threatened". The ESA states that it is unlawful to "take" any animal listed as an endangered species. ESA lists "Endangered" animals or plants that are in danger of being extinct. ESA broadly defines a "take" to include, "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect," or an attempt to engage in such conduct. Chinook salmon, bull trout and the bald eagle are listed as threatened under the Federal Endangered Species Act and live within the Green/Duwamish Watershed and Central Puget Sound Watershed. These watersheds extend from the Cascade Mountains to Puget Sound.

National Emission Standards for Hazardous Air Pollutants (NESHAP) (Code of Federal Regulations, Title 40, Volume 5, Parts 61 to 71

The EPA's rules concerning the removal and disposal of asbestos-containing materials (ACM) were issued under NESHAP. NESHAP requires a thorough inspection for friable and nonfriable ACM within a structure prior to demolition activities. An accredited inspector as required by the Asbestos Hazard Emergency Response Act (AHERA) must conduct all inspections. The NESHAP regulation also includes specific notification, work practice, packaging, labeling, and disposal requirements.

The Puget Sound Clean Air Agency (PSCAA) requires that a notice of intent be submitted prior to beginning any work on an asbestos demolition. The only exception is asbestos projects involving less than 48 square feet and the removal of nonfriable asbestos containing roofing material. An AHERA building inspector or competent person must make the determination if it is nonfriable material. There is a

notification waiting period and fee that will need to be considered prior to planning any abatement work. Asbestos removed from buildings prior to demolition must be disposed in a landfill permitted to receive ACM.

State Regulations

Washington State implements many of the federal statues pertaining to hazardous materials and wastes along with its own, often more stringent, laws and regulations. These requirements, listed below, take precedence over all other laws for governing business and operations within the state.

Model Toxics Control Act (MTCA) Regulations (Chapter 173-340 WAC)

Chapter 173-340 Washington Administrative Code (WAC) implements MTCA, Revised Code of Washington (RCW) 70.105D. Several administrative rules include strict requirements for site discovery and reporting, site assessments, and hazardous site listing. This regulation defines standard methods used to assess whether a site is contaminated or clean. An overview of the cleanup standards is detailed in WAC 173-340-700 and groundwater and soil cleanup standards are listed in WAC 173-340-720 and WAC 173-340-740, respectively. WAC 173-340-450 sets forth the requirements for addressing underground storage tanks (USTs).

MTCA will apply to any site identified with environmental contamination that may pose a threat to human health and/or the environment during this project. MTCA establishes the acceptable cleanup limits for contaminated media. Cleanups of contaminated sites are likely to be accomplished as independent actions, with technical review provided by Ecology on an as- needed basis as provided for under MTCA.

Sediment Management Standards (SMS) (Chapter 173-204 WAC)

WAC 173-204 implements marine sediment quality and cleanup standards similar to those contained in MTCA. The SMS establish a narrative standard with specific biological effects criteria and numerical chemical concentrations for Puget Sound sediment. Under the SMS, cleanup of a site should result in the elimination of adverse effects on biological resources and any health threats to humans. SMS has

numerical standards for biological resources, and narrative standards for protection of human health.

Dangerous Waste Regulations (Chapter 173-303 WAC).

Chapter 173-303 WAC implements RCRA and the Hazardous Waste Management Act, RCW 70-105. This provides for waste identification procedures unique to Washington State. Waste designation procedures are the most likely portion of this regulation that would affect the project. Detailed requirements for forms and rules related to manifesting and transporting of hazardous waste are included. As stated above, any handling, treatment, or transport of hazardous waste associated with the project would be required to be in compliance with RCRA and also with Washington's Dangerous Waste Regulations and Hazardous Waste Management Act. Contaminated materials generated during construction, including soil, water, and debris, would need to be properly designated before disposal. WAC 173-303-070 through 173-303-110 includes the specific regulations that identify dangerous waste characteristics and criteria. In addition, wastes generated by the contractor during construction would need to be properly designated. The requirements for generators of dangerous waste are included in WAC 173-303-170 through 173-303-230. A transporter of dangerous waste must comply with the procedures listed in WAC 173-303-240 through 173-303-250.

WAC 173-303-145 lists the reporting requirements for spills and discharges into the environment, except when otherwise permitted under state or federal law. This section of the WAC applies "when any dangerous waste or hazardous substance is intentionally or accidentally spilled or discharged into the environment such that human health or the environment is threatened, regardless of the quantity of dangerous waste or hazardous substance." This portion of the regulation also details the required procedures for notification and mitigation should a spill occur on site.

Solid (Non-Dangerous) Waste Disposal (RCW 70.95, Chapter 173-304 WAC)

Under the State Solid Waste Management Act, RCW 70.95 states that primary responsibility for managing solid waste is assigned to local government. The state, however, is responsible for assuring the establishment of effective local programs throughout the state.

The local jurisdiction's Health Department regulates the handling and disposal of solid waste. Identifying the appropriate waste disposal facility is the most likely the portion of local solid waste regulation that could impact the project. The local Health Department evaluate whether a waste material is acceptable at one or more of the public and private solid waste facilities in the county. In some cases, testing may be required prior to disposal. Even waste that is being shipped to a disposal facility out of the county, and soil treatment facilities, falls under the jurisdiction of the local Health Department.

WAC 173-304 lists the Minimum Functional Standards for Solid Waste Handling. WAC 173-304-200 designates the on-site containerized storage, collection, and transportation standards for solid waste. The regulations apply to all persons storing containerized solid waste that is generated on-site. Revisions are anticipated for Chapter 173-304 WAC, and the final revised rules should be reviewed prior to the commencement of construction. The updated solid waste rule is likely to include new provisions for demolitions and inert waste streams.

Water Pollution Control Act

RCW 90.48 implements two administrative regulations that control pollution in state waters. Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC, establishes standards for toxic substances, conventional parameters (i.e., pH, dissolved oxygen, temperature), and aesthetic values for marine and fresh surface waters. Water Quality Standards for Groundwater of the State of Washington contain similar regulations for groundwater, with special emphasis on radionuclides and carcinogens, due to potability issues. Any construction or operational activities associated with the project must comply with Washington's water quality standards. Wastewater Discharges to Surface Waters, Chapter 173-220 WAC regulates discharges to surface water from construction projects. Under this program, it is unlawful to discharge polluting matter to surface waters without a National Pollutant Discharge Elimination System (NPDES) permit. A general NPDES permit for construction would be required for the project. Wastewater Discharges to the Ground, Chapter 173-216 WAC, regulates discharge of stormwater to detention basins if this water contains unacceptable concentrations of polluting matter. The proposed project would likely be exempt from the requirements of this regulation if an NPDES Stormwater Permit for construction

is acquired. This should be verified during the permitting process conducted for this project.

Water Quality Standards for Surface Waters (Chapter 173-201A WAC)

WAC 173-201A-040 is the section of the Water Quality Standards that specifically deals with toxic substances within surface waters of the state. The WAC indicates that toxic substances, above natural background levels, shall not be introduced into waters of the state if: 1) The substance will singularly or cumulatively adversely affect characteristic water uses, 2) Cause acute or chronic toxicity to the most sensitive biota dependent on the water, or 3) Adversely affect public health. The Department of Ecology shall employ or require chemical toxicity testing and biological assessments as appropriate to evaluate compliance with the above- mentioned requirements. WAC 173-201A-160 lists the primary means for controlling municipal, commercial, and industrial waste discharges through the issuance of waste disposal permits.

Wastewater Discharges to Ground (Chapter 173-216 WAC)

The State Water Discharge Permit program includes a variety of exemptions, most of which relate to discharges that are permitted under an National Pollution Discharge Elimination System (NPDES) permit or are otherwise authorized by a publicly owned treatment works (POTW) with an authorized pretreatment program. This regulation may apply to stormwater detention basins planned on the project if the water contains unacceptable concentrations of polluting materials.

Underground Utilities (RCW 19.122)

There are multiple operating utilities that exist within the project footprint. RCW 19.122 states that an excavator shall provide notice of the scheduled commencement of excavation to all owners of underground facilities through a one-number locator service. The RCW also states that all owners of underground facilities within a one-number locator service shall subscribe to the service. Notice needs to be communicated to the locator service no less than 2 days and no more than 10 days prior to the commencement of excavation activities. If the excavator discovers utilities that were not identified or damages a utility, the excavator will stop work and notify the locator service and

the owner of the utility service if possible. If the damage causes an emergency situation, the excavator shall also alert the appropriate public health agencies and take all steps necessary to ensure public safety. A failure to notify the locator service of damage to a hazardous liquid or gas pipeline is subject to a civil penalty of not more than ten thousand dollars for each violation. Any excavator who willfully or maliciously damages a field-marked underground facility shall be liable for triple the costs incurred in repairing or relocating the facility.

Underground Storage Tank Statute and Regulations (RCW 90-76, Chapter 173-360 WAC)

The purpose of RCW 90-76 and the Chapter 173-360 WAC regulations is to address the serious threat posed to human health and the environment by leaking underground storage tank systems (LUSTS) containing petroleum and other regulated substances. The regulations describe the enforcement, notification, and reporting requirements for LUSTS. The regulations also detail the performance standards and operating and closure requirements.

Washington Industrial Safety and Health Act (WISHA)

Occupational Health Standards Chapter 296-62 WAC implements the RCW 49-17. RCW 49-17 also implements Safety Standards for Construction Work, Chapter 296-155 WAC, which contains the Safety Standards for Asbestos and Encapsulation Chapter 296-65 WAC. These safety requirements apply to all construction activities, and the regulations are enforced by the Washington State Department of Labor and Industries (L&I).

The standards include rules covering operations at known hazardous waste sites and initial investigations conducted at sites before the presence or absence of hazardous substances has been determined. Also included are rules on site assessment and control, training, protective equipment, and emergency response. Chapter 296-155 WAC requires employers to inform their workers of the potentially hazardous conditions of the workplace. When WSDOT informs the Contractor of these conditions, the Contractor is required to train the workers to recognize hazardous conditions in the workplace and train them how to respond to and report such conditions. It is important the WSDOT inform the Contractor though the Contract and/or Special Provisions so that the Contractor is aware and responsible to

prepare its employees to appropriately and safely handle encounters of hazardous materials with minimal delays.

The safety requirements also provide specific procedures for work with asbestos-containing materials (ACM) and lead-based paint (LBP). L&I regulate asbestos and LBP removal and encapsulation (WAC 296-62 Part I-1 and 296-155). All contractors must be certified in asbestos and LBP removal, and their supervisors and laborers must be trained. For asbestos, L&I and the Puget Sound Clean Air Agency (PSCAA) must be notified of any asbestos removal. Fees also must be paid, calculated on the linear or square amount of material removed. ACM and LBP must be disposed of in a specially permitted landfill. This includes disposable clothing, respirator filters, and equipment, as well as the ACM and LBP itself. The use of landfills results in an irreversible and irretrievable commitment of landfill space. Liability for asbestos and LBP disposal remains with WSDOT indefinitely.

Hazardous Waste Operations and Treatment, Storage, and Disposal Facilities (Chapter 296-62 WAC Part P, RCW 49-17)

Chapter 296-62 WAC Part P includes all of the required procedures for work involving hazardous materials. Due to the possible impacts indicated above for specific sites, there are sections of Chapter 296-62 WAC that are of key importance for this project.

Chapter 296-62 WAC Part P also details the requirements for handling drums and containers. Unlabeled drums and containers must be considered to contain hazardous waste and handled accordingly until the contents are positively identified and labeled. Drums and containers that cannot be moved without rupture, leakage, or spillage must be emptied into a sound container. Personal protective equipment selection protocol is outlined in WAC 296-62-30605. The training requirements for site personnel are included within multiple sections of Part P depending upon the designation of the contamination on-site.

Safety Standards for Construction Work - Lead (Chapter 296-155 WAC)

Chapter 296-166 WAC indicates that workers may not be exposed to lead at concentrations greater than fifty micrograms per cubic meter of air (50 $\mu g/m^3$) averaged over an 8-hour period. Chapter 296-166 WAC also outlines the personal protective equipment that shall be given to

employees as well as medical surveillance procedures that are to be implemented for exposed personnel.

General Occupational Health Standards – Asbestos (Chapter 296-62 WAC Part I-1)

Chapter 296-62 WAC requires that prior to commencement of work an owner must conduct a good faith inspection to determine whether materials to be worked on or removed contain asbestos. An accredited inspector must conduct the good faith inspection. Chapter 296-62 WAC Part I-1 requires that an employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter (0.1 f/cc) of air as an 8-hour time-weighted average. Besides the permissible exposure limit, the regulation also requires appropriate respiratory protection as well as exposure assessment and monitoring.

Washington State Ferries

Attachment 2

Hazardous Materials Site Screening Process

Attachment 2 Hazardous Materials Site Screening Process

Laws and Regulations Associated with Hazardous Materials

Hazardous materials may be classified in different categories based on the laws and regulations that define their characteristics and uses. These classifications include the following:

- Hazardous waste
- Dangerous waste
- Hazardous substances
- Toxic substances

The U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology) maintain several databases to track facilities and sites with potential and confirmed releases of chemicals to the environment. These agencies also identify and monitor facilities that manage hazardous materials or hazardous waste as part of their operations, from the point of generation to the point of disposal. Below are listed the types of federal and state databases that are searched as part of the screening process, followed by a brief summary of regulations enforced by the agencies.

Federal Databases Searched for the Screening Process

Comprehensive Environmental Response and Liability Information System (CERCLIS)

CERCLIS contains data on potentially hazardous waste sites that have been reported to the EPA by states, municipalities, private companies, and private persons pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, the Superfund law). CERCLIS contains sites either proposed for listing or listed on the National Priorities List (NPL) and sites in the screening

and assessment phase for possible inclusion on the NPL. The CERCLIS list contains sites reported from 1983 to the present.

Emergency Response Notification System (ERNS)

The ERNS records and stores information on reported releases of oil and hazardous substances.

Resource Conservation and Recovery Information System (RCRIS)

RCRIS includes selective information on sites that generate, transport, store, treat and/or dispose of hazardous waste, as identified by the Resource Conservation and Recovery Act (RCRA).

Corrective Action Report (CORRACTS)

CORRACTS identifies waste handlers with RCRA corrective action activity.

Facility Index System (FINDS)

The Facility Index System (FINDS) is an index of facilities (or sites) that are monitored and regulated by the EPA. FINDS uses several databases to track these sites, including the following:

- Permit Compliance System (PCS)
- Aerometric Information Retrieval System (AIRS)
- Docket for civil enforcement cases (DOCKET)
- Docket for criminal enforcement cases (C-DOCKET)
- Federal Underground Injection Control (FURS)
- Federal Facilities Information System (FFIS)
- State Environmental Laws and Statutes (STATE)
- PCB Activity Data System (PADS)

The FINDS database is updated quarterly; the version evaluated during the 2003 hazardous materials site assessment was dated November 2002.

Hazardous Materials Information Reporting System (HMIRS)

HMIRS contains hazardous material spill incidents that are reported to the U.S. Department of Transportation.

RCRA Administrative Action Tracking System (RAATS)

RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA.

Records of Decision (ROD)

ROD documents mandate a permanent remedy at an NPL (Superfund) site and contain technical and health-related information to aid in the cleanup.

Materials Licensing Tracking System (MLTS)

The MLTS is maintained by the Nuclear Regulatory Commission (NRC), which lists approximately 8,100 sites that possess or use radioactive materials and are subject to NRC licensing requirements.

Toxic Chemical Release Inventory System (TRIS)

TRIS identifies facilities that release toxic chemicals to the air, water, or land in reportable quantities under the Superfund Amendments and Reauthorization Act (SARA) Title III Section 313.

Toxic Substances Control Act (TSCA)

TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. The list also includes the product volume of these substances by site.

State Databases Searched for the Screening Process

Confirmed & Suspected Contaminated Sites List (CSCSL)

State hazardous waste site (SHWS) records are the state equivalents to the federal Superfund CERCLIS. These sites may or may not be included on the federal CERCLIS list.

Hazardous Sites List (HSL)

The HSL is a subset of the CSCSL report. It includes sites that have been assessed and ranked using the Washington ranking method (WARM).

Leaking Underground Storage Tank Site List (LUST)

LUST records contain an inventory of reported leaking underground storage tank incidents. The LUST list may also identify the type of material released and the affected media (e.g., air, soil, and water).

Underground Storage Tank Database (UST)

USTs are regulated under Subtitle I of RCRA and must be registered with Ecology. The database contains information such as the site location, number of tanks, materials stored, and date of installation of registered tanks.

Solid Waste Facility Database (SWF/LF)

Solid waste facilities and landfill site records contain an inventory of solid waste disposal facilities and landfills throughout the state.

Voluntary Cleanup Program (VCP) and Independent Cleanup Reports (ICR) Databases

The Washington VCP and its predecessor, ICR, contain records showing that the owner or operator of a hazardous materials release site has submitted remedial action reports to Ecology. These are independent remedial actions conducted without Ecology oversight or approval. Owners and operators are not under an order or decree to conduct these cleanup actions.

Ecology Records Review

For sites identified on the LUST and CSCSL lists, all available Ecology records were reviewed for the present study. Information gathered from the file reviews included the type of release, affected media (i.e., soil, groundwater, surface water, or sediment), limits of contamination, and corrective actions taken. Results of recent site investigations (i.e., compliance monitoring) conducted on documented release sites provide information on current site conditions and can be used to evaluate potential effects that may result from planned construction.

Types of Historical Records Reviewed

- Sanborn fire insurance maps with coverage in 1884 and 1969
- Historical aerial photographs with coverage from 1956 through 2006
- Historical U.S. Geological Survey (USGS) topographic maps with coverage from 1895 through 1983
- City directories (Polk, Pacific Telephone, and Cole) between 1920 and 2005 on approximate 5-year intervals

- Numerous sediment characterization studies referenced in Attachment 3

Visual Reconnaissance of the Project Area and Adjacent Properties

A visual reconnaissance of the project area and adjacent properties was conducted on October 24, 2012. The purpose of a visual reconnaissance is to observe current site conditions and to identify visible indications of hazardous or potentially hazardous substances historically or currently used, generated, stored, or disposed of. Reconnaissance of adjacent properties was restricted to observations from public areas.

Washington State Ferries

Attachment 3

Sediment Analysis Report for the Seattle Multimodal Terminal at Colman Dock Project

SEDIMENT ANALYSIS REPORT

SEATTLE MULTIMODAL TERMINAL AT COLMAN DOCK PROJECT

Prepared for
Washington State Ferries

Prepared by
Herrera Environmental Consultants, Inc.

HERRERA

SEDIMENT ANALYSIS REPORT

SEATTLE MULTIMODAL TERMINAL AT COLMAN DOCK PROJECT

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February 20, 2014

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INTRODUCTION

The Washington State Department of Transportation, Ferries Division (WSF), the Federal Transit Administration (FTA), and the Federal Highway Administration (FHWA) propose to replace the north (timber) trestle portion of the Seattle Terminal at Colman Dock, as well as the main terminal building and auxiliary structures located on the timber trestle. The vehicular transfer span, overhead loading (OHL), and some marine components of Slips 2 and 3 would also be replaced. Operational efficiency and safety and terminal safety would be improved by measures to reduce pedestrian and vehicle conflicts.

Herrera Environmental Consultants (Herrera) prepared this report to summarize existing sediment contamination information in the project area. Relevant project components are described, historical sediment studies are summarized, existing sediment data are presented, future sediment cleanup activities are proposed, and a preliminary design for additional sediment characterization is presented.

Information in this report is intended to assist WSF with the regulatory process and acquisition of permits and approvals from federal and state agencies, Indian tribes, and local governments. This report will also provide information to help the project team develop appropriate construction best management practices (BMPs). The regulatory process and construction BMPs related to sediment management have been identified by Herrera (2010) for Washington State Department of Transportation (WSDOT) projects.

PROJECT ELEMENTS

The Seattle Terminal consists of three ferry slips connected to a trestle and associated terminal buildings (Figure 1). The trestle was constructed in 1936 with creosote-treated timber piles and decking and rebuilt in 1964 using many of the original creosote-treated timber piles. As part of the 1964 pier reconstruction, WSF also constructed the main terminal building. In 1971, the north (timber) trestle was expanded near the northwest corner of the terminal building, also using creosote-treated timber piles. WSF added a southern, concrete portion of the dock in 1990.

The existing north (timber) trestle is an overwater structure that includes the timber piles, pile caps, and deck. It extends from the south edge of the terminal building to the north edge of the facility, adjacent to the fire station. The proposed project would remove the timber trestle north of Marion Street. Concrete decking would be constructed on the south edge of the facility, including Pier 50 passenger-only ferry (POF) facilities. The area north of Marion Street would not be reconstructed. A section of fill contained behind a bulkhead underneath the north trestle would be dredged; no other dredging is proposed for the project.

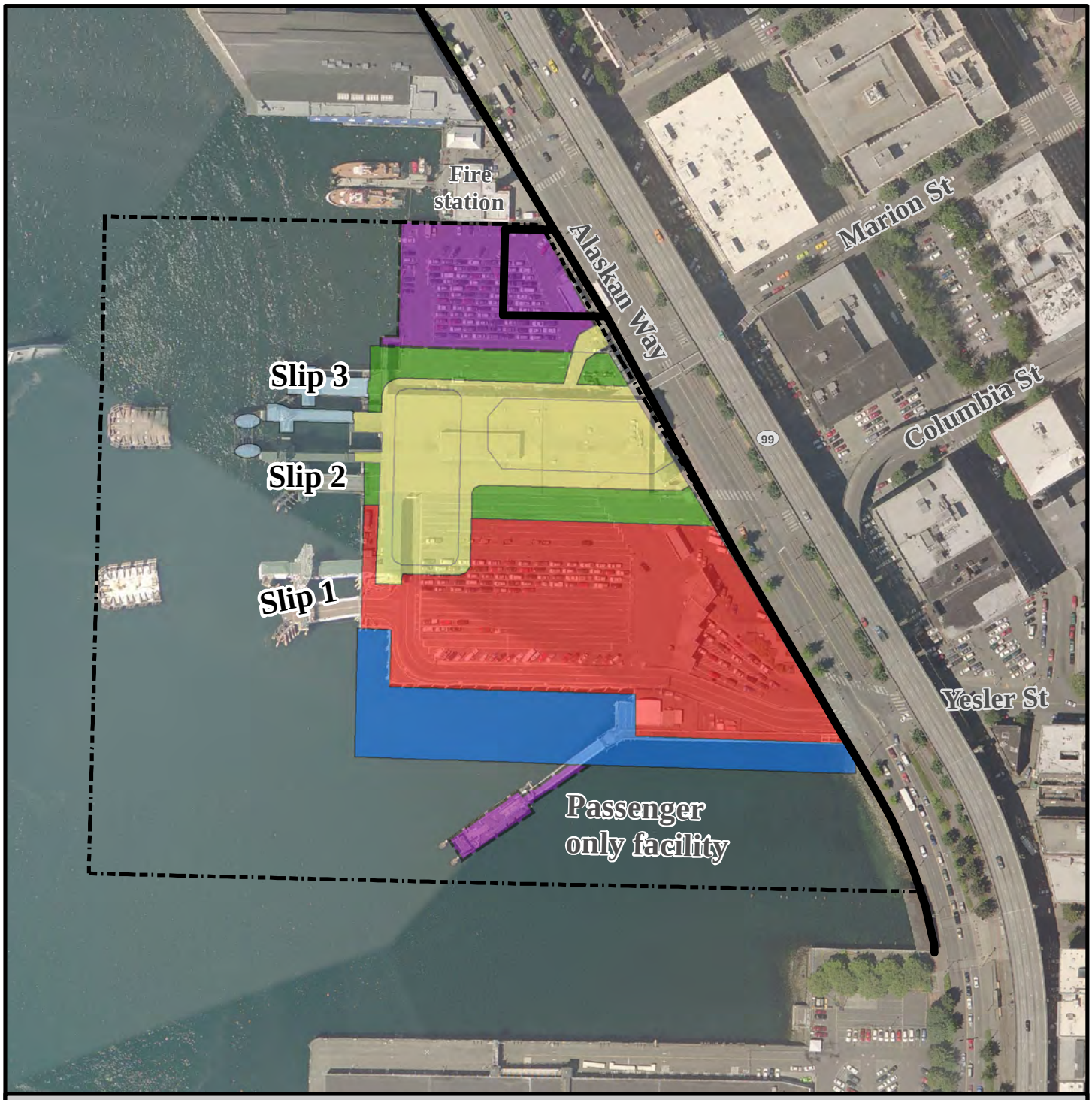
The vehicle transfer span and the passenger OHL structures of Slip 3 would be reconstructed as part of the project. The new OHL would be wider, allowing faster movement of walk-on passengers, and ADA accessible. Two timber berthing structures in Slip 2 and 3 would be replaced. The POF slips at Pier 50 would be reconstructed similar to the existing facility with a street level connection to Alaskan Way. The new facility would also be connected to the terminal building and the Marion Street pedestrian bridge via an ADA-compliant overhead walkway. The existing POF barge and gangway would be relocated east within 100 feet of the current alignment to allow for construction equipment access.

The existing terminal building would be demolished and replaced with a new building. A portion of the south (concrete) trestle would need to be reconstructed to support the new building.

Contaminated sediments have been documented in the project footprint. A sediment cap would be placed underneath the trestle to contain contaminated sediments in the project footprint. Project work is expected to occur in four phases. The above components occur in the following phases, with the anticipated phase duration indicated:

- **Phase 1** – a temporary platform for the POF slip would be constructed on the south side of the trestle. The existing POF pier and walkway, including supporting piles, would be removed and the float and gangway temporarily relocated east on the existing trestle.

  The Slip 3 transfer span and the OHL structures would be replaced. The Slip 3 transfer span and overhead loading structure would be supported by drilled shafts. Steel



Legend

Colman Dock

- Existing Structures Removed
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Terminal Structures
- New Slip 2 and 3 Structures
- Property boundary
- Approximate Sea Wall

Figure 1.
Conceptual Terminal Layout for Colman Dock Project.

N

0 100 200 400 Feet

HERRERA

Aerial: King County 2007

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casings for the drilled shafts would be vibrated into place. Steel piles would be used for the bridge seat.

A new trestle with concrete piles and decking would be built on the south side of the facility during Phase 1. An edge of the existing concrete trestle between Slips 1 and 2 would be temporarily removed and replaced. Concrete piles for the southern portion of the new trestle would be driven with an impact hammer.

The new POF slip would be constructed as part of the south trestle using concrete piles. An elevated walkway would be constructed to connect the POF slip to the new terminal building, supported by drilled shafts.

The two timber dogleg dolphins between Slips 2 and 3 would be replaced by two new steel pile dolphins. A temporary dolphin would be built to allow vessels to dock at Slip 2. Steel piles would be used for the dolphins.

Work would occur from the existing trestle as well as from up to two barges on the south side of the trestle. Barges would be anchored with spuds extending to the sea floor. It is anticipated that a clean sediment cap would be placed underneath the new section of trestle once the old trestle sections and piles are removed; final details on the sediment cap would be established in coordination with Ecology.

Phase 1 is scheduled to begin in 2015 and would last approximately 9 to 12 months. Operations of the facility during this phase would be out of Slips 1 and 2.

- **Phase 2** – the Slip 1 OHL walkway would be removed and the new terminal building would be built in stages, with the first (southern) portion of the building built during this phase. The new terminal building would require a new pile foundation for support. To accomplish this, a portion of the concrete trestle would be removed, piles driven, and the trestle portion rebuilt. These piles would be installed with both vibratory and impact hammers to the necessary depth. A barge would be anchored south of Slip 2 to support construction equipment necessary for the work. An elevated walkway would be constructed to connect the POF slip to the new terminal building during Phase 2, supported by drilled shafts.

  During construction of Phase 2, the terminal would operate out of Slips 2 and 3. Phase 2 construction activities are estimated to take approximately 22 months, with one season of in-water work.

- **Phase 3** – passenger processing would move into the new section of the terminal building constructed in Phase 2. The Slip 2 transfer span and overhead loading would be temporarily removed and the vehicle attendant crew building under the Slip 2 OHL would be demolished. The existing terminal building would then be demolished, and a strip of the north (timber) trestle approximately 100 feet wide immediately north of the existing concrete trestle would be demolished and replaced with a new steel and concrete trestle supported by concrete-reinforced steel piles. Approximately 750 timber piles and 75 concrete-reinforced steel piles would be removed. Piles would be vibrated out of the substrate to the extent possible to minimize disturbing

contaminated sediments. The new concrete-reinforced steel piles would be both vibratory and impact-driven to the appropriate load-bearing depth.

Two temporary vehicle bridges would span the 100-foot gap during construction. After the gap is replaced with new piles and decking, the center third of the new terminal building would be constructed and the Slip 2 vehicle and OHL spans reinstalled using steel piles. Temporary pedestrian bridges would maintain a link to the Marion Street Overpass and Slip 3 to the new terminal building. A derrick and barge would be anchored with spuds south of the slip for Phase 3.

During construction of Phase 3, the terminal would operate out of Slips 1 and 3. Phase 3 construction activities are estimated to take approximately 21 to 24 months, with one season of in-water work.

- **Phase 4** - the remaining portion of the north (timber) trestle would be demolished. Approximately 1,267 piles would be removed, consisting of 1,187 timber piles and 80 steel piles.

  Piles would be removed using vibratory methods to the extent possible to minimize suspending potentially contaminated sediments. Afterward, a section of fill estimated to be 7,700 cubic yards (about 14,500 square feet of surface area) underneath the trestle and now contained behind a sheet pile bulkhead would be removed. The fill would be dredged while the bulkhead is still in place and disposed of at an approved location. Once the fill has been removed and the area restored to match the bathymetry on either side, the bulkhead would be removed.

  After removal of the bulkhead, the remainder of the new trestle and a stormwater vault would be constructed using concrete-reinforced steel piles. The final third of the new terminal building would be constructed and temporary pedestrian bridges replaced with permanent structures.

  A new sediment cap would be placed in accordance with an approved plan developed in cooperation with Ecology.

  During construction of Phase 4, the terminal would operate out of Slips 1 and 2. Phase 4 construction activities are estimated to take approximately 22 to 25 months, with one season of in-water work.

New Southern Concrete Trestle

A new concrete trestle would be constructed beyond the southern edge of the existing concrete trestle. The area added would be equivalent to the area removed from the northern timber trestle (40,000 square feet). A replacement POF would be incorporated into the new trestle.

Modification of Existing Concrete Trestle

In 1990, WSF added the southern, concrete portion of the dock (approximately 150,000 square feet) located between Columbia and Yesler streets. That project also included capping

existing sediments underneath the concrete portion of the dock, as described below. Testing is currently being conducted to determine if the existing concrete trestle would require modification to support future structures and activities on the existing concrete portion of the dock.

Replacement of Southern Timber Trestle

The existing timber trestle is an overwater structure approximately 140,000 square feet in size. The trestle includes timber piles, decking, and deck structural supports. It extends from the northern edge of the Colman Dock facility (adjacent to the fire station) to the southern edge of the terminal building. The trestle was originally constructed in 1936 and rebuilt in 1964 using many of the original timber piles. As part of the 1964 pier reconstruction, WSF also constructed the main terminal building. In 1971, the timber trestle was expanded near the northwest corner of the terminal building.

The Colman Dock Project would remove the southern portion of the timber trestle between Marion and Columbia streets and a new concrete trestle would be constructed to support the proposed terminal building.

Removal of Northern Timber Trestle

The Colman Dock Project would remove the northern portion of the timber trestle, located north of Marion Street and covering approximately 40,000 square feet. The northern portion would not be reconstructed; instead, the equivalent holding capacity would be replaced by constructing a new southern concrete trestle, as described above. Reconfiguring the dock would enhance safety by reducing pedestrian/vehicle conflicts. It would increase operational efficiency, while opening approximately 180 linear feet of waterfront and nearshore habitat. Use of the future waterfront and nearshore area has yet to be determined by the Elliott Bay Seawall Project or the Waterfront Seattle Project. Once the Colman Dock Project is complete, total overwater coverage of the Colman Dock facility would increase by about 5,200 square feet.

SEDIMENT EVALUATION PROCESS

This section summarizes the sediment evaluation process for the Colman Dock Project, as required by the State of Washington. The project is expected to disturb existing sediment, but it would not require sediment dredging or coordination with the Dredged Material Management Program. Examples of sediment disturbance activities for the project include pier construction, pile removal, and pile driving.

A summary of the sediment evaluation process and contaminated sediment management is provided below. A detailed description of the regulatory process associated with sediment disturbance during construction can be found in *Sediment Evaluation Process for SR 520 and Other WSDOT Projects* (Herrera 2010).

Before beginning the regulatory process, sediments should be evaluated to determine if contaminated sediments are present at the construction site. Sediment that may be disturbed during work activities must be evaluated using criteria established in the Sediment Management Standards (SMS) for the state of Washington (Chapter 173-204 WAC). The standards were developed under the Model Toxics Control Act (WAC 173-340) to reduce (and ultimately eliminate) adverse effects on biological resources and threats to human health from sediment contamination. The regulation includes both numeric and narrative standards used to reduce pollutant discharges and to provide a decision process for the cleanup of contaminated sediment sites.

The SMS contain two levels of chemical numeric criteria for sediment in Washington State:

- **Sediment Quality Standards** (SQS) correspond to sediment quality that will result in no adverse effects on biological resources or significant risk to human health. Sediments are considered to be contaminated if SQS values are exceeded.
- **Cleanup Screening Levels** (CSL) correspond to sediment quality that may result in minor adverse effects. CSL values are greater than or equal to SQS values.

CSL values are also known as Minimum Cleanup Levels (MCUL) and Sediment Impact Zone Maximum Chemical Criteria (SIZmax). The different names correspond to how the criteria are used for different purposes, but the criteria are the same.

The SQS serve as the cleanup objective for all cleanup actions. Sediment cleanup standards should be as close as practicable to the SQS standards, but they may also consider cost, technical feasibility, and net environmental effects. Site-specific cleanup standards shall not exceed the CSL.

The SMS have numeric criteria for SQS and CSL levels in marine sediments of Puget Sound for 47 chemicals and chemical groups, plus narrative criteria for other chemicals and deleterious substances. The numeric levels address only the toxic impacts of sediments on benthic organisms and do not address bioaccumulative effects to human health or wildlife,which must

be evaluated separately on a site-specific basis. The SMS also contain biological effects criteria equivalent to the SQS (no adverse effects) and CSL (minor adverse effects). Biological effects are determined by laboratory toxicity tests (bioassays) or benthic abundance tests compared to reference sediment sites.

Both chemical concentrations and biological effects tests are used to evaluate sediment quality, but biological effects test results can override the chemical concentration results. For chemicals without numeric criteria, and for freshwater sediments, the biological criteria and a bioaccumulation assessment are used to evaluate sediment quality for toxic effects on aquatic life.

Marine sediment investigations conducted under SMS rely on a combination of dry weight concentrations and carbon-normalized concentrations. Bulk sediment dry weight concentrations are normalized by the amount of organic carbon (OC) present for most of the organic compounds (including polycyclic aromatic hydrocarbons [PAHs], phthalates, chlorinated benzenes, polychlorinated biphenyls [PCBs], and other miscellaneous extractables). However, if the total OC content of the sediment is less than 0.5 percent or more than 4 percent, use of the carbon-normalized SQS and CSL criteria generally is not appropriate (Michelsen 1992). In such cases, comparison of dry weight values to lowest apparent effects threshold (LAET) criteria should be used. In addition, some parameters that do not have SQS or CSL criteria (including chlorinated pesticides and some metals) can be compared to dry weight LAET criteria (PTI 1988).

If additional sediment testing is required to obtain the required project permits, a project-specific Sampling and Analysis Plan (SAP) must be developed, based on requirements in two documents:

- *Sediment Management Standards* (WAC 173-204-600)
- *Sediment Sampling and Analysis Plan Appendix* (Ecology 2008)

Before beginning sampling, the Washington State Department of Ecology (Ecology) must approve the SAP. The approval process can take anywhere from a few weeks to 6 months, depending on the complexity of the project or site and the involvement of other stakeholders. If sediment samples will be collected for preliminary planning purposes or are "samples of opportunity," an Ecology-approved SAP is not required. However, protocols established in the above documents should be used for sample collection and analysis.

Biological testing may only be required if SMS chemical criteria are exceeded and Ecology desires biological confirmation; however, Ecology may require biological testing when chemical criteria are not exceeded in certain situations. Similarly, biological testing may be conducted without performing chemical testing, if desired.

Current biological test methods and requirements are described in the Sediment Sampling and Analysis Plan Appendix (Ecology 2008).

If contaminated sediments are found at a project site, removal or containment of sediments may be required. If sediments are removed, disposal can occur either in-water or at an

upland disposal facility. In-water disposal of sediments is permitted through the Dredged Material Management Program (DMMP). Requirements for disposal of removed sediments at upland sites in Washington are specified by Solid Waste Regulations (WAC 173-350 and WAC 173-351), and Dangerous Waste Regulations (WAC 173-303).

Containment of contaminated sediments by capping is an alternative to removal. Capping is appropriate when the following circumstances apply:

- The original source of contamination has been removed.
- The environmental effects of removing the contaminated sediments are a concern.
- Hydrologic conditions will not disturb the sediment capping material.

Although the capital costs of sediment capping can be less than for sediment removal, it requires long-term monitoring and maintenance to ensure the cap remains in place and contaminants are not migrating through the cap.

Historical Sediment Studies

Numerous sediment samples were collected under and in the vicinity of Colman Dock during investigations performed in the 1980s and 1990s. The significance of those studies to the Colman Dock project is summarized below. Figure 2 presents historical sediment sampling locations.

Colman Dock South Sediment Cap

Prior to adoption of the SMS in 1991, various agency studies had reported the presence of elevated chemical concentrations in surface sediments throughout the central Seattle Waterfront area (Romberg et al. 1984; King County 1988; Tetra Tech 1988a, 1988b). In recognition of those concerns, WSF voluntarily constructed a sediment cap within the area of the former Pier 50, currently under an expanded Pier 51 (Existing Ferry Terminal Cap; Figure 2), in November 1989. The cap was placed immediately after pier demolition and took advantage of open-water construction conditions that existed at the time. The cap was designed to isolate chemicals in the underlying sediments prior to driving piles for the southerly expansion of Pier 51, constructed by placing approximately 1.5 feet of clean, commercially obtained sand on the existing sediment using a clamshell bucket (CH2M Hill 2005).

Based on results of initial monitoring of the cap in 1994, a long-term monitoring plan was developed, which included additional monitoring every 5 years for a 10-year period (1999 and 2004). Parameters included in the initial monitoring event were:

- Cap physical integrity and stability
- Chemical quality of the cap
- Benthic infauna in surface sediment
- Cap effectiveness in isolating underlying contaminated sediment

Parameters included in the long-term monitoring program are:

- Cap thickness, a measure of erosion or accretion of the cap
- Cap material chemistry, a measure of the cap's continued effectiveness in isolating contaminants

A total of seven surface sediment samples were collected from the cap for chemical analysis during each of three monitoring events. The two northernmost stations (CHM-1 and CHM-4) in the cap area are shown in Figure 2. Surface sediment samples were analyzed for:

- Lower weight polycyclic aromatic hydrocarbons (LPAHs) (acenaphthene, naphthalene, acenaphthylene, fluorene, phenanthrene, anthracene)

- Higher weight polycyclic aromatic hydrocarbons (HPAHs) (fluoranthene, pyrene, benz(a)anthracene, chrysene, total benzofluoranthes, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, and benzo(g,h,i)perylene)
- Metals (arsenic, cadmium, chromium, copper, lead, mercury, silver, and zinc)
- Conventionals (total organic carbon [TOC], total solids, and particle size)

Results of the study are discussed in further detail in the "Existing Sediment Data" section of this report.

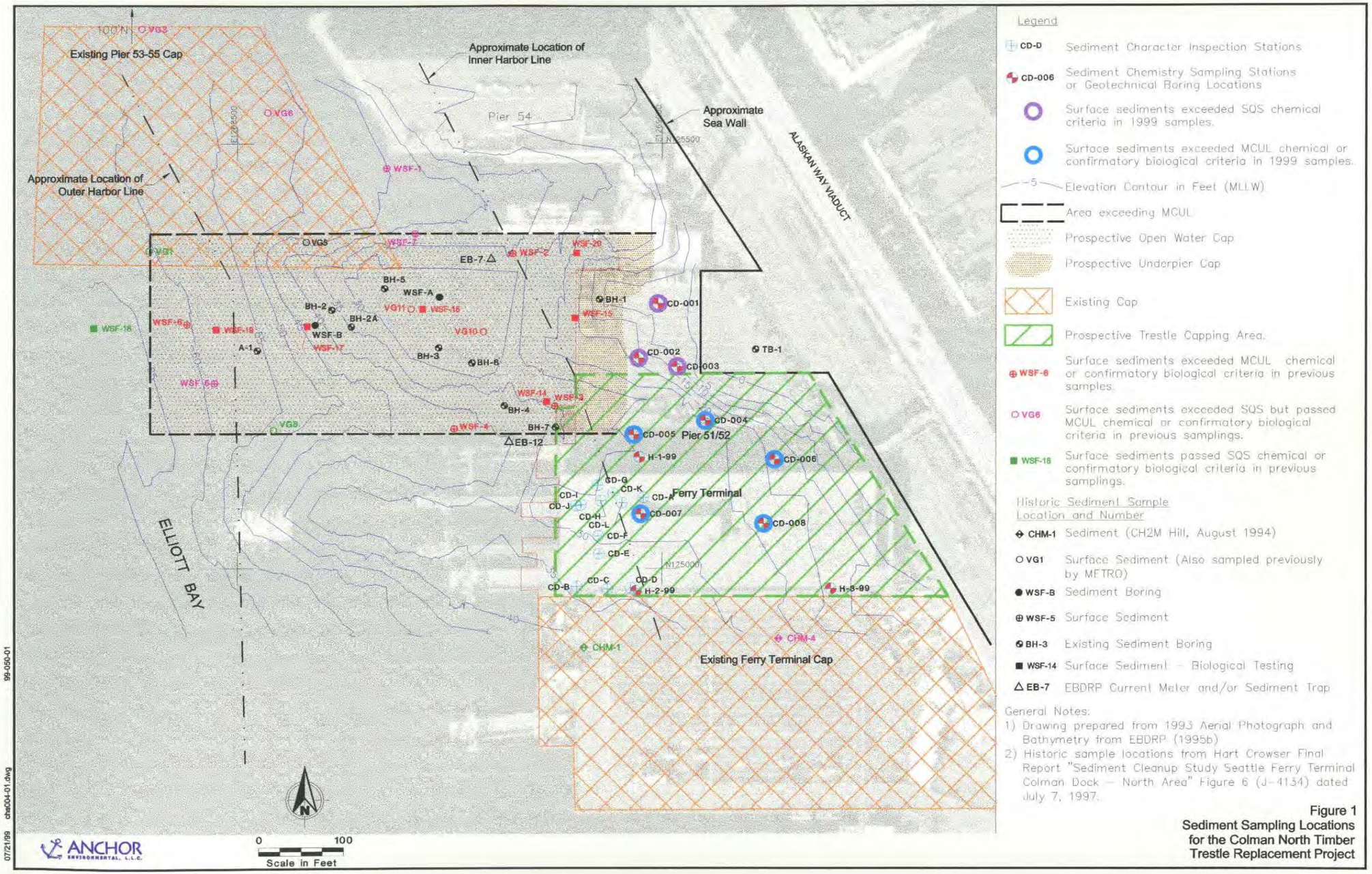
Pier 53-55 Sediment Cap

In 1992, a 3-foot cap and 1-foot enhanced natural remediation (ENR) area were constructed over 4.5 acres of chemically contaminated sediments offshore of Piers 53, 54, and 55 (see Figure 2). The project, known as the Pier 53 project, was the result of 4 years of study and planning by several agencies, including the City of Seattle Department of Engineering, the King County Department of Natural Resources and Parks (formerly Metro), the US Army Corps of Engineers, Ecology, Washington State Department of Natural Resources (DNR), the Washington State Department of Fisheries, and the US Environmental Protection Agency (King County 2010).

Cap monitoring activities occurred over a 10-year period, ending in 2002. Monitoring activities occurred once prior to cap installation (1992), and four times after the cap was installed, following 4 months (1992), 1 year (1993), 4 years (1996), and 10 years (2002) (King County 2010). A total of four surface sediment stations for chemistry and benthic community analyses (VG1 through VG5), three additional surface sediment stations for chemistry analysis only (VG5 through VG7), and five sediment coring stations for chemistry analysis (C1 through C5) were established for the project.

The King County (2010) report summarized results of surface sediment over the monitoring period:

> *High values of polycyclic aromatic hydrocarbons (PAHs) and metals that occurred due to the adjacent piling removal project in 1993 [conducted in 1992, reported in 1993] dropped significantly in three years. After nine years, only the most impacted station (VG5) had concentrations that exceeded the pre-cap concentration of PAHs at the site. The PAH values at all stations were below SQS values, but remained elevated above the original baseline PAH values. The 2002 samples contained no 4-methylphenol and phenol, which were present in the 1996 samples. Polychlorinated biphenyls (PCBs) were detected on the cap for the first time in the 1996 samples and several stations had increased values in 2002. Increased PCB concentrations probably originated from resuspension of contaminated sediments, potentially including those located under piers where high PCB concentrations are documented. Bis(2-ethylhexyl)phthalate (BEHP) was only present at one station after one year (1993), at all stations after four years, and most values were similar after another six years. One station showed an increase in 2002 and now exceeds the SQS (VG4). The two highest BEHP values in 2002 were at VG4 and VG5, which are located on opposite*



Source: Patmont, Clay and John Verduin (1999)

Figure 2. Historical Sediment Sampling Locations in the Vicinity of Colman Dock.

ends of the cap and ENR, and probably reflect input from existing contaminated sediment located beyond the cap and ENR via redistribution of resuspended sediments. Mean concentrations of the major site contaminants (PCBs, PAHs, BEHP, copper and lead) measured in 2002 were similar between the cap and ENR area stations and significantly lower than pre-cap.

Colman Dock South Sediment Quality Assessment

A sediment quality assessment was conducted on the south side of Pier 51/52 within the vicinity of the existing and planned POF in 1994. Surface sediment sampling was performed at a total of nine locations (WSF-8 through WSF-13, WSF-C, WSF-D, and WSF-E) and sediment borings were advanced at three locations (WSF-C, WSF-D, and WSF-E). Sediments were submitted for chemical analysis. Surface sediment and boring locations are not shown on Figure 2 because they are located south of the map area, but these locations are shown on a separate map in the Pile Installation section below.

Results for chemical testing summarized in the 1994 Hart Crowser assessment, indicating that:

- Both metal and PAH concentrations detected in surface samples were generally within the low to middle concentration range previously reported for the central Elliott Bay waterfront, except for silver, which was near the upper end of the historical range.
- Overall, chemical concentrations were higher in the upper sediment unit, within 10 to 15 feet below the mudline, than the surface samples. Maximum metals and PAH concentrations were observed in 0- to 1.5-foot and 6- to 11-foot intervals at WSF-C.
- The upper 10 to 15 feet was composed of an extremely soft, unconsolidated mixture of organic silt fill and recently deposited sediments. Beneath that, the sediments were a more consolidated silty sand to clayey silt for approximately 10 feet and then silty sand till and layers of hard clay beneath.

Colman Dock North Sediment Cleanup Study

A sediment cleanup study was conducted between 1994 and 1996 in preparation for planned renovation and redevelopment of Colman Dock. Two phases of sediment sampling and analysis were conducted for the Colman Dock – North Area Sediment Cleanup Study (Hart Crowser 1997). Phase I activities performed in July 1994 included collection of sediment samples primarily for chemical characterization; subsequent Phase II confirmatory bioassay testing and grain size mapping were performed in May 1996.

During Phase I, surface sediment sampling was performed at 14 locations in the Colman Dock - North Area, which included seven existing locations (VG1, VG3, VG5, VG6, VG8, VG10, and VG11) and seven new locations denoted WSF-1 through WSF-7. In addition, sediment boring samples were collected at two locations (WSF-A and WSF-B). Samples were submitted for chemical analysis. Surface sediment and boring locations are shown on Figure 2.

During Phase II, seven sediment samples (WSF-14 through WSF-20) were collected from the Colman Dock – North Area for confirmatory biological testing (bioassay). Concurrent with

sediment bioassay sampling, sediment grain size was visually documented, with nine surface sediment samples collected for grain size analysis. Bioassay sampling locations are indicated on Figure 2.

Results for chemical testing are summarized in the 1997 Cleanup Study (Hart Crowser):

> *During the 1994 sampling, the highest LPAH and HPAH concentrations, well above SQS chemical criteria, were detected at WSF-2, WSF-3, WSF-4, and VG-11, in the vicinity of the former wing and fender wall structure... The maximum total LPAH and HPAH concentrations at these locations were approximately 5,100 and 14,000 mg/kg (milligrams per kilograms) TOC (sic), respectively. LPAH and HPAH concentrations decreased with distance from these sampling locations. Locations WSF-5, WSF-7, VG-5, and VG-6 exhibited LPAH and/or HPAH concentrations which were marginally above the SQS chemical criteria. Because of its location, elevated HPAH concentrations detected at VG-6 may include sources originating in a net upcurrent direction (north) of Colman Dock. Current meter deployments and detailed sediment grain size mapping performed along the Seattle Waterfront (Boatman et al., 1995 and McLaren and Ren, 1994) indicate a net north to south transport of sediments in the Colman Dock – North Area, decreasing the likelihood that all of the PAH recontamination of the Pier 53-55 Cap originated from the Pier 52 wingwall removal project to the south.*

Results for bioassay testing are summarized in the 1997 Cleanup Study (Hart Crowser):

> *Five of the seven samples exceeded the current SMS severe biological effect criterion (SBEC) in at least one bioassay. These samples (WSF-14 through WSF-17 and WSF-19) therefore exceeded the MCUL confirmatory biological effects criteria. One location (WSF-20) exceeded the biological effect criterion (BEC) in two of the three bioassay tests, and thus exceeded the MCUL confirmatory biological effects criteria based on the SMS "two-hit" rule. Only the most offshore sediment sampling location (WSF-18) passed the SQS confirmatory biological effects criterion.*

Colman North Trestle Replacement

Based on recommendations of the Colman Dock – North Area Sediment Cleanup Study (Hart Crowser 1997), additional sediment sampling was conducted in 1999 to provide information for the proposed capping remedial action. In April 1999, eight surface sediment samples were collected from the North Trestle area and submitted for physical and chemical analyses. All eight samples exceeded SQS chemical criteria for one or more sediment contaminants. Five of these samples also exceeded the MCUL chemical criteria. Chemicals of potential concern identified from this comparison included mercury, silver, LPAHs, HPAHs, dibenzofuran, and 2,4-dimethylphenol. HPAHs were the most prevalent contaminants identified at the site, and were present locally at highest concentrations beneath the Ferry Terminal Building (Herrera 1999).

Three bioassays, including a 10-day amphipod mortality test using *Rhepoxynius abronius*, a 20-day juvenile polychaete growth test using *Neanthes arenaceodentata*, and a 96-hour bivalve larval development test using *Mytilus galloprovincialis*, were conducted to assess

potential sediment toxicity at the site. Three sediment samples from the North Trestle area (CD-005, CD-006, and CD-007) and one reference sediment sample collected from Carr Inlet were submitted for toxicity testing (Herrera 1999).

All three test sediments passed the SQS biological effects criteria for the amphipod and polychaete bioassays; however, when bivalve larvae test sediments were compared with controls, all three samples exceeded MCUL biological effects criteria. The more conservative (control-based) approach typically recommended by Ecology in this situation was used in the evaluation of larval test results because the reference sediment sample did not meet criterion for test acceptability.

Results for this study are discussed in further detail in the *Existing Sediment Data* section of this report.

Recent Colman Dock Project Investigations

Environmental sampling was conducted in 2010 and 2011 to support the WSF-proposed Seattle Terminal Building Replacement and Trestle Preservation project. Detailed surface sediment sampling results are discussed in the *Existing Sediment Data* section below.

In April 2010, sediment samples were collected from two boring locations in the area of the Seattle Ferry Terminal Slip 2 (Landau 2010). Those two borings extended to depths of 11.5 feet and 32.5 feet below the mudline. Sediment samples were collected at 2.5-foot depth intervals from the mudline to the bottom of the borings. The samples were then composited into sediment samples representing 5-foot depth intervals and submitted for PAH, metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), and TOC analyses.

In 2011, sediment sampling was conducted at four locations across the project area (Landau 2011), with one upland soil boring advanced east of the existing sea wall where existing fill is planned for removal. The results indicated sediment containing PAHs and other SVOCs, PCBs, and metals (arsenic, mercury, lead, and silver) at concentrations exceeding SMS criteria present in the project area. The exceedances primarily occurred in the upper 10 feet of sediment; however, PAHs also were present at concentrations exceeding SMS criteria at depths of 30 feet and 40 feet below the mudline. In addition, lead and mercury were detected at concentrations above SMS criteria at (20 to 30 feet below ground surface) in the upland soil boring (following construction activities, soil at this depth may be overlain by marine water and become marine sediments).

Sediment Contamination Sources

The Seattle Ferry Terminal Colman Dock was first developed in 1882, about the time that uplands along the waterfront were converted from residential to commercial/industrial uses. Beginning in the 1880s, Seattle-area wastewater was discharged directly into Elliott Bay through a number of local outfalls. Those discharges persisted until the late 1960s to early 1970s, when the Elliott Bay Interceptor was constructed to convey combined (sanitary and storm) sewer flows to the West Point Treatment Plant. Many of the former sewer outfalls were converted to combined sewer overflows (CSOs) during this period. Several CSOs are still present in the Colman Dock area.

From approximately 1880 through 1930, the historical shoreline received extensive fill deposits associated with waterfront development. Sediment descriptions are available from geotechnical boring logs collected in the vicinity of Colman Dock (e.g., Hong West 1989). Those logs identified fill material of unknown origin located beneath and immediately offshore of the north area of Colman Dock (Pier 52). Fill material was also observed south of Pier 52 below the locations of former Pier 50 and Pier 51.

Based on a review of historical records available for the Seattle Ferry Terminal area (CH2M Hill 1993), supplemented with additional historical research of the area performed by Hart Crowser (1994), chemical contaminants could have been released to the site as a result of the following:

- Recent (ca. 1970 to present) CSO and storm drain discharges to the general area
- Historical wastewater discharges to the general area(via many of the existing CSO outfalls)
- Waste material deposited historically as fill along the waterfront
- Releases of fuel oil and coal from historical pier railway or industrial activities, including coal bunkering

Continuing inputs or redistribution of mercury, PAHs, and 4-methylphenol to the Colman Dock area are suggested by historical sediment trap data (Hart Crowser 1997). Concentrations of settling particulate material in the vicinity of Colman Dock, and at many other locations along the central Seattle Waterfront, exceed SQS and/or MCUL chemical criteria.

Existing point sources of mercury and PAHs that currently discharge near Colman Dock include the City of Seattle Madison Street CSO and storm drain. The intertidal outfalls for these discharges are located at the base of the seawall between Pier 53 and Pier 54 (Figure 2). Beginning in the early 1990s, CSO discharges from this location have been controlled to no more than one overflow event per year, while allowing for regular storm water discharges (EBDRP 1993).

The Elliott Bay/Duwamish Restoration Program (EBDRP) predicted that Madison Street CSO and storm drain discharges appear to have been controlled to a level that, within a mixing zone defined as an area approximately 200 meters (600 feet) offshore, the upper-bound sediment concentration increases of mercury and PAHs are below SQS chemical criteria (Boatman et al. 1995). Also, particulate concentrations of mercury and PAHs within regional CSO and storm drain discharges are generally below existing sediment concentrations along the Seattle Waterfront (see Boatman et al. [1995] for a more detailed discussion of regional CSO and storm drain discharge data).

The EBDRP concluded that existing point sources, including CSOs, storm drains, and Duwamish River discharges, are not the cause of sediment quality problems observed in surface sediments and settling particulate material collected along the central Seattle Waterfront (Boatman et al. 1995). It was postulated that non-point sources, including small spills and sloughing of material from creosoted pilings and bulkheads, particularly those in disrepair,

have the potential to affect PAH concentrations in sediments. To date, the magnitude of these non-point sources has not been well characterized.

Residual (historical) contaminants present in surface sediments along the Seattle Waterfront may resuspend and migrate across the study area. Control of resuspension of these materials was identified by the EBDRP as a primary target of forthcoming sediment cleanup decisions(Boatman et al. 1995).

Sediment sampling of the Pier 53-55 Cap surface performed by King County in 1996 (after two earlier sampling events in 1992 and 1993) revealed a new contaminant of concern, 4-methylphenol (one of many components of creosote), at concentrations exceeding the MCUL (Romberg and Wilson 1997). 4-methylphenol had already been indicated as an accumulating pollutant by earlier EBDRP sediment trap data (Norton and Michelsen 1995). Annual average concentrations of 4-methylphenol detected in those sediment traps near the Pier 53-55 Cap had ranged from two to five times the MCUL. Furthermore, sediment traps located south of Colman Dock near the King Street CSO contained sediment with 4-methylphenol concentrations greater than 100 times the MCUL. Recent observations of decreasing concentrations over time suggests that the primary source of 4-methylphenol to the central Seattle Waterfront area may have resulted from removal of the former wingwall and fender structure on the north end of Pier 52 conducted in 1992 (King County 2010).

EXISTING SURFACE SEDIMENT DATA

This section presents a summary of existing surface or near-surface sediment data collected within each of the following project work areas:

- Northern timber trestle
- Southern timber trestle
- Existing concrete trestle
- New concrete trestle

Data from three studies reported chemistry results for surface or near-surface sediment results for locations located within the listed project areas:

- Colman North Trestle Replacement (Herrera 1999)
- Colman Dock South Sediment Cap (CH2M Hill 2005)
- Recent Colman Dock Replacement Investigations (Landau 2011)

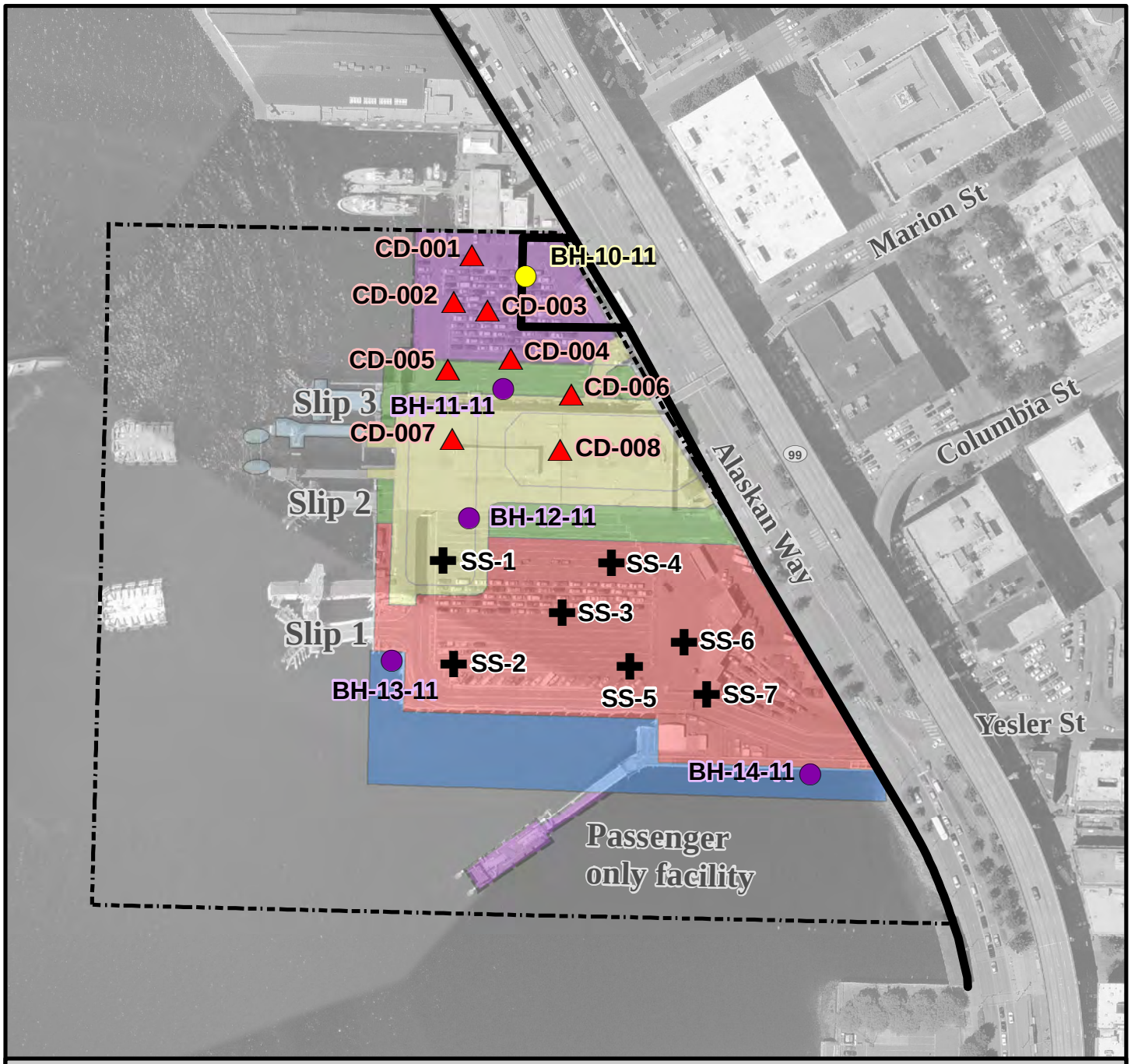
All samples were analyzed for metals, LPAHs, HPAHs, total solids, and TOC. Additionally, samples collected in 1999 (Herrera) were analyzed for SVOCs and samples collected in 2011 (Landau) were analyzed for SVOCs and PCBs. Appendix A presents data for all samples collected within the project area compared to SMS criteria. Figure 3 presents sample locations for the three studies.

In general, contaminants of concern during construction activities across all work areas are metals, LPAHs, and HPAHs (PCBs were only analyzed during the limited 2011 investigation, with sediment samples collected from the southern timber trestle and expanded southern concrete trestle area). PCBs were detected above reporting limits, but less than SMS criteria at all locations, indicating the possible presence of PCBs across the entire project site.

Northern Timber Trestle

In 1999, three surface sediment samples (CD-001, CD-002, and CD-003) were collected within the northern timber trestle area as part of the Colman North Trestle Replacement (Herrera) (Figure 3). Samples were collected from the top 10 centimeters of sediment and submitted for analysis of metals, LPAHs, HPAHs, and SVOCs. Concentrations of metals and LPAHs were below SMS criteria at all three locations. The total HPAH concentration at all three locations (ranging from 1,000 to 1,500 mg/kg OC) exceed the SQS criteria of 960 mg/kg OC (Herrera 1999).

In 2011, a soil boring was completed within the fill area behind the existing seawall at location BH-10-11 (Figure 3). A sample was collected by compositing soil from 0 to 10 feet



Legend

Colman Dock

- Existing Structures Removed
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Terminal Structures
- New Slip 2 and 3 Structures
- Property boundary
- Approximate Sea Wall

- 1999 Herrera surface sediment sample location (0-0.3' bgs)
- 2005 CH2M Hill Sediment Cap Monitoring Location
- 2011 Landau Associates Surface Sample Location (0-0.3' bgs)
- 2011 Landau Associates near-surface fill material sample location (0-10' bgs)

Figure 3.
Historical Sediment Sampling Locations within the Colman Dock project site.

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0 100 200 400 Feet

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Aerial: King County 2007

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below ground surface. The only exceedance of SMS criteria in the near-surface fill material was for dibenzofuran (19 mg/kg OC), compared to the SQS criterion of 15 mg/kg OC (Landau 2011). Some fill in this area may remain after planned removal is completed.

Southern Timber Trestle

In 1999, five surface sediment samples (CD-004 through CD-008) were collected within the southern timber trestle area as part of the Colman North Trestle Replacement (Herrera 1999). Samples were collected from the top 10 centimeters of sediment and submitted for analysis of metals, LPAHs, HPAHs, and SVOCs. Exceedance of SMS criteria occurred at all five locations for LPAHs and HPAHs, at four locations for hexachlorobutadiene, at one location (CD-005) for 2,4-dimethylphenol, and at one location (CD-006) for mercury and zinc (Herrera 1999). Bioassay testing conducted at three selected sample locations (CD-005, CD-006, and CD-007) were found to exceed CSL criteria for biological effects criteria.

As part of the 2011 Colman Dock Replacement study (Landau), two surface sediment samples (BH-11-11 and BH-12-11) were collected from the southern timber trestle area (Figure 3). Samples were collected from the top 10 centimeters and analyzed for metals, LPAHs, HPAHs, SVOCs, and PCBs. Metals, LPAHs, HPAHs, phenols, phthalates, and PCBs were found in the two samples. Sample BH-11-11, collected to the north of the existing terminal building contained mercury (0.71 mg/kg) and 2,4-dimethylphenol (54 micrograms per kilogram [µg/kg]), exceeding CSL criteria (0.59 mg/kg and 54 µg/kg, respectively), and HPAHs (2,100 mg/kg OC), exceeding the SQS criterion (960 mg/kg OC). Sample BH-12-11, collected east of Slip 2, contained HPAHs (990 mg/kg OC), exceeding the SQS criterion (960 mg/kg OC) (Landau 2011).

Existing Concrete Trestle

As described in the "Historical Sediment Studies" section above, a sediment cap was placed under the existing concrete trestle area in 1989. In 2004, a study of the cap was conducted (CH2M Hill 2005) and seven cap material samples were collected (Figure 3). Sediment samples were not collected from the surface, but samples were collected from the original cap material (i.e., beneath recently accumulated sediment). The study concluded that the cap was intact and deposition of new sediment (between 11 to 21 centimeters) had occurred over the 25-year period since cap placement. Samples analyzed for metals, LPAHs, and HPAHs indicated that at six of seven locations, the chemical quality of the cap met SMS criteria. At one location in the eastern portion of the cap, lead (850 mg/kg), mercury (11.5 mg/kg), silver (11.9 mg/kg), and zinc (555 mg/kg) exceeded SMS criteria (the cap was reported as thin in this area and the sample may have included contaminated material from below the cap). The 2005 report also reported the presence of marine organisms across the cap surface.

New Concrete Trestle

As part of the 2011 Colman Dock Replacement study (Landau), two surface sediment samples (BH-13-11 and BH-14-11) were collected from the new concrete trestle area (Figure 3). Samples were collected from the top 10 centimeters and analyzed for metals, LPAHs, HPAHs, SVOCs, and PCBs. Metals, LPAHs, HPAHs, phenols, phthalates, and PCBs were found in the two samples. Sample BH-13-11, collected near Slip 1, contained mercury (0.45 mg/kg) and

phenol (440 µg/kg), exceeding SQS criteria (0.41 mg/kg and 420 µg/kg, respectively). Sample BH-14-11, collected near the shoreline, contained mercury (1.10 mg/kg) and 2,4-dimethylphenol (35 µg/kg), exceeding CSL criteria (0.59 mg/kg and 29 µg/kg, respectively).

Proposed Sediment Cleanup

Historical sampling in the vicinity of the Colman Dock site indicates that contaminated surface sediments are likely to be encountered across all areas during project construction activities. Several studies have concluded that capping is the proposed method for contaminated sediment management.

Capping is a common technique used for sediment cleanup projects in Puget Sound and has been the primary remediation method used in other projects along the central Seattle Waterfront. Two previous reports have evaluated sediment capping in the northern and southern timber trestle areas of Colman Dock:

- Sediment Cleanup Study for the Seattle Ferry Terminal, Colman Dock – North Area (Hart Crowser 1997)
- Colman North Trestle Replacement Study (CH2M Hill et al. 1999)

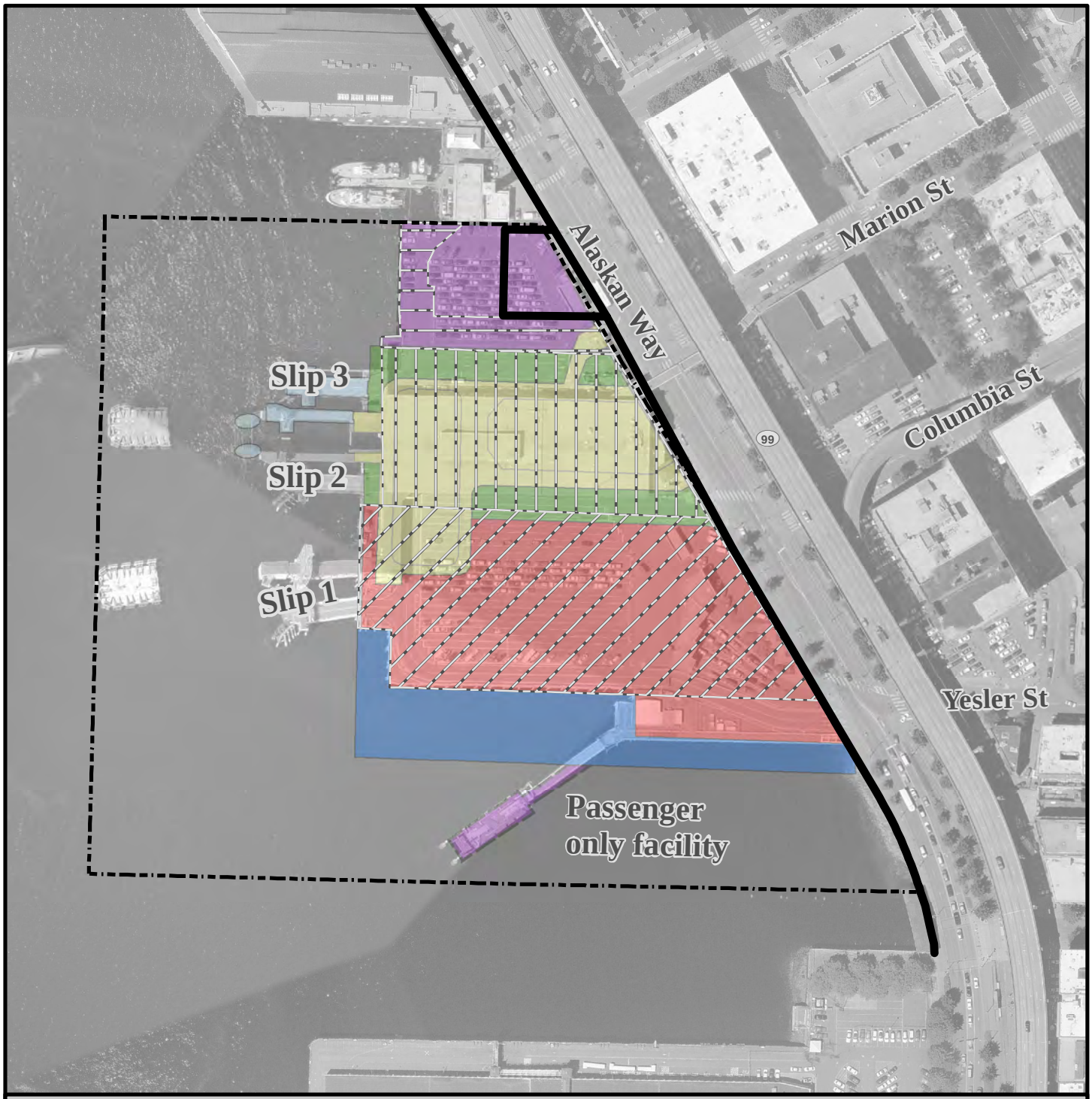
Sediment capping in these areas would consist of covering contaminated sediments with a clean sediment layer to prevent long-term contact of the sediments by benthic infauna. The caps would also further minimize resuspension of underlying sediments into the water column. Because the existing northern timber trestle would be removed, an open-water cap is recommended in this portion of the project area. An under-pier sediment cap is recommended for the existing southern timber trestle area. Proposed sediment cap areas are shown on Figure 4 and discussed below for each type of sediment cap.

Northern Timber Trestle Area Sediment Cap

The 1997 Cleanup Study (Hart Crowser) evaluated four types of remedial options as potentially appropriate for addressing contaminated sediments at the Colman Dock - North Area:

- Natural recovery
- Capping
- Limited sediment removal with capping (to maintain existing water depths)
- Total sediment removal and disposal

A feasibility study considering overall protection of human health and the environment, compliance with cleanup standards, short-term effectiveness, long-term effectiveness, implementability, and cost was performed. Based on a detailed analysis of the options, sediment capping in a portion of the current project area was recommended (see Figure 4). The open water cap would be similar to that developed by the US Army Corps of Engineers and already used successfully between Piers 53 and 55. Dredged sands from the Duwamish or another source would be transported to the site and placed as described in the Cleanup Study report. The northern trestle area and the new concrete trestle area to the south have been



Legend

Colman Dock

- Existing Structures Removed
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Terminal Structures
- New Slip 2 and 3 Structures
- Property boundary
- Existing south cap
- Proposed trestle cap
- Proposed open-water cap
- Approximate Sea Wall

Figure 4.
Proposed Sediment Cap at Colman Dock.

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0 100 200 400 Feet

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Aerial: King County 2007

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excluded based on historical sampling results that indicate no contamination above SMS criteria (additional samples would be proposed to address these areas).

In the 1997 report, an additional open-water cap was recommended for areas west of the current project boundary. For the purposes for this report, recommended sediment management applies only to the project boundary; however, capping outside of the project boundary may be considered, or required, as part of negotiated area-wide plans for Elliott Bay.

Southern Timber Trestle Area Sediment Cap

Capping was recommended beneath the existing southern timber trestle area, using 12 to 18 inches of sand and gravel (Patmont and Verduin 1999). Design for the cap would be based on results of sediment sampling and engineering analysis performed in 1999 (CH2M Hill et al. 1999).

Based on analysis of ferry-induced scour within the North Trestle area, a coarse-grained cap would be required to resist propeller wash. The cap should be constructed to have a grain size sufficient to resist propeller wash-induced scour.

Sequencing the cap placement with other construction activities would be critical to avoid recontamination of the cap surface or impacts to the new structure. For instance, pile removal or cutting, new pile driving, or deck construction could resuspend contaminated sediments into the water column and onto an adjacent newly placed cap. In addition, cap placement around piles would also likely induce downdrag onto the piles. The capping construction sequence would be controlled to a large degree by trestle replacement construction.

Long-Term Monitoring

Following the placement of sediment caps, bathymetric surveys of the capped areas should be performed following completion of the remedial actions. Changes in bathymetry should be used to verify that sediment cap materials are not eroded by vessel operations and to identify areas of potentially significant erosion or deposition over time. Additional chemical and/or biological testing also may be performed as part of the long-term monitoring program. The need for corrective actions should take into consideration the results of sediment cap chemical and/or confirmatory biological tests (if performed) to determine if surface sediments exceed SMS criteria.

PILE INSTALLATION

Of the estimated 983 piles to be installed for trestle replacement, 570 30-inch diameter steel/concrete piles would be installed to a depth of 30 feet and various shafts would be installed to a depth of 25 feet. Installation of these particular piles and shafts would require removal of approximately 3,480 cubic yards of sediment and approximately 950,000 gallons of potentially contaminated marine water. Sediment would be removed by suction or air lift from the casings as they are driven, discharged to a flat scow barge, and allowed to dewater before transport for disposal. The current construction schedule assumes the pile-related work would be completed in four phases over 4-1/2 years, with amounts of sediment and water generated shown in Table 1. No attempt would be made to segregate sediment based on chemical characteristics within each phase, so all sediment would be mixed on each barge load.

Table 1. Sediment and Water Waste Generation Schedule.

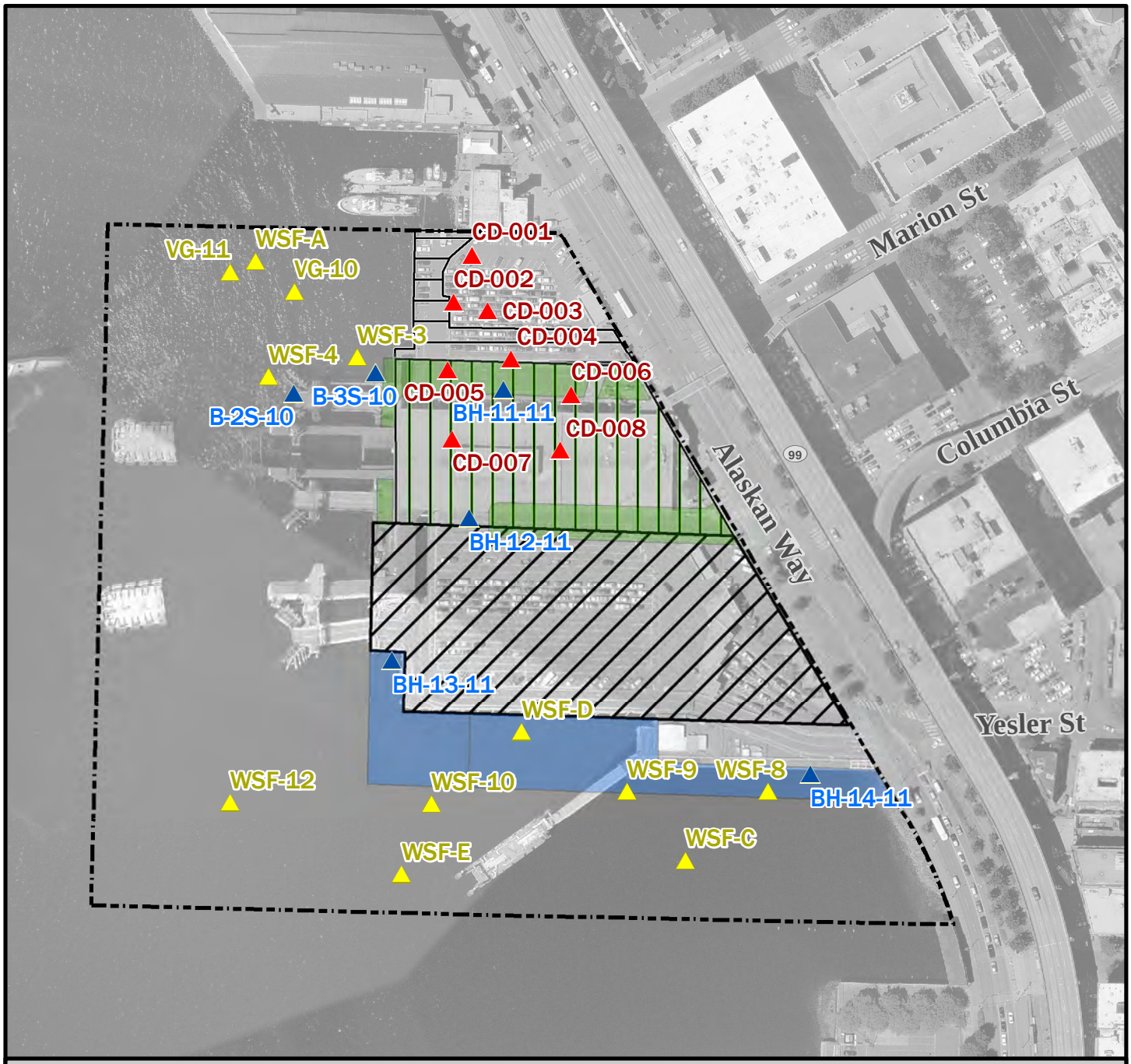
Construction Phase	Sediment Generated (cubic yards)	Water Generated (gallons)
1	320	87,300
2	380	104,000
3	1,480	404,000
4	1,300	355,000

The 1997 Sediment Cleanup Study for the Colman Dock – North Area completed by Hart Crowser considered dredged sediment onsite disposal options as inappropriate, due to site restrictions, permitting requirements, and cost considerations. Regional offshore disposal facilities were considered as a possibility that would require significant coordination with other projects. Upland disposal was considered as the most likely option; open water disposal through the DMMP was not considered. Both open water disposal and upland disposal options are considered below.

All disposal options are predicated on whether the sediment in question is suitable for open water disposal. If suitable for open water disposal, the sediment is not considered a solid waste and can either be disposed of at a designated open water location or at an upland location with a grading permit or reclamation permit. If not suitable for open water disposal, it would be considered a solid waste and require disposal at a regulated site.

To evaluate disposal options for sediment removed during pile installation, historical sediment data from within 200 feet of the project footprint extending from the surface to 30 feet deep were considered representative of site conditions. Data from studies conducted by WSF and Metro between 1993 and 2011 included 57 samples collected from 15 locations within the project footprint and 12 locations surrounding the dock facility (Figure 5).

Samples were initially evaluated based on various depth intervals to determine contaminant distribution patterns, as follows:



Legend

- Property boundary
- Existing south cap
- Proposed open-water cap
- Proposed trestle cap
- New Concrete Trestle Replacing Timber Trestle
- New Concrete Trestle
- B/BH 2010/2011 Sample (Landau)
- CD 1994 Sample (Herrera)
- WSF/VG 1994 Sample (Hart Crowser)

Note: 2005 sediment cap sampling locations are not included.

Figure 5.
Historical Sediment Sampling Locations Within 200 Feet of Colman Dock.

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Aerial: King County 2007

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- Almost 3/4 of the 38 samples collected in the top 10 feet identified lead at concentrations greater than 100 parts per million, indicating a potential to be classified a hazardous waste; no samples collected deeper than 10 feet indicated this potential.
- Over 90 percent of the 27 samples collected in the top 5 feet identified one or more PAH compounds greater than DMMP criteria.
- Thirty percent of the 20 samples collected deeper than 5 feet below the mudline identified one or more PAH compounds greater than DMMP criteria.

Open Water Disposal

Open water disposal sites were established by the DMMP agencies for dredged material disposal, and are managed by DNR. There are two types of open water disposal sites: dispersive and nondispersive. Dispersive sites are located in areas with strong tidal currents, where dredged material placed at these sites disperses quickly. Dredged material placed at nondispersive sites remains onsite and is subject to long-term monitoring by DNR.

Nondispersive sites are managed to allow minor adverse effects, such as sub-lethal effects to some species after long-term exposure. No adverse effects are allowed at dispersive sites, so dredged material must meet more stringent evaluation guidelines to be eligible for disposal at these sites.

There are eight dredged material disposal sites around Puget Sound (three dispersive and five nondispersive) and two dispersive estuarine sites each in Grays Harbor and Willipa Bay. Additionally, Grays Harbor has one 3.9-mile long Ocean disposal site.

Prior to disposal of dredged material in any Puget Sound, Grays Harbor, or Willipa Bay disposal site, a disposal site use authorization (SUA) must be obtained from DNR. SUA applications will not be processed until all required permits have been issued. Anticipated permits and compliances required for the project are shown in Table 2. Once the SUA application form and all required permits have been received, it takes approximately 2 to 3 weeks to process the application and produce an unsigned SUA. The applicant must then sign and notarize the SUA, and return it to DNR's DMMP office for final signatures.

There are four tiers of evaluation to determine if dredged materials are suitable for disposal in open water (Figure 6):

- **Tier 1** – Site Evaluation and History
- **Tier 2** – Chemical Testing
- **Tier 3** – Biological Testing (bioassay and/or bioaccumulation testing)
- **Tier 4** – Special Studies

Tier 1 evaluation is a review of historical and ongoing sources of contamination, land use, and any previously collected data. Once the Tier 1 evaluation is completed, sampling and analysis requirements are determined, following the *Dredged Material Evaluation and*

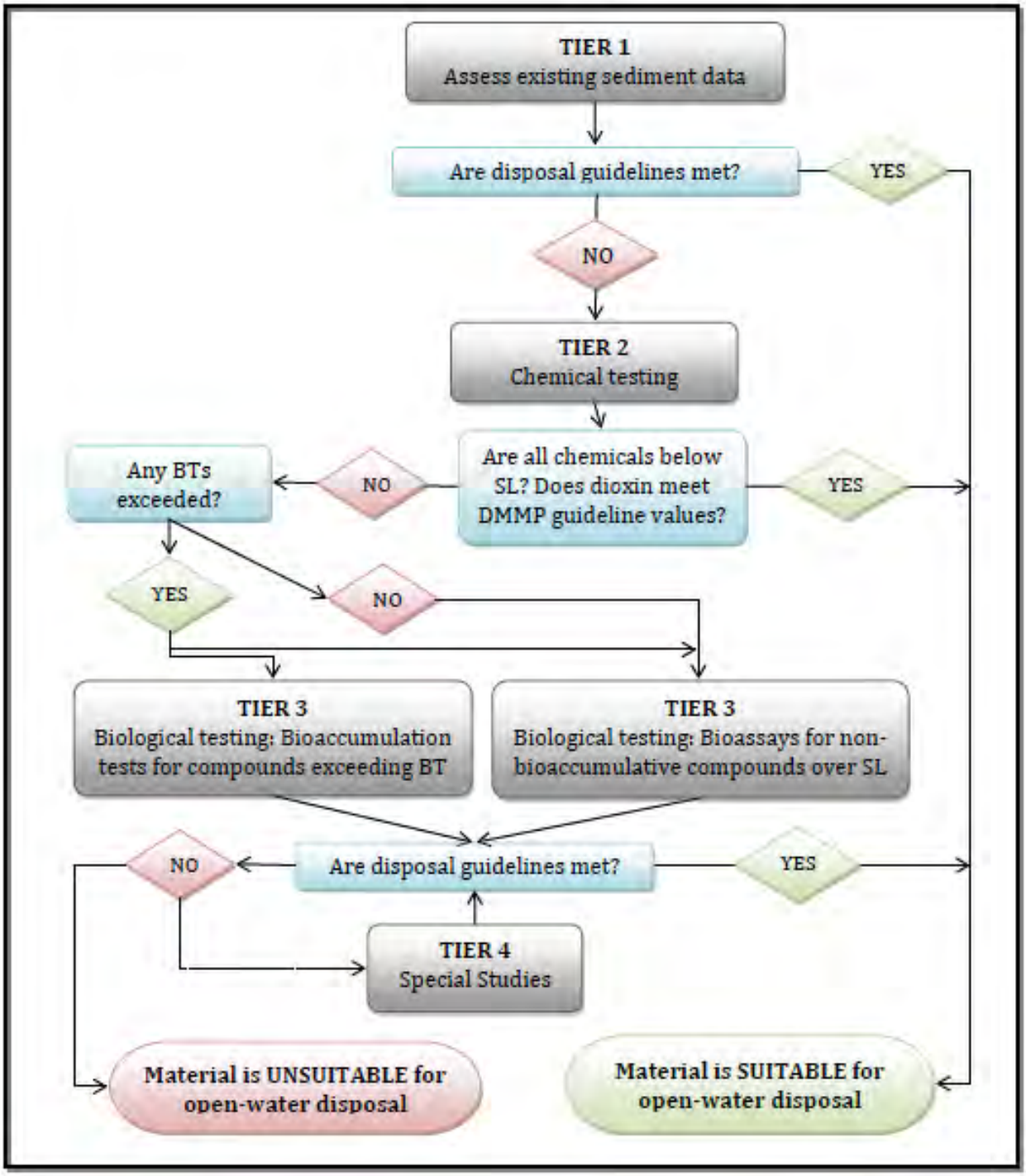

Figure 6. Open Water Disposal Suitability Analysis Decision Process.

Disposal Procedures User Manual (User Manual) (USACE 2013). This includes determining project rank, number of samples required based on dredging volumes, and preparing a project sampling and analysis plan.

Table 2. Anticipated Permits and Compliances Required for the Project.

Government Level	Issuing Body	Permit or Compliance
Federal	US Army Corps of Engineers	Rivers and Harbor Act, Section 10 Permit
		Clean Water Act, Individual Section 404 Permit
	US Fish and Wildlife Service	Endangered Species Act (ESA)
		Marine Mammal Protection Act (MMPA) Authorization
		Magnuson-Stevens Act, Essential Fish Habitat Determination
State	Department of Archaeology and Historic Preservation	Section 106 of the NHP Consultation
	Department of Ecology	Section 401 Water Quality Certification
		CZM, Consistency Determination
		NPDES Stormwater General Construction Permit (CWA)
		NPDES Municipal Permit
	Department of Fish and Wildlife	Washington Hydraulic Code, Hydraulic Project Approval (HPA)
	Department of Natural Resources	Aquatic Lands Act, Aquatic Land Use Authorization
Municipal	City of Seattle	SMA, Master Use Permit for Shoreline Substantial Development Permit (SSDP)
		Noise Variance

CZM Coastal Zone Management Act
NHPA National Historic Preservation Act
NPDES National Pollution Discharge Elimination System
SMA Shoreline Management Act

The project site is in a "high" ranking location, based on the User's Manual, requiring a Tier 2 evaluation. This evaluation includes chemical analysis of parameters identified by DMMP as chemicals of concern (COCs) in Table 8-2 of the Users Manual.

Similar to SMS, DMMP also contains two levels of chemical numeric criteria for sediment:

- **Screening Level** (SL) is defined as the chemical concentration at or below which there is no reason to believe that dredged material disposal would result in unacceptable adverse effects. For most COCs, the SL is set equal to the LAET. Sediment with chemical concentrations present at levels above the SL require biological testing (Tier 3) before a decision can be made on suitability for open water disposal.

- **Maximum Level** (ML) is equal to the highest Apparent Effects Threshold (HAET). The HAET is a chemical concentration at which all biological indicators with AETs show significant effects. The ML values are no longer used by the DMMP agencies as pass/fail

indicators, but rather serve to provide information to project proponents. While sediment with ML exceedances has passed biological testing, the majority have failed. By comparing sediment chemical data to the MLs, a dredging proponent can better judge how to proceed with a project, i.e., whether to invest more time and money into further testing for open water disposal, or rechanneling that effort into other disposal options and testing for those options (e.g., leachate tests for upland disposal).

For Tier 2 evaluations, the following scenarios are possible:

1. All chemicals are at or below SLs; no biological testing is needed and the material is considered suitable for open water disposal at any DMMP site.
2. One or more chemicals are present at levels between SL and ML; standard biological testing is needed (Tier 3).
3. One or more chemicals are present at levels above the ML. Standard biological testing (Tier 3) may still be pursued, but there is a high probability that the dredged material will fail Tier 3 testing.

DMMP has also established bioaccumulation trigger (BT) values, which are used as guidelines to determine when bioaccumulation testing is required (Tier 3). If any COC exceeds the BT guideline value, additional information gained via bioaccumulation testing would be required in order to determine whether dredged material is suitable for open water disposal.

A Tier 4 assessment may be required if the standard chemical and biological evaluations (Tiers 2 and 3) are unable to determine suitability of dredged material. A Tier 4 assessment is considered a special, non-routine evaluation and would require discussions among the agencies and project proponent to determine specific testing or assessment requirements. If two or more COCs exceed the ML guidelines (Tier 2), or if any one chemical exceeds the ML by more than 100 percent, the material is considered unsuitable for open water disposal unless a Tier 4 assessment is conducted.

Based on a review of historical data within the top 5 feet of sediment, several metals, PAHs, other SVOCs, and PCBs exceed SL and ML values (see Appendix B). Samples collected from 5 to 30 feet below the sediment surface exceeded SL and ML values for metals (cadmium, silver, and zinc), PAHs, and 2,4-dimethylphenol. Based on existing data, further consideration for open water disposal would require additional chemistry and bioassay sampling and analysis, as well as bioaccumulation testing. The historical relationship between ML exceedances and bioassay failure indicates that open water disposal is not a viable option for Colman Dock sediments and, as such, defines the sediment as a solid waste that qualifies for upland disposal at a regulated facility.

Upland Disposal

Sediment Management

Upland disposal facilities are permitted by Federal and State agencies and County Health Departments, which regulate waste acceptance criteria. Federal permits are issued by the

US Environmental Protection Agency through the Resource Conservation Recovery Act (RCRA) to manage hazardous waste (Subtitle C) and the Toxics Substance Control Act (TSCA) to manage PCB waste. Some Colman Dock sediments have a potential to be categorized as hazardous waste based on lead content; PCBs have not been detected at high enough concentrations to trigger TSCA requirements.

Within the State of Washington, the Department of Ecology, per RCW 70.95.060, is directed to write minimum standards for solid waste handling. Jurisdictional health departments have primary oversight of solid waste facilities and issue permits and enforce the standards. Solid waste facilities include municipal solid waste (MSW) landfills, limited purpose landfills, and inert waste landfills, among others. Contaminated dredged material that qualifies as solid waste contains contaminants at concentrations not suitable for open water disposal, is not dangerous waste, and is not regulated by Section 404 of the Federal Clean Water Act (P.L. 95-217).

MSW landfills primarily accept household waste, but also may receive other types of RCRA subtitle D wastes, such as commercial solid waste, nonhazardous sludge, conditionally-exempt small quantity generator waste, and industrial solid waste.

Limited purpose landfills receive segregated industrial solid waste, construction, demolition and land-clearing debris, wood waste, ash (other than special incinerator ash), and dredged material.

Inert waste landfills accept solid wastes that do not contain chemical, physical, biological, or radiological substances at concentrations that:

- Produce leachate or emissions that have the potential to negatively impact soil, groundwater, surface water, or air quality
- Pose a health threat to humans or other living organisms through direct or indirect exposure
- Result in applicable air quality standards to be exceeded, or pose a threat to human health or the environment under potential conditions during handling, storage, or disposal

Each of these landfill types operates under different waste acceptance criteria, determined by the diminishing levels of environmental protection offered through design and operation protection, respectively. MSW and limited purpose landfills require liners and environmental monitoring to different degrees; inert waste landfills do not.

Data from the 27 locations in and around the Colman Dock facility were evaluated to determine upland disposal facility acceptance options. The first step required a determination as to whether the sediment can be considered a solid waste based on whether it qualifies for open water disposal. Since the sediment does not qualify for open water disposal, it is considered a solid waste, which must be managed at a permitted facility.

Twenty-five of 38 samples collected from the top 10 feet indicated lead concentrations with the potential to exhibit a hazardous waste characteristic ranging from 110 to 750 mg/kg (parts per million). Three of those samples, collected onsite in 2011 with total lead concentrations of

182, 570, and 672 mg/kg, were tested using the Toxicity Characteristic Leachate Procedure (TCLP). No lead was detected in leachate from any of the samples, indicating no hazardous waste designation is required.

Analytical results from samples collected in and adjacent to the new and replacement trestle installation areas were summarized (i.e., volume-weighted) and offered to representatives of MSW, limited purpose, and inert waste landfill facilities to determine suitability based on their acceptance criteria.

The average concentration of carcinogenic polycyclic aromatic hydrocarbons (cPAHs) of 3.5 mg/kg exceeds the MTCA method A cleanup level of 0.1 mg/kg, so the sediment cannot be considered for disposal at inert waste landfills.

No limited purpose landfills permitted to accept Colman Dock sediment were found in King, Snohomish, or Pierce counties. Both the Caton Landfill and the Anderson Rock and Demolition Pits limited purpose landfills are located in Yakima County; however, neither have liners. Yakima Public Health and Ecology will not allow disposal of waste that exceeds MTCA method A cleanup criteria for unrestricted land use. Based on the lack of reasonably close limited purpose landfills that can accept the sediment, only MSW landfills were further considered.

Roosevelt landfill in Kittitas County, managed by Republic Services, routinely accepts contaminated sediment for disposal. The typical approach involves placement in water-tight containers on barges at the site, shuttling the barges to the contractor waterfront facility, transferring the containers to the Republic transfer station at 3rd and Lander, and shipping by rail to the landfill (transportation from the contractor's facility is provided by Republic Services). The sediment may be wet (i.e., does not need to meet the paint filter test); however, it is best to dewater to a point that balances the $50 per ton disposal cost.

Greater Wenatchee Landfill and Columbia Ridge Landfill are managed by Waste Management that routinely accepts contaminated sediment for disposal. Transport to either landfill would follow the same process as outlined for Roosevelt landfill above, using a south Seattle Waste Management transfer station facility.

Cedar Hills Regional Landfill (CHRLF), managed by King County, can accept contaminated sediment at the volumes projected over the 4-year construction period. Seattle-King County Public Health evaluates characterization data against Dangerous Waste chemical criteria to determine the need for fish bioassay testing. For Colman Dock sediment, "special waste" designation may apply to toxic waste (Category D toxicity - WAC 173-303-100(5)) or persistent waste that is not Extremely Hazardous Waste (WAC 173-303-100(6)). Special wastes pose a relatively low hazard to human health and the environment and can be safely managed with a level of protection that is intermediate between dangerous and nondangerous solid wastes. Existing data do not indicate that Colman Dock sediment can likely be disposed of at CHRLF without a need for bioassay testing (final determination is made with formal application). Sediment needs to be dewatered prior to disposal, but does not need to pass the paint filter test. Transport to the landfill must be provided by a private entity.

Disposal cost information for facilities with waste acceptance criteria that allow for Colman Dock sediment is provided in Table 3. Sediment would be transferred to the contractor staging

area and removed by the waste disposal company service either for direct load or accumulation at their transfer facility; delivery to the MSW landfill would be managed based on capacity conditions at the time.

Table 3. Colman Dock Sediment Disposal Cost Information.

Facility	Location	Volume (cubic yard)	Weight (ton)	Disposal Cost per Ton	Total Cost
Roosevelt	Kittitas County	3,480	5,220	$50[a]	$261,000
Greater Wenatchee	Chelan County	3,480	5,220	$60-$65[a]	$313,200 - $339,300
Columbia Ridge	Oregon	3,480	5,220	$50-$55[a]	$261,000 - $287,100
Cedar Hills	King County	3,480	5,220	$130[b]	$678,600

[a] Includes both transportation and disposal, provided by the facility

[b] Includes disposal only (transportation costs were not developed, based on the high disposal cost)

Water Management

Management of sediment removed from the casings would require some dewatering prior to transport to an upland facility. Water removed from the sediment by gravity drainage would entrain contaminants. Some treatment would be required prior to discharge to Elliott Bay (e.g., filtration, adsorption) or the sewer system (e.g., settling). Water discharged to Elliott Bay must meet Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC) plus other criteria for pollutants of concern determined by Ecology; water discharged to the sanitary sewer must meet King County Industrial Wastewater acceptance criteria, determined on a case-by-case basis. An estimated total of 950,000 gallons of water would be generated over the four construction seasons.

A Section 401 Water Quality Certification would be obtained from Ecology requiring compliance with state water quality standards and other requirements of state law. Application for the certification would require a Water Quality Monitoring Plan. Monitoring would be required for pollutants of concern identified at the site, based on sediment sample analysis results. Water quality standards include a variety of metals, cyanide, pesticides, ammonia, pentachlorophenol, and PCBs. Sediment sampling has identified metals and PCBs present in sediment at or near Colman Dock. Other organic compounds likely would be determined as pollutants of concern by Ecology (e.g., PAHs) that would be assigned discharge limits. Based on recently obtained Elliott Bay Seawall project information, it is likely that Ecology would not allow discharge of water with detectable concentrations of any PAHs and other organic compounds not included in the water quality standards. Treatment required to meet these criteria may involve settling, filtration, and/or adsorption.

Settling may be accomplished using a weir tank positioned adjacent to the sediment stockpile, likely on a barge. Water draining from the stockpile would be pumped into the tank, which would be discharged on a batch basis following tests indicating discharge criteria were met. Assuming a 20,000-gallon tank, this would result in discharges once every 1 to 3 weeks. The tank would be delivered to the site at the beginning of the construction period and removed at the end of each year. Approximate monthly cost for this system would be $1,300, for a total project cost of $22,180.

A sand filter system would require installation of two tanks, piping, pump, filter, and control components. Treatment and discharge would be conducted on a batch basis, as described above. The treatment system would be delivered to the site at the beginning of the construction period and removed at the end of each year. Approximate monthly costs are estimated at $20,000, for a total project cost of $340,000.

Additional treatment using an adsorption medium (e.g., activated carbon) may be plumbed into a sand filtration system. The use of carbon would add product, equipment, and operational costs. Approximate monthly costs are estimated at $26,150, for a total project cost of $444,600.

Discharge to King County Sewer

Water drained from sediments may be discharged to the sanitary sewer, first through a side sewer lateral managed by SPU that is connected to the Elliott trunk managed by King County. King County requires a permit and charges by the volume discharged; SPU coordination occurs through the King County permitting process.

King County would issue either a Major Discharge Authorization or Discharge Permit (depending on discharge volume, waste characteristics, level of oversight required, and duration of project). A Discharge Permit is normally required if a facility discharges more than 25,000 gallons per day or is a federally regulated industry. Discharge greater than 25,000 gallons per day is not permitted during November through April unless discharge to surface water is not feasible.

A Major Discharge Authorization would cost $1,900 and a Discharge Permit would cost $3,755, based on current rates. In addition, sewer fees would be 0.71 cents per gallon, costing an estimated $6,737 for 950,000 gallons over the 4-year period. It is assumed that gravity settling would be required prior to discharge, with equipment costs as described above. Daily average and maximum water quality screening requirements are established for metals and PCBs (neither of which should be of concern based on historical data); screening levels for PAHs and SVOCs would be developed at the time of permit issuance.

SEDIMENT CHARACTERIZATION RECOMMENDATIONS

Based on previous sampling results and planned project activities, it is recommended that additional surface sediment samples be collected to meet anticipated permit requirements (e.g., hydraulic project approval, Section 401, Section 404), for refinement of cap design, and to serve as baseline pre-cap conditions for evaluating cap effectiveness in the future. The following study recommendations are preliminary and may change based on input from regulatory agencies as the project develops.

Surface (10 centimeter depth) sediment samples should be collected from two locations within three project areas (total of six samples) (Figure 7):

- Northern timber trestle – inshore (near the existing seawall) and offshore sample locations to better determine extent of contamination to the north to support cap placement decision making.
- Existing concrete trestle – samples located in areas of maximum (northeast corner) and minimum (southwest corner) sediment accumulation to determine extent of recontamination that has occurred on the existing cap surface.
- New concrete trestle –inshore and offshore locations south of the existing cap.

The following SMS contaminants of concern and conventional chemistry analyses should be conducted on all samples:

- SMS Metals
- LPAHs
- HPAHs
- SVOCs
- PCBs
- Grain size
- TOC
- Total solids

It is also recommended that additional sample volume be collected and stored for bioassay analysis, in the event that sediment chemistry results exceed SMS chemical criteria.

Legend

Colman Dock

- Existing Structures Removed
- New Concrete Trestle/ Replacing Timber Trestle
- Existing Concrete Trestle
- New Concrete Trestle
- Terminal Structures
- New Slip 2 and 3 Structures
- Property boundary
- Proposed surface sediment sample
- Approximate Sea Wall

Figure 7.
Proposed Surface Sediment Sample Locations at Colman Dock.

N

0 100 200 400 Feet

HERRERA

Aerial: King County 2007

K:\Projects\Y2009\09-04410-004\Project\Sediment_Technical_Analysis\ProposedSurfaceSedimentSampleLocations.mxd (2/19/2014)

CONSTRUCTION BEST MANAGEMENT PRACTICES

A review of BMPs related to sediment management was conducted for protection of water quality, sediment quality, sensitive species, and habitat during in-water construction. BMPs are intended to prevent and minimize adverse effects of construction caused by sediment suspension, release of contaminated sediment, deposition of sediments, and noise. BMPs are also used to satisfy state water quality standards and to comply with the Endangered Species Act (ESA).

During the ESA process, it is the responsibility of the project engineer and ecologist/biologist to identify BMPs and conservation measures (e.g., procedural timing restrictions) that avoid and minimize effects on listed threatened and endangered species and critical habitat that occur in the project area. Contractors are required to implement those BMPs identified during the ESA process before construction.

BMPs target reduction and containment of sediment suspension and subsequent turbidity, which can be the primary concern during in-water work. If sediments are contaminated, however, fish exposure caused by suspending sediments may be the primary concern during in-water work. Turbidity is a measure of water clarity and is associated with suspended particles and reduced visibility. Suspension of sediment in the water column can adversely affect the physiology and behavior of fish and can interfere with light penetration to vegetation (e.g., macroalgae). Suspension of contaminated sediment can be toxic to fish and other aquatic organisms. At low concentrations, metals such as copper and zinc are toxic to fish. Long-term bioaccumulation impacts can also occur. Deposition of suspended sediment also can have adverse effects on sensitive habitats.

Through a review of available literature and information, standard BMPs implemented by contractors were identified relating to typical work involving sediment disturbance, including pile driving and pile removal (Herrera 2010). A range of BMP categories were identified, including those implemented during the planning and design phase (e.g., equipment selection) and construction phase associated with procedures (e.g., timing restrictions), operations (e.g., equipment use), methods (e.g., disposal), and physical controls (e.g., silt curtains). BMPs relevant to the Colman Dock Project are presented in Table 4.

Each BMP category is described and characterized in terms of ease of implementation (low, moderate, or high – high being the easiest), effectiveness (low, moderate, or high), and cost. This characterization is based on professional judgment and may vary widely among projects. In general, most BMPs are considered to be highly practical because they have been used by many contractors for a long time and are effective when used properly.

Table 4. Summary of BMPs for Sediment Management at the Colman Dock Site.			
BMP	**Ease of Implementation**	**Effectiveness and Limitations**	**Cost**
Planning and Design			
BMP and equipment selection [b]	**High.** Selecting the appropriate BMPs including type of capping equipment is project specific and should be chosen based on site characteristics (e.g., size, sediment type, depth). Typically, the contractor is responsible for determining equipment and methods; however, specific BMPs may be identified during planning and design phase as part of the ESA compliance process. During this process, the project engineer and project ecologist/biologist should discuss specific BMPs that avoid and minimize impacts to listed threatened and endangered species and critical habitat in the project area.	**High.** Selecting the appropriate BMPs and equipment allows for effective compliance with permit conditions and water quality standards. Selecting the appropriate BMPs and equipment for the size of the project can reduce the cost of construction.	**Low to High.**
Procedural			
Construction work windows [c]	**Moderate**. Construction work windows are a management tool to map out the times of year during which in-water construction may be limited due to the presence of threatened or endangered species or other sensitive marine or freshwater life. The US Fish and Wildlife Service, National Marine Fisheries Service, and Washington Department of Fish and Wildlife are the agencies that designate work windows. Work proposed for times outside these windows requires consultation with these resource agencies.	**High**. Depending on the size of the project, working within designated work windows may require work to be completed over the course of several years unless work windows can be extended or impacts can be avoided to sensitive species.	**Low to High.**
Adjustments during construction	**High**. The contractor shall make adjustments to BMPs during construction based on the performance of BMPs. Monitoring shall occur during construction and, as necessary, after construction (see below).	**High**. Through environmental monitoring, the contractor or project proponent shall evaluate how effective BMPs are at complying with permit conditions and water quality standards.	**Low to High.**
Water quality monitoring [a]	**High**. Turbidity and additional parameters may be applicable for testing depending on the nature of the project and the potential for introduction of contaminants to the surrounding waters. Water quality monitoring may be required to comply with permit conditions and water quality standards.	**High**. To be effective, water quality monitoring plans should present a scientifically valid and defensible method for monitoring. A water quality monitoring plan should detail how to properly conduct water quality monitoring appropriate for the particular project in accordance with permit requirements.	**Moderate to High.**

Table 4 (continued). Summary of BMPs for Sediment Management at the Colman Dock Site.			
BMP	**Ease of Implementation**	**Effectiveness and Limitations**	**Cost**
Procedural (continued)			
Biological monitoring [a]	**High**. Biological monitoring is necessary to determine any direct or indirect biological impacts to the ecosystem caused by physical or chemical changes to the environment resulting from the project. Biological monitoring may be required to comply with permit conditions.	**High**. Biological monitoring should be conducted using the scientific method. Specifically, the biological monitoring should: (1) identify the purpose/potential threats/areas of concern, (2) document the environmental background conditions, (3) provide detailed, scientifically valid methods for data collection and analysis, (4) state anticipated outcomes with "success/acceptance" criteria, (5) include a peer/independent review, and (6) provide references of typical methods for different habitats. The level of detail of the biological monitoring plan should be equivalent to the anticipated environmental impact.	**Moderate to High.**
Physical Dredging Controls – Turbidity Reduction			
Turbidity Curtains [a, b, c]	**Moderate to High**. Turbidity curtains allow suspended sediment at an in-water construction site to settle out of the water column in a controlled area, minimizing the area that is affected by the increased suspended sediment. A turbidity curtain is an impermeable barrier constructed of a flexible reinforced thermoplastic material. The upper hem has floatation material and the lower hem is weighted. Examples include open-ended barriers along channel edges, enclosed barriers for dredging, staged barriers for small, enclosed areas, and box curtains for low-flow areas. The effective depth of the turbidity barrier must be calculated based on the conditions at each site. Turbidity curtains must remain in place and operational throughout construction.	**High**. Turbidity curtains are most effective when used on a project where they are not opened and closed to allow equipment access to the dredging or disposal area. Turbidity curtains are also limited to project locations with less than 1-2 knot currents. Turbidity barriers may be used in tidal and non-tidal areas; however, they should not be installed across channel flows, as they are not designed to stop water movement. Furthermore, turbidity barriers are less effective in project locations with high winds (especially areas with long fetch) or excessive wave heights (including ship wakes). In some waters, the sediments that have been confined to the bottom by the curtain may be re-suspended when the curtain is removed.	**High.**
Gunderbooms (aka, turbidity screens) [c]	**Moderate to High**. Gunderbooms are similar to turbidity curtains but are constructed of permeable geotextile fabrics. They are also designed to extend from the water surface to the project bottom.	**Moderate**. Gunderbooms are designed to allow water to flow through the curtain while filtering suspended dredged sediment from the flow.	**High.**

Table 4 (continued). Summary of BMPs for Sediment Management at the Colman Dock Site.			
BMP	**Ease of Implementation**	**Effectiveness and Limitations**	**Cost**
Physical Dredging Controls – Turbidity Reduction (continued)			
Air bubble screen [d]	**Moderate**. Air bubble screens are an alternative to turbidity curtains and screens. Air bubble screens do not interfere with the logistics of transport and are easy to handle.	**Low to Moderate**. Air bubble screens have limited effect and can only be successfully applied under certain conditions. Also, they require high power consumption of the compressors and related air emissions.	**High.**
Cofferdam/Sheet piling [a]	**Moderate to High**. Sheet piling is a reusable, water-tight barrier made of steel, vinyl, plastic, wood, recast concrete, or fiberglass. Types of sheet piling include Z type (used for intermediate to deep wall construction), arch shaped/light weight type (used for shallow wall construction), Larson type, and flat/straight type. Interlocks between sheets form tight connections and allow minimum shift. Sheet piles are costly and less adaptable to hard driving conditions, particularly where irregular rock surfaces occur. Cofferdams are temporary barriers commonly made of wood, steel, or concrete. A braced cofferdam is primarily used for bridge/pier construction in shallow water. It is constructed from a single wall of sheet piling that is driven into the ground and surrounds the excavation site. The cofferdam is braced on the inside for structural support and dewatered. The advantages associated with using cofferdams during in-water construction projects include easy installation and removal of the sheet piles, and the potential reuse of materials on future projects.	**Moderate to High**. Sheet piles are costly and less adaptable to hard driving conditions, particularly where irregular rock surfaces occur. Cofferdam disadvantages include the requirement of special equipment; expensive, time consuming and tedious process; the sheets can be driven out if rushed; and log jams may occur in high current locations, putting stress on the structure. Permits are required to address sediment disturbance.	**High.**
Pile Removal Methods			
Clamshell bucket [f]	**High**. Broken and damaged piles are commonly removed with a clamshell bucket. The bucket is lowered from a crane and the jaws grasp the pile stub as the crane pulls up.	**Moderate**. Can suspend sediment and contaminants when pile is raised through the water column or when grabbing the pile. The size of the clamshell bucket is minimized to reduce turbidity during pile removal.	**Moderate**.
Direct pull [f]	**High**. Generally used to remove timber piles. Each pile is wrapped with a choker cable or chain that is attached at the top of a crane. The crane pulls the pile directly upward, removing the pile from the sediment.	**Moderate**. Depending on substrate and pile depth, may not be as effective as vibratory extraction. Can suspend sediment and contaminants when pile is raised through the water column.	**Moderate**.

Table 4 (continued). Summary of BMPs for Sediment Management at the Colman Dock Site.			
BMP	**Ease of Implementation**	**Effectiveness and Limitations**	**Cost**
Pile Removal Methods (continued)			
Vibratory extraction [f]	**High**. Common method for removing both steel and timber piles. The vibratory hammer is a large mechanical device that is suspended from a crane by a cable. The hammer is activated to loosen the pile, and it vibrates while the crane pulls up. Vibration is used to break bond between sediment and pile. NOAA Fisheries recommended method to reduce impacts.	**High**. May cause temporary turbidity due to sediment suspension and contaminant release. Highly effective at reducing turbidity when compared to direct pull and clamshell methods.	**High**.
Pile cutting [f]	**Moderate**. Removing the upper portion of timber pile to a point below the mudline. Sediment removal around the base of the pile can be accomplished by digging or siphon dredging.	**Moderate**. May suspend small amounts of sediment if digging or siphon dredging is necessary to access the pile.	**Moderate**.
Operational Pile Removal Controls – Turbidity Reduction			
Remove piles completely [f]	**High**. If pile is structurally sound, remove pile completely rather than cutting or breaking off.	**High**. Complete removal is the preferred approach. Complete removal can result in less turbidity (depending on the removal method) and remove a source of contaminants (creosote treated timber).	**Moderate to High**.
Remove pile slowly [f]	**High**. Remove pile slowly to allow sediment to slough off at, or near, the mudline.	**Moderate**. Can result in less turbidity, but may significantly extend schedule if many piles are involved.	**Low.**
Break sediment bond	**High**. The operator should first hit or vibrate the pile to break the bond between the sediment and pile to minimize the potential for the pile to break.	**Moderate**. Reduces the amount of sediment sloughing off the pile during removal.	**Low.**
Place sand	**High**. Place ring of clean sand around the base of the pile.	**Moderate**. Ring of sand will contain some of the sediment that normally is suspended.	**Low.**
Pile Removal Containment			
Oil containment boom	**High**. Oil containment booms are installed around the pile removal work area to contain oils and collect floating debris. Oil absorbent materials are used if visible product is observed on the surface of the water. Oil absorbent materials shall be disposed in a landfill that meets the liner and leachate standards of the Minimal Functional Standards, Chapter 173-304 WAC.	**High**. Contains and aids in removal of floating oil contaminants and creosote timber debris.	**Low.**

Table 4 (continued). Summary of BMPs for Sediment Management at the Colman Dock Site.			
BMP	**Ease of Implementation**	**Effectiveness and Limitations**	**Cost**
Pile Disposal			
Creosote-treated piles	**High**. Creosote-treated piles, pile stubs, and associated sediments can be disposed in a landfill that meets the liner and leachate standards of the Minimal Functional Standards, Chapter 173-304 WAC. Creosote treated wood also may be burned for energy recovery in a regulated commercial or industrial furnace or boiler.	**High**. Effectively removes long-term source of contaminants to the environment. Landfilling uses landfill space; burning reduces waste volume. Burning wood used in marine setting may result in high concentration of chlorinated residuals.	**High.**

[a] PBS&J (2008).
[b] Thomas & Hutton Engineering Co. (2005).
[c] USACE et al. (2001).
[d] PIANC (2009).
[e] PDCA (2001).
[f] WSDOT (2010).

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APPENDIX A

Existing Sediment Data Compared to SMS Criteria

Table A-1. Recent Surface Sediment Sample Results for the Colman Dock Project Compared to Dry Weight SMS Criteria.

Parameter	SMS Criteria		2011 Landau Study					2005 CH2M Hill Study							1999 Herrera Study							
	SQS[a]	CSL[b]	BH-10-11	BH-11-11	BH-12-11	BH-13-11	BH-14-11	SS-1	SS-2	SS-3	SS-4	SS-5	SS-6	SS-7	CD-001	CD-002	CD-003	CD-004	CD-005	CD-006	CD-007	CD-008
			(0-10 ft) 6/28/2011	(0-0.3 ft) 7/20/2011	(0-0.3 ft) 7/20/2011	(0-0.3 ft) 7/20/2011	(0-0.3 ft) 7/20/2011	cap material 10/26/2004	cap material 10/26/2004	cap material 10/26/2004	cap material 10/27/2004	cap material 10/26/2004	cap material 10/26/2004	cap material 10/26/2004	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999	(0-0.3 ft) 4/21/1999
TOTAL METALSs (mg/kg dry-wt)																						
Arsenic	57	93	**6**	**30**	20 U	**40**	**30**	**1.6**	**1.7**	**2**	**2.2**	**3.2**	**24**	**1.4**	NA	NA	NA	NA	NA	NA	NA	NA
Barium	--	--	**66.4**	**141**	**50.3**	**53.9**	**109**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Beryllium	--	--	**0.2**	**0.3**	0.5 U	0.4 U	**0.3**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cadmium	5.1	6.7	0.2 U	1.8	1 U	0.9 U	**2.6**	**0.07**	**0.04**	**0.05**	**0.09**	**0.21**	**3.8**	**0.06**	NA	0.3 U	0.2 U	**0.7**	**0.9**	**3.7**	**1.0**	**2.2**
Chromium	260	270	**41.1**	**62**	**29**	**32**	**115**	**19.9**	**16**	**15.4**	**17.4**	**24**	**37**	**16.8**	NA	NA	NA	NA	NA	NA	NA	NA
Copper	390	390	**20.9**	**149**	**78**	**119**	**199**	**18.9**	**10.5**	**13.1**	**19.8**	**26.4**	**289**	**13.7**	NA	**21.0**	**41.2**	**85.2**	**99.9**	**223**	**87.0**	**170**
Lead	450	530	**19**	**348**	**240**	**77**	**178**	**5.9**	**3.9**	**4.7**	**8.3**	**24**	**850**	**6.1**	NA	**19**	**28**	**189**	**128**	**403**	**83**	**238**
Mercury	0.41	0.59	**0.04**	**0.71**	**0.24**	**0.45**	**1.10**	0.05 U	0.04 U	0.05 U	0.06 U	**0.11**	**11.5**	0.04 U	NA	**0.06**	0.05 U	**0.41**	**0.40**	**1.20**	**0.4**	**1.1**
Selenium	--	--	5 U	10 U	20 U	20 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Silver	6.1	6.1	0.3 U	**3.3**	1 U	**2**	**4.7**	**0.04**	0.02 U	**0.03**	**0.08**	**0.33**	**11.9**	0.02 U	NA	0.4 U	0.4 U	**1.9**	**1.2**	**7.0**	**0.9**	**5.4**
Zinc	410	960	**51**	**224**	**156**	**111**	**231**	**38.2**	**25.1**	**27.3**	**36.7**	**45**	**555**	**29.4**	NA	**76.6**	**70.1**	**208**	**169**	**382**	**165**	**305**
PAHs (µg/kg -dry wt)																						
Naphthalene	--	--	**43**	**530**	**190**	**220**	**360**	6.4 U	6.4 U	6.1 U	6.6 U	**8.4**	**86**	6.3 U	**86**	**20**	19 U	**500**	**1100**	**660**	**520**	**520**
Acenaphthylene	--	--	**23**	**630**	**250**	**130**	**150**	**9.6**	6.4 U	6.1 U	**8.0**	**33**	**73**	6.3 U	**22**	**40**	**23**	**550**	**630**	**820**	**440**	**580**
Acenaphthene	--	--	**74**	**350**	**100**	**130**	**95**	6.4 U	6.4 U	6.1 U	6.6 U	**10**	**250**	6.3 U	**53**	**68**	**35**	**950**	**2800**	**1300**	**900**	**2400**
Fluorene	--	--	**91**	**550**	**200**	**120**	**120**	6.4 U	6.4 U	6.1 U	6.6 U	**18**	**230**	6.3 U	**77**	**140**	**59**	**2500**	**4000 J**	**2400**	**1600**	**3900**
Phenanthrene	--	--	**280**	**3300**	**1600**	**550**	**660**	**40**	**27**	**28**	**23**	**94**	**950**	**8.2**	**320**	**600**	**280**	**11000 J**	**13000 J**	**12000 J**	**7400 J**	**14000 J**
Anthracene	--	--	**48**	**1800**	**840**	**1000**	**540**	**23**	**34**	**15**	**17**	**89**	**570**	6.3 U	**190**	**410**	**270**	**4400 J**	**6900 J**	**9500 J**	**4000**	**5100**
2-Methylnaphthalene	--	--	**16 J**	**180**	**140**	**88**	**87**	6.4	6.4 U	6.1 U	6.6 U	6.5 U	43 U	6.3 U	**37**	19 U	19 U	**330**	**1300**	**380**	**350**	**440**
Total LPAH [c]	--	--	**560**	**7200**	**3200**	**2200**	**1900**	**73**	**61**	**43**	**48**	**170**	**1600**	**8.2**	**790**	**1300**	**670**	**20000 J**	**30000 J**	**27000 J**	**15000 J**	**27000 J**
Fluoranthene	--	--	**600**	**4200**	**4400**	**1500**	**1400**	**130**	**13**	**76**	**57**	**180**	**3700**	**8.9**	**860**	**2200 J**	**1300**	**10000 J**	**27000 J**	**24000 J**	**22000 J**	**12000 J**
Pyrene	--	--	**440**	**22000**	**6200**	**2300**	**3500**	**240**	**44**	**62**	**120**	**250**	**4200**	**9.5**	**720**	**2300 J**	**1100**	**22000 J**	**39000 J**	**59000 J**	**22000 J**	**25000 J**
Benzo(a)anthracene	--	--	**260**	**4800**	**1500**	**1100**	**760**	**43**	**56**	**48**	**42**	**190**	**750**	6.3 U	**510**	**980**	**710**	**9100 J**	**18000 J**	**20000 J**	**9900 J**	**8800 J**
Chrysene	--	--	**260**	**8600**	**2600**	**2200**	**1200**	**92**	**96**	**70**	**73**	**370**	**1000**	**11**	**780**	**1200**	**870**	**12000 J**	**20000 J**	**22000 J**	**9900 J**	**12000 J**
Total Benzofluoranthenes[d]	--	--	**320**	**21000**	**3100**	**2500**	**2400**	**190**	**95**	**100**	**160**	**560**	**1200**	**14**	**910**	**1730**	**1030**	**21100 J**	**23900 J**	**42300 J**	**14500 J**	**22500 J**
Benzo(a)pyrene	--	--	**160**	**9100**	**1500**	**1300**	**1200**	**78**	**44**	**44**	**68**	**270**	**550**	**70**	**380**	**740**	**420**	**10000 J**	**11000 J**	**19000 J**	**6600 J**	**10000 J**
Indeno(1,2,3-cd)pyrene	--	--	**88**	**3800**	**560**	**560**	**450**	**32**	**17**	**19**	**30**	**120**	**300**	6.3 U	**150**	**270**	**130**	**4000 J**	**4600 J**	**7700 J**	**2400**	**3900**
Dibenz(a,h)anthracene	--	--	**50**	**1400**	**250**	**190**	**170**	**13**	**7.0**	6.1 U	**14**	**48**	**90**	6.3 U	**73**	**130**	**67**	**2400**	**2800**	**3700**	**1300**	**2000**
Benzo(g,h,i)perylene	--	--	**83**	**3900**	**530**	**520**	**410**	**35**	**17**	**18**	**31**	**120**	**320**	6.3 U	**130**	**220**	**120**	**3500 J**	**3500 J**	**7400 J**	**2200**	**3700**
Total HPAH[e]	--	--	**2300**	**79000**	**21000**	**12000**	**11000**	**1000**	**480**	**540**	**750**	**2700**	**13000**	**58**	**3600**	**8000 J**	**4700**	**73000 J**	**130000 J**	**160000 J**	**76000 J**	**77000 J**
SVOCs (µg/kg dry-wt)																						
1,2-Dichlorobenzene	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
1,3-Dichlorobenzene	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
1,4-Dichlorobenzene	--	--	19 U	**17 J**	20 U	19 U	**48**	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
1,2,4-Trichlorobenzene	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Hexachlorobenzene	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Dimethylphthalate	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	54	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Diethylphthalate	--	--	48 U	48 U	49 U	47 U	49 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Di-n-Butylphthalate	--	--	19 U	**32**	20 U	19 U	**20**	NA	NA	NA	NA	NA	NA	NA	**27**	19 U	**370**	**120**	40 U	81 U	77 U	79 U
Butylbenzylphthalate	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	350	77 U	79 U
bis(2-Ethylhexyl)phthalate	--	--	24 U	**500**	**80**	**180**	**350**	NA	NA	NA	NA	NA	NA	NA	**74**	**120**	**99**	**920**	**820**	**2200**	**790**	**1400**
Di-n-octyl phthalate	--	--	19 U	19 U	26	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Dibenzofuran	--	--	**90**	**360**	**110**	**110**	**110**	6.4 U	6.4 U	6.1 U	6.6 U	7.2 U	**200**	6.3 U	**53**	**57**	**19**	**1100**	**2400**	**1100**	**720**	**2100**
Hexachlorobutadiene	--	--	95 U	96 U	98 U	94 U	98 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
N-Nitrosodiphenylamine	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Phenol	420	1,200	19 U	**62**	**39**	**440**	**82**	NA	NA	NA	NA	NA	NA	NA	**87**	19 U	19 U	**150**	**95**	**82**	**120**	**90**
2-Methylphenol	63	63	19 U	**24**	20 U	**18 J**	**17 J**	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
4-Methylphenol	670	670	38 U	**100**	**29 J**	**46**	**110**	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	**64**	**110**	77 U	79 U
2,4-Dimethylphenol	29	29	38 UJ	**54**	**19 J**	**28 J**	**35 J**	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	**40**	81 U	77 U	79 U
Pentachlorophenol	360	690	190 U	190 U	200 U	190 U	200 U	NA	NA	NA	NA	NA	NA	NA	93 U	94 U	94 U	200 U	200 U	400 U	390 U	390 U
Benzyl Alcohol	57	73	19 UJ	19 U	20 U	**26**	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
Benzoic Acid	650	650	380 U	**130 J**	390 U	**120 J**	**250 J**	NA	NA	NA	NA	NA	NA	NA	190 U	190 U	190 U	390 U	400 U	810 U	770 U	790 U
Hexachloroethane	--	--	19 U	19 U	20 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U
1-Methylnaphthalene	--	--	19 U	**91**	**120**	**69**	**51**	NA	NA	NA	NA	NA	NA	NA								
PCBs (µg/kg dry-wt)																						
Aroclor 1016	--	--	19 U	20 U	19 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	--	--	19 U	20 U	19 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	--	--	19 U	**63**	**21**	**54**	**47**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	--	--	19 U	**150**	**43**	**130**	**150**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	--	--	19 U	**97**	**27**	**81**	**140**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	--	--	19 U	20 U	19 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	--	--	19 U	20 U	19 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1262	--	--	19 U	20 U	19 U	19 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1268	--	--	19 U	20 U	19 U	19 U	**54**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	--	--	19 U	**310**	**91**	**265**	**391**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CONVENTIONALS (percent)																						
Total Organic Carbon	--	--	**0.465**	**3.79**	**2.09**	**3.01**	**7.41**	**0.31**	**0.16**	**0.17**	**0.43**	**1.3**	**6.9**	**0.087**	**0.44**	**0.67**	**0.44**	**3.2**	**3.3**	**8.9**	**2.6**	**5.0**
Total Solids	--	--	**87.6**	**46.20**	**54.60**	**53.80**	**38.40**	**81**	**85**	**88**	**80**	**75**	**48**	**87**	**76.6**	**75.2**	**84.2**	**56.4**	**44.2**	**32.2**	**41.5**	**38.5**

Notes:
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the reported concentration is considered an estimate.
NA = Not analyzed.
mg/kg dry-wt = milligrams per kilogram dry weight.
µg/kg dry-wt = micrograms per kilogram dry weight.
Bold indicates detected compound.
Gray shading indicates an exceedance of SQS criteria.
Box indicates an exceedance of CSL criteria.
(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds listed.
(d) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers
(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed

Table A-2. Recent surface sediment sample results for the Colman Dock project compared to organic carbon normalized SMS criteria.

Parameter	SMS Criteria		2011 Landau Study					2005 CH2M Hill Study							1999 Herrera Study							
	SQS[a]	CSL[b]	BH-10-11 (0-10 ft) 6/28/2011	BH-11-11 (0-0.3 ft) 7/20/2011	BH-12-11 (0-0.3 ft) 7/20/2011	BH-13-11 (0-0.3 ft) 7/20/2011	BH-14-11 (0-0.3 ft) 7/20/2011	SS-1 cap material 10/26/2004	SS-2 cap material 10/26/2004	SS-3 cap material 10/26/2004	SS-4 cap material 10/27/2004	SS-5 cap material 10/26/2004	SS-6 cap material 10/26/2004	SS-7 cap material 10/26/2004	CD-001 (0-0.3 ft) 4/21/1999	CD-002 (0-0.3 ft) 4/21/1999	CD-003 (0-0.3 ft) 4/21/1999	CD-004 (0-0.3 ft) 4/21/1999	CD-005 (0-0.3 ft) 4/21/1999	CD-006 (0-0.3 ft) 4/21/1999	CD-007 (0-0.3 ft) 4/21/1999	CD-008 (0-0.3 ft) 4/21/1999
PAHs (mg/kg -OC)																						
Naphthalene	99	170	**9.2**	**14**	**9.1**	**7.3**	**4.9**	2.1 U	4.0 U	3.6 U	1.6 U	**0.65**	**1.2**	7.2 U	**20**	**3.0**	4.3 U	**16**	**33**	**7.4**	**20**	**10**
Acenaphthylene	66	66	**4.9**	**17**	**12**	**4.3**	**2.0**	**3.1**	4.0 U	3.6 U	**2.0**	**2.6**	**1.1**	7.2 U	**5.0**	**6.0**	**5.2**	**17**	**19**	**9.2**	**17**	**12**
Acenaphthene	16	57	**16**	**9.2**	**4.8**	**4.3**	**1.3**	2.1 U	4.0 U	3.6 U	1.6 U	**0.78**	**3.6**	7.2 U	**12**	**10**	**8.0**	**30**	**85**	**15**	**35**	**48**
Fluorene	23	79	**20**	**15**	**9.6**	**4.0**	**1.6**	2.1 U	4.0 U	3.6 U	1.6 U	**1.4**	**3.3**	7.2 U	**18**	**21**	**13**	**78**	**121 J**	**27**	**62**	**78**
Phenanthrene	100	480	**60**	**87**	**77**	**18**	**8.9**	**13**	**17**	**16**	**5.6**	**7.3**	**14**	**9.4**	**73**	**90**	**64**	**344 J**	**394 J**	**135 J**	**285 J**	**280 J**
Anthracene	220	1200	**10**	**47**	**40**	**33**	**7.3**	**7.5**	**21**	**8.8**	**4.2**	**6.9**	**8.2**	7.2 U	**43**	**61**	**61**	**138 J**	**209 J**	**107 J**	**154**	**102**
2-Methylnaphthalene	38	64	**3.4 J**	**4.7**	**6.7**	**2.9**	**1.2**	**2.1**	4.0 U	3.6 U	1.6 U	0.5 U	0.62 U	7.2 U	**8.4**	2.8 U	4.3 U	**10**	**39**	**4.3**	**13**	**8.8**
Total LPAH [c]	370	780	**120**	**190**	**150**	**71**	**26**	**24**	**38**	**25**	**12**	**20**	**31**	**9.4**	**180**	**190**	**150**	**630 J**	**900 J**	**300 J**	**590 J**	**540 J**
Fluoranthene	160	1200	**129**	**111**	**211**	**50**	**19**	**42**	**8.0**	**45**	**14**	**14**	**53**	**10**	**195**	**328 J**	**295**	**313 J**	**818 J**	**270 J**	**846 J**	**240 J**
Pyrene	1000	1400	**95**	**580**	**297**	**76**	**47**	**78**	**27**	**36**	**29**	**19**	**61**	**11**	**164**	**343 J**	**250**	**688 J**	**1182 J**	**663 J**	**846 J**	**500 J**
Benzo(a)anthracene	110	270	**56**	**127**	**72**	**37**	**10**	**14**	**35**	**28**	**10**	**15**	**11**	7.2 U	**116**	**146**	**161**	**284 J**	**545 J**	**225 J**	**381 J**	**176 J**
Chrysene	110	460	**56**	**227**	**124**	**73**	**16**	**30**	**59**	**41**	**18**	**29**	**14**	**13**	**177**	**179**	**198**	**375 J**	**606 J**	**247 J**	**381 J**	**240 J**
Total Benzofluoranthenes[d]	230	450	**68.8**	**554**	**148**	**83**	**32**	**63**	**59**	**59**	**38**	**43**	**17**	**16**	**207**	**258**	**234**	**659 J**	**724 J**	**475 J**	**558 J**	**450 J**
Benzo(a)pyrene	99	210	**34.4**	**240**	**72**	**43**	**16**	**25**	**27**	**26**	**17**	**21**	**7.9**	**8**	**86**	**110**	**95**	**313 J**	**333 J**	**213 J**	**254 J**	**200 J**
Indeno(1,2,3-cd)pyrene	34	88	**18.9**	**100**	**27**	**19**	**6.1**	**10**	**10**	**11**	**7.4**	**9.3**	**4.3**	7.2 U	**34**	**40**	**30**	**125 J**	**139 J**	**87 J**	**92**	**78**
Dibenz(a,h)anthracene	12	33	**10.8**	**37**	**12**	**6.3**	**2.3**	**4.2**	**4.3**	3.6 U	**3.4**	**3.7**	**1.3**	7.2 U	**17**	**19**	**15**	**75**	**85**	**42**	**50.0**	**40**
Benzo(g,h,i)perylene	31	78	**17.8**	**103**	**25**	**17**	**5.5**	**11**	**10**	**11**	**7.6**	**9.3**	**4.6**	7.2 U	**30**	**33**	**27**	**109 J**	**106 J**	**83 J**	**85**	**74**
Total HPAH[e]	960	5300	**486**	**2100**	**990**	**400**	**160**	**280**	**240**	**260**	**140**	**160**	**170**	**58**	**1000**	**1500 J**	**1300**	**2900 J**	**4500 J**	**2300 J**	**3500 J**	**2000 J**
SVOCs (mg/kg-OC)																						
1,2-Dichlorobenzene	2.3	2.3	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
1,3-Dichlorobenzene	--	--	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
1,4-Dichlorobenzene	3.1	9	4.1 U	**0.45 J**	1.0 U	0.6 U	**0.6**	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
1,2,4-Trichlorobenzene	0.81	1.8	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
Hexachlorobenzene	0.38	2.3	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
Dimethylphthalate	53	53	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	**12**	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
Diethylphthalate	61	110	10 U	1.3 U	2.3 U	1.6 U	0.7 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
Di-n-Butylphthalate	220	1700	4.1 U	**0.84**	1.0 U	0.6 U	**0.3**	NA	NA	NA	NA	NA	NA	NA	**6.1**	2.8 U	**84**	**3.8**	1.2 U	0.9 U	3.0 U	1.6 U
Butylbenzylphthalate	4.9	64	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	3.9	3.0 U	1.6 U
bis(2-Ethylhexyl)phthalate	47	78	5.2 U	13	**3.8**	**6.0**	**4.7**	NA	NA	NA	NA	NA	NA	NA	**17**	**18**	**23**	**29**	**25**	**25**	**30**	**28**
Di-n-octyl phthalate	58	4500	4.1 U	0.50 U	**1.2**	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
Dibenzofuran	15	58	**19**	**9.5**	**5.3**	**3.7**	**1.5**	2.1 U	4.0 U	3.6 U	1.6 U	**0.56**	**2.9**	7.2 U	**12**	**8.5**	**4.3**	**34**	**73**	**12**	**28**	**42**
Hexachlorobutadiene	3.9	6.2	20 U	2.5 U	4.7 U	3.1 U	1.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
N-Nitrosodiphenylamine	11	11	4.1 U	0.50 U	1.0 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	4.3 U	2.8 U	4.3 U	1.2 U	1.2 U	0.9 U	3.0 U	1.6 U
PCBs (mg/kg-OC)																						
Aroclor 1016	--	--	4.1 U	0.5 U	0.9 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1242	--	--	4.1 U	0.5 U	0.9 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1248	--	--	4.1 U	**1.7**	**1.0**	**1.8**	**0.6**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1254	--	--	4.1 U	**4.0**	**2.1**	**4.3**	**2.0**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1260	--	--	4.1 U	**2.6**	**1.3**	**2.7**	**1.9**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1221	--	--	4.1 U	0.5 U	0.9 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1232	--	--	4.1 U	0.5 U	0.9 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1262	--	--	4.1 U	0.5 U	0.9 U	0.6 U	0.3 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Aroclor 1268	--	--	4.1 U	0.5 U	0.9 U	0.6 U	**0.7**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total PCBs	12	65	4.1 U	**8.3**	**4.4**	**8.8**	**5.3**	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
U = Indicates the compound was undetected at the reported concentration.
J = Indicates the reported concentration is considered an estimate.
NA = Not analyzed.
mg/kg-OC = milligrams per kilogram organic carbon.
Bold indicates detected compound.
Gray shading indicates an exceedance of SQS criteria.
Box indicates an exceedance of CSL criteria.
(a) SMS Sediment Quality Standard (Chapter 173-204 WAC).
(b) SMS Cleanup Screening Level (Chapter 173-204 WAC).
(c) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: naphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds listed.
(d) The total benzofluoranthenes criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.
(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: fluoranthene, pyrene, benzo(a)anthracene, chrysene, total benzofluoranthenes, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, dibenz(a,h)anthracene, and benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

APPENDIX B

Existing Sediment Data Compared to DMMP Criteria

Table B-1. Existing surface (0 to 5 feet below mudline) data compared to Dredged Material Management Program criteria.

Location:				BH-11-11	BH-12-11	BH-13-11	BH-14-11	B-2S/S1/0-5	B-3S/S1/0-5	CD-001	CD-002	CD-003	CD-004	CD-005	CD-006	CD-007	CD-008	WSF-C	WSF-C	WSF-E	WSF-E	WSF-3	WSF-4	WSF-8	WSF-9	WSF-10	WSF-10D	WSF-11	WSF-12	VG-10	VG-11
Depth:				(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-5 ft.)	(0-5 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft.)	(0-0.3 ft)	(0-5 ft)	(0-0.3 ft)	(0-5 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)	(0-0.3 ft)
Sample Date:	SL	BT	ML	07/20/2011	07/20/2011	07/20/2011	07/20/2011	4/23/2010	4/21/2010	1999	1999	1999	1999	1999	1999	1999	1999	34542	7/27/1994	7/28/1994	7/28/1994	7/29/1994	7/29/1994	7/26/1994	7/26/1994	7/26/1994	7/26/1994	7/27/1994	7/27/1994	7/29/1994	7/29/1994
TOTAL METALSs (mg/kg dry-wt)																															
Methods SW6010B/SW7471A																															
Antimony	150	--	200															2.1 J	5.9 J	1.3 J	0.5 UJ	0.7	0.5 U	4.8	1.6	0.7 U	0.9	0.6 U	0.8	1 U	0.4 U
Arsenic	57	507.1	700	30	20 U	40	30	9	56									42	97	15	16	7.2	13	58 J	29 J	24 J	24 J	12	68	7.2	8.7
Cadmium	5.1	11.3	14	1.8	1 U	0.9 U	2.6	0.8	0.7		0.3 U	0.2 U	0.7	0.9	3.7	1.0	2.2	3.5	5.9	3 U	2.7	1.8 U	1.7 U	2.6 U	2 U	2.5 U	2.4 U	1.8 U	2 U	1.7 U	1.5 U
Chromium	260	260	--	62	29	32	115	32.3	30.2																						
Copper	390	1027	1300	149	78	119	199				21.0	41.2	85.2	99.9	223	87.0	170	190	410	120	110	42	37	240	180	150	150	77	170	130	60
Lead	450	975	1200	348	240	77	178	570	672		19	28	189	128	403	83	238	340	750	170	180	48	58	450	300	230	220	110	160	280	120
Mercury	0.41	1.5	2.3	0.71	0.24	0.45	1.10	0.57	0.22		0.06	0.05 U	0.41	0.40	1.20	0.40	1.1	1.4	3.1	0.8	1.0	0.20	0.20	1.6	1.3	1.2	1.0	0.40	1.2	1.7	0.60
Selenium	--	3	--	10 U	20 U	20 U	10 U	6 U	6 U																						
Silver	6.1	6.1	8.4	3.3	1 U	2	4.7	0.7	0.4 U		0.4 U	0.4 U	1.9	1.2	7.0	0.9	5.4	6.8	17	3 U	7.8	1.8 U	1.7 U	1.4	5.5	4.3	4.5	1.8 U	3.6	5.3	2.1
Zinc	410	2783	3800	224	156	111	231				76.6	70.1	208	169	382	165	305	870	750	170	170	110	90	480	250	220	210	170	190	220	120
PAHs (µg/kg -dry wt)																															
Method SW8270D																															
Naphthalene	2100	--	2400	530	190	220	360	2,800 U	1,900	86	20	19 U	500	1,100	660	520	520	1,612	1,560	270 J	368 J	1,100	792	593 J	429 J	371 J	242 J	396	384 J	731	264
Acenaphthylene	560	--	1300	630	250	130	150	2,800 U	390 U	22	40	23	550	630	820	440	580	1,300	612 J	660	83 J	1,100	348	593	199 J	507 J	484 J	110 J	288 J	331	198
Acenaphthene	500	--	2000	350	100	130	95	2,800 U	860	53	68	35	950	2,800	1,300	900	2,400	884	4,560	341 J	782	4,103	1,800	648 J	250 J	250 J	242 J	180 J	150 J	731	103
Fluorene	540	--	3600	550	200	120	120	4,300	720	77	140	59	2,500	4,000 E	2,400	1,600	3,900	1,196	2,640	660	552	5,995	1,800	869	351 J	624	484 J	234	2,496 J	731	1,716
Phenanthrene	1500	--	21000	3,300	1,600	550	660	190,000	3,200	320	600	280	11,000 E	13,000 E	12,000 E	7,400 E	14,000 E	6,084	6,720	3,795	2,300	33,000	7,500	4,266	1,716	2,691	2,420	918	1,088	3,784	748
Anthracene	960	--	13000	1800	840	1,000	540	5,000	1,300	190	410	270	4,400 E	6,900 E	9,500 E	4,000	5,100	3,380	5,520	2,420	1,104	11,000	2,796	2,686	1,092	3,198	1,584	594	928	1,505	638
2-Methylnaphthalene	670	--	1900	180	140	88	87	2,800 U	420	37	19 U	19 U	330	1,300	380	350	440	432	492 J	149 J	2,392 U	1,100	336	261 J	3,003 U	3,705 U	3,608 U	92 J	2,912 U	310	2,002
LPAH (f, g)	5200	--	29000	7,160	3,180	2,150	1,925	199,300	7,980	785	1,278	667	20,230 E	29,730 E	27,060 E	15,210 E	26,940 E	14,456	21,480 J	8,195 J	5,198 J	56,298	15,036	9,717 J	4,017 J	7,644 J	5,456 J	2,412 J	3,104 J	7,783	2,134
Fluoranthene	1700	4600	30000	4,200	4,400	1,500	1,400	530,000	12,000	860	2,200 E	1,300	10,000 E	27,000 E	24,000 E	22,000 E	12,000 E	8,476	26,040	6,325	1,978	50,996	15,996	8,216	2,496	4,017	6,204	1,098	1,600	6,192	11,990
Pyrene	2600	11980	16000	22,000	6,200	2,300	3,500	370,000	40,000	720	2,300 E	1,100	22,000 E	39,000 E	59,000 E	22,000 E	25,000 E	13,988	33,960	6,820	5,014	27,995	14,004	13,035	5,304	6,318	7,084	1,296	2,688	11,008	11,000
Benzo(a)anthracene	1300	--	5100	4,800	1,500	1,100	760	31,000	5,000	510	980	710	9,100 E	18,000 E	20,000 E	9,900 E	8,800 E	51,792	8,040	4,015	782	14,003	6,696	6,004	2,184	4,212	4,488	666	1,088	3,397	4,290
Chrysene	1400	--	21000	8,600	2,600	2,200	1,200	130,000	5,500	780	1,200	870	12,000 E	20,000 E	22,000 E	9,900 E	12,000 E	6,396	8,760	6,380	1,196	16,995	7,404	6,873	3,198	6,786	6,380	1,008	2,016	3,698	4,906
Total Benzofluoranthenes	3200	--	9900	21,000	3,100	2,500	2,400	88,000	7,800	910	1,730	1,030	21,100 E	23,900 E	42,300 E	14,500 E	22,500 E	12,012	9,960	8,525	1,702	16,995	6,504	12,008	6,084	12,012	12,012	1,692	3,200	6,321	4,994
Benzo(a)pyrene	1600	--	3600	9,100	1,500	1,300	1,200	17,000	3,900	380	740	420	10,000 E	11,000 E	19,000 E	6,600 E	10,000 E	5,512	5,160	4,675	874	6,996	2,904	5,214	2,691	5,889	5,280	864	1,696	3,010	2,398
Indeno(1,2,3-cd)pyrene	600	--	4400	3,800	560	560	450	6,800	1,000	150	270	130	4,000 E	4,600 E	7,700 E	2,400	3,900	2,080	1,800	2,200	409	2,299	900	1,896	1,092	2,301	1,980	414	992	817	880
Dibenz(a,h)anthracene	230	--	1900	1,400	250	190	170	2,800 U	550	73	130	67	2,400	2,800	3,700	1,300	2,000	988	3,720 U	880	248	1,001	420	1,027	546	936	1,188	234	1,504 U	378	330
Benzo(g,h,i)perylene	670	--	3200	3,900	530	520	410	5,900	960	130	220	120	3,500 E	3,500 E	7,400 E	2,200	3,700	1,716	1,680	2,200	451	1,804	756	1,580	741	1,599	1,408	360	768	860	924
HPAH (f, i)	12000	--	69000	78,800	20,640	12,170	11,490	1,178,700	76,710	4,513	9,770 E	5,747	94,100 E	149,800 E	205,100 E	90,800 E	99,900 E	68,172	109,200 J	50,490	14,352	156,101	62,076	67,782	30,537	56,043	58,080	9,324	18,752 J	42,011	46,728
SVOCs (µg/kg dry-wt)																															
Method SW8270D																															
1,2-Dichlorobenzene	35	--	110	19 U	20 U	19 U	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
1,4-Dichlorobenzene	110	--	120	17 J	20 U	19 U	48			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
1,2,4-Trichlorobenzene	31	--	64	19 U	20 U	19 U	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Hexachlorobenzene	22	168	230	19 U	20 U	19 U	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Dimethylphthalate	71	--	1400	19 U	20 U	19 U	20 U			54	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Diethylphthalate	200	--	1200	48 U	49 U	47 U	49 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Di-n-Butylphthalate	1400	--	5100	32	20 U	19 U	20			27	19 U	370	120	40 U	81 U	77 U	79 U														
Butylbenzylphthalate	63	--	970	19 U	20 U	19 U	20 U			19 U	19 U	19 U	39 U	40 U	350	77 U	79 U														
bis(2-Ethylhexyl)phthalate	1300	--	8300	500	80	180	350			74	120	99	920	820	2,200	790	1,400														
Di-n-octyl phthalate	6200	--	6200	19 U	26	19 U	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Dibenzofuran	540	--	1700	360	110	110	110	2,800 U	830	53	57	19	1,100	2400.0	1,100	720	2,100														
Hexachlorobutadiene	11	--	270	96 U	98 U	94 U	98 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
N-Nitrosodiphenylamine	28	--	28	19 U	20 U	19 U	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Phenol	420	--	1200	62	39	440	82			87	19 U	19 U	150	95	82	120	90														
2-Methylphenol	63	--	77	24	20 U	18 J	17 J			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
4-Methylphenol	670	--	3600	100	29 J	46	110			19 U	19 U	19 U	39 U	64	110	77 U	79 U														
2,4-Dimethylphenol	29	--	210	54	19 J	28 J	35 J			19 U	19 U	19 U	39 U	40	81 U	77 U	79 U														
Pentachlorophenol	400	504	690	190 U	200 U	190 U	200 U			93 U	94 U	94 U	200 U	200 U	400 U	390 U	390 U														
Benzyl Alcohol	57	--	870	19 U	20 U	26	20 U			19 U	19 U	19 U	39 U	40 U	81 U	77 U	79 U														
Benzoic Acid	650	--	760	130 J	390 U	120 J	250 J			190 U	190 U	190 U	390 U	400 U	810 U	770 U	790 U														
PCBs (µg/kg dry-wt)																															
Method SW8082																															
Total PCBs	130	38 (1)	3100	310	91	265	391																								

: (1) This value is normalized to TOC, and is expressed in mg/kg carbon.
U = Indicates the compound was undetected at the reported concentration.
J or E = Indicates the associated value is an estimated concentration.
µg/kg = microgram per kilogram.
mg/kg = milligram per kilogram.

SL = screening level
BT = bioaccumulation trigger
ML = maximum level

Bold indicates detected compound.
Gray shading indicates an exceedance of ML criteria.
Outlined cell indicates an exceedance of ML guidelines.
Blank cell = Not analyzed

Table B-2. Existing subsurface (5 to 30 feet below mudline) data compared to Dredged Material Management Program criteria.

Location:	SL	BT	ML	BH-11-11	BH-11-11	BH-12-11	BH-12-11	BH-13-11	BH-13-11	BH-14-11	BH-14-11	B-2S/S2/5-10	B-3S/S2/5-10	B-3S/S3/10-15	B-3S/S4/15-20	B-3S/S5/20-25	B-3S/S6/25-30	WSF-A	WSF-C	WSF-C	WSF-E	WSF-E	WSF-E
Depth:				(10.0-20.0 ft)	(20.0-30.0 ft)	(10.0-20.0 ft)	(20.0-30.0 ft)	(10.0-20.0 ft)	(20.0-30.0 ft)	(10.0-20.0 ft)	(20.0-30.0 ft)	(5-10 ft.)	(5-10 ft.)	(10-15 ft.)	(15-20 ft.)	(20-25 ft.)	(25-30 ft.)	(18-20 ft)	(6-11 ft)	(14-16 ft)	(5-10 ft)	(15-17 ft)	(19-20 ft)
Sample Date:				06/28/2011	06/28/2011	07/25/2011	07/25/2011	08/03/2011	08/03/2011	08/03/2011	08/03/2011	40,291	40,289	40,289	40,289	40,289	40,289	34,547	34,542	34,542	34,543	34,543	34,543
TOTAL METALSs (mg/kg dry-wt)																							
Methods SW6010B/SW7471A	150	--	200																				
Antimony	150	--	200									7.0 U	61	7.0	8.0	8.0	7.0	0.4 UJ	2.5 J	0.4 UJ	0.4 UJ	0.4 UJ	0.4 UJ
Arsenic	57	507	700	9.0	6.0	7.0	6.0 U	8.0	6.0 U	7.0 U	6.0 U	26	57	58	24	101	88	20	40	3.8	4.4	4.0	5.1
Cadmium	5	11	14	0.4	0.2 U	0.4	0.3	0.3	0.2 U	0.5	0.3	20	26	21	24	60	41	1.2 U	7.1	1.3 U	1.5 U	1.2 U	1.5
Chromium	260	260	--	21	24	20	40	19	30	30	36												
Copper	390	1,027	1,300	30	12	26	22	26	16	21	16	4.0	182	9.0	3.0	5.0	3.0	13	390	19	22	10	61
Lead	450	975	1,200	23	2	4	3	5	2 U	24	2.0 U	0.03	0.24	0.04	0.03	0.04	0.03 U	8	580	30	4.0 U	2.5	14
Mercury	0.41	1.5	2.3	0.09	0.02	0.03 U	0.02 U	0.03	0.02 U	0.11	0.03 U	7.0 U	7.0 U	7.0 U	7.0 U	6.0 U	6.0 U	0.10 U	4.9	0.10 U	0.10 U	0.10 U	0.10 U
Selenium	--	3	--	7.0 U	5.0 U	7.0 U	6.0 U	7.0 U	6.0 U	7.0 U	6.0 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U	0.4 U						
Silver	6.1	6.1	8.4	0.4 U	0.3 U	0.4 U	0.3 U	0.4 U	0.3 U	0.4 U	0.3 U							1.2 U	8.3	1.3 U	1.5 U	1.2 U	1.2 U
Zinc	410	2,783	3,800	41	27	33	36	33	28	49	33							34	490	40	34	27	84
PAHs (µg/kg -dry wt)																							
Method SW8270D																							
Naphthalene	2,100	--	2,400	3,000	850	1,400	270	1,800	390	140	18 U	64 U	1,900	470	61 U	61 U	570	3,099	2,992	3,887	71	159 U	16 J
Acenaphthylene	560	--	1,300	25	19 U	20 U	19 U	18 U	20 U	18 U	18 U	64 U	61 U	62 U	61 U	61 U	62 U	109	748 J	19 J	7 J	130 U	180 U
Acenaphthene	500	--	2,000	100	28	79	30	14 J	44	89	18 U	64 U	4,900	1,700	61 U	61 U	62 U	16,999	7,040	1,001	331	18 J	211 U
Fluorene	540	--	3,600	75	19 U	46 J	22 J	18 U	36	75	18 U	64 U	5,400	2,000	61 U	61 U	62 U	14,999	4,576	637	218	18 J	171 U
Phenanthrene	1,500	--	21,000	250	19 U	200	110	37	120	270	10 J	64 U	18,000	7,000	61 U	61 U	62 U	53,999	11,968	592	827	65	24 J
Anthracene	960	--	13,000	65	19 U	31	19	12 J	25	88	18 U	64 U	1,100	520	61 U	61 U	62 U	6,900	13,024	143	278	12 J	149 U
2-Methylnaphthalene	670	--	1,900	310	94	110	39	33	34	33	18 U	64 U	1,600	390	61 U	61 U	62 U	1,100	748 J	988	52	181 U	239 U
LPAH (f, g)	5,200	--	29,000	3,515	878	1,756	451	1,863	615	662	10	64 U	31,300	11,690	61 U	61 U	570	96,106	40,392 J	3,887 J	1,740 J	402 J	750 J
Fluoranthene	1,700	4,600	30,000	200	19 U	83	64	54	77	280	18 U	64 U	7,700	3,100	61 U	61 U	62 U	39,000	43,032	351	966	27	149 U
Pyrene	2,600	11,980	16,000	170	19 U	53	48	42	79	230	18 U	64 U	4,300	1,600	61 U	61 U	62 U	22,001	33,968	228	870	54	12
Benzo(a)anthracene	1,300	--	5,100	48	19 U	15 J	13 J	11 J	22	92	18 U	64 U	1,600	470	61 U	61 U	62 U	5,899	11,968	72	313	12 J	140 U
Chrysene	1,400	--	21,000	48	19 U	16 J	13 J	13 J	26	89	18 U	64 U	1,500	450	61 U	61 U	62 U	4,901	16,016	91	374	15 J	149 U
Total Benzofluoranthenes	3,200	--	9,900	65	19 U	11 J	12 J	15 J	38	150	18 U	64 U	1,320	260	61 U	61 U	62 U	2,501	16,016	98	331	21 J	350 U
Benzo(a)pyrene	1,600	--	3,600	44	19 U	20 U	19 U	18 U	19 J	94	18 U	64 U	640	140	61 U	61 U	62 U	1,100	7,040	44 J	191	12 J	68
Indeno(1,2,3-cd)pyrene	600	--	4,400	23	19 U	20 U	19 U	18 U	20 U	110	18 U	64 U	160	62 U	61 U	61 U	62 U	250	2,816	19 J	86	111 U	149 U
Dibenz(a,h)anthracene	230	--	1,900	10 J	19 U	20 U	19 U	18 U	20 U	16 J	18 U	64 U	92	62 U	61 U	61 U	62 U	151	3,784 U	189 U	49	92 U	121 U
Benzo(g,h,i)perylene	670	--	3,200	29	19 U	20 U	19 U	18 U	20 U	170	18 U	64 U	140	62 U	61 U	61 U	62 U	169	2,376	25 J	96	70 U	96 U
HPAH (f, i)	12,000	--	69,000	637	19 U	178	150	135	261	1,231	18 U	64 U	17,452	6,020	61 U	61 U	62 U	78,471	153,032 J	1,216 J	3,602	435 J	1,237 J
SVOCs (µg/kg dry-wt)																							
Method SW8270D																							
1,2-Dichlorobenzene	35	--	110	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
1,4-Dichlorobenzene	110	--	120	19 U	19 U	20 UJ	19 UJ	18 U	20 U	18 U	18 U												
1,2,4-Trichlorobenzene	31	--	64	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
Hexachlorobenzene	22	168	230	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
Dimethylphthalate	71	--	1,400	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
Diethylphthalate	200	--	1,200	47 U	48 U	49 U	48 U	46 U	49 U	46 U	46 U												
Di-n-Butylphthalate	1,400	--	5,100	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
Butylbenzylphthalate	63	--	970	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
bis(2-Ethylhexyl)phthalate	1,300	--	8,300	24 U	24 U	25 U	24 U	18 J	23 J	18 J	19 J												
Di-n-octyl phthalate	6,200	--	6,200	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U	64 U	4,100	1,400	61 U	61 U	62 U						
Dibenzofuran	540	--	1,700	63	11 J	71	28	18 U	30	55	18 U												
Hexachlorobutadiene	11	--	270	94 U	96 U	99 U	97 U	92 U	99 U	92 U	92 U												
N-Nitrosodiphenylamine	28	--	28	19 U	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
Phenol	420	--	1,200	12 J	19 U	20 U	19 U	18 U	20 U	18 U	18 U												
2-Methylphenol	63	--	77	25	28	20	42	19	20 U	18 U	18 U												
4-Methylphenol	670	--	3,600	85	12 J	11 J	13 J	18 J	40 U	23 J	37 U												
2,4-Dimethylphenol	29	--	210	1,600 J	700 J	2,000	370	3,400	160	37 U	37 U												
Pentachlorophenol	400	504	690	190 U	190 U	200 U	190 U	180 U	200 U	180 U	180 U												
Benzyl Alcohol	57	--	870	19 UJ	19 UJ	20 U	19 U	18 U	20 U	18 U	18 U												
Benzoic Acid	650	--	760	380 U	380 U	400 U	390 U	370 U	400 U	370 U	370 U												
PCBs (µg/kg dry-wt)																							
Method SW8082																							
Total PCBs	130	38 (1)	3,100	19 U	19 U	20 U	20 U	20 U	20 U	19 U	19 U												

Notes:
(1) This value is normalized to TOC, and is expressed in mg/kg carbon
U = Indicates the compound was undetected at the reported concentration
J = Indicates the associated value is an estimated concentration
µg/kg = microgram per kilogram
mg/kg = milligram per kilogram
Bold indicates detected compound.
Gray shading indicates an exceedance of ML criteria
Outlined cell indicates an exceedance of ML guidelines

Washington State Ferries

Attachment 4

Standard Hazardous Materials Impacts and Mitigation Methods (tailored to the site)

WSDOT Standard Hazardous Materials Impacts & Mitigation Measures (tailored to this project)				
Impact Type		**Impact**	**Mitigation Measure**	**Impacted Site Identification**
Environmental Impacts		**Environmental Impacts are impacts that the project causes to the environment or sensitive receptors.**		
Direct Impacts to the Environment		**Direct Environmental Impacts[1] are impacts that a project causes that occur at the same time and place. Direct Impacts from construction activities are typically short term and temporary in nature**		
	Spills	Accidental hazardous materials spills may occur due to construction activities. Construction sites involve various activities, equipment, and materials that can result in a release of hazardous materials into the environment. Traffic detours and lane closures can increase the risk of accidents that cause spills of hazardous materials or substances into the environment. Hazardous materials have the highest adverse affect on waters of the state (i.e., Puget Sound) - releases of relatively small amounts of chemicals may impact the Sound directly when discharged to the trestle deck. Hazardous materials have the potential to harm endangered species and their habitat. Particulates of lead-based paint (LBP), asbestos-containing material (ACM) can migrate off-site in dust particles. The contaminated dust can expose the surrounding populace to these materials.	A Spill Prevention, Containment, and Countermeasures (SPCC) Plan is required for all WSDOT construction projects per Standard Specifications Section 1-07.15. Prior to beginning construction, the Contractor is required to prepare a project-specific plan to be used throughout the duration of the project. The plan must be updated to reflect actual site conditions and practices. Preventing a spill is the primary goal; however, the Contractor is expected to be prepared to minimize the impacts of a spill through immediate and appropriate response actions. The current Standard Specifications Section 1-07.15 and SPCC plan guidance are available to Contractors at:http://www.wsdot.wa.gov/Environment/HazMat/SpillPrevention.htm In most cases, spills can be controlled and mitigated with the SPCC plan and normal erosion/runoff controls at the construction site. Care should be taken to prevent dust from traveling off-site by maintaining a water truck on-site to wet down areas around structures that may contain LBP or ACM,. All suspected LBP and ACM will be placed in appropriate containment as soon as it is removed from structures in order to decrease the possibility of exposure to the general public.	Colman Dock.
	In-situ Soil and Sediment Contamination	Environmental impacts may result if contaminated soil and sediment are not properly managed and are allowed to spread to clean surfaces (contaminated water may also result from clean water coming into contact with contaminated stockpiled soil). Contamination not managed properly in accordance with existing regulations could potentially affect human health and ecological receptors.	Hazardous materials investigations that identify known or suspected contaminated sites can allow WSDOT staff to make informed decisions regarding planning, acquisition, design, and/or construction options. Hazardous materials investigations are conducted early in the environmental planning, design, and acquisition phase. The reports often indicate the type and severity of contaminants in the area. These environmental reports are maintained in the Regional Environmental Office's project file. Alternative construction design or techniques are used to avoid contaminated areas or minimize quantity of material generated. For example, driven piles may be used where concrete is tremied into place to limit the volume of dewatering. WSDOT Standard Specifications Section 1-07.5 requires the Contractor to comply with Environmental Regulations and current federal and state laws and regulations. General Special Provisions and Special Provisions (GSPs and SPs) can be added to the construction contract when site-specific circumstances warrant special measures that can be contractually enforced. GSPs are used when the contamination is predicted but not known. SPs are project-specific and used for known contamination. GSPs and SPs can inform the Contractor of known or potential contaminants and the investigative reports that are available for the Contractor's review. Once informed, the Contractor is responsible for safely and responsibly managing contamination in accordance with all federal, state, and local laws. WSDOT Manuals provide policy and procedures for hazardous materials encountered during construction. The *Environmental Procedures Manual* (31-11), Chapter 620.08 provides policy and procedures for identifying, handling, and disposing of hazardous materials encountered during construction. The *Construction Manual* (M41-01), Section 1-2.2K provides WSDOT staff guidance and procedures to ensure environmental compliance during construction. These publications are available at http://www.wsdot.wa.gov/fasc/EngineeringPublications/library.htm. Proper planning and training should be conducted for projects likely to encounter contamination. Planning should address the project-specific needs (e.g., limited space constraints preventing ability to stockpile contaminated soil or store several Baker tanks) to identify specific techniques and training requirements needed to effectively manage the hazardous materials generated during construction. Training should include key construction staff and project inspectors to recognize hazardous materials and understand appropriate protocols for safely isolating, containing, characterizing, and properly disposing of hazardous materials, and for securing disposal documentation. WSDOT Hazardous Materials and Solid Waste Program staff is available to provide construction support by giving guidance and recommendations for general hazardous materials management procedures. WSDOT On-call environmental consultants are available to provide hazardous materials management support. For projects that expect to encounter contaminants, it is recommended that a contract with an environmental consultant be established prior to the start of construction.	Colman Dock

[1] *See* 40 CFR 1508.8(a) (NEPA implementing regulations)

WSDOT Standard Hazardous Material Impacts and Mitigation Measures (tailored to this project) – continued

Impact Type		Impact	Mitigation Measure	Impacted Site Identification
	Indirect Impacts to the Environment	**Indirect Impacts[2] (also known as secondary & operational impacts), are impacts caused by a project that occur later in time or further removed in distance, but are still reasonably foreseeable. Indirect impacts caused by a project usually include changes in land use, water quality, social issues, and population density.**		
	Traffic Flow	Vehicle accident spills and long-term ongoing vehicular use and road maintenance may contaminate adjacent soils and surface water. Hazardous materials associated with accident spills, vehicular use, and roadway maintenance typically include petroleum products and metals. Improved traffic flow from the project will reduce vehicle accidents, traffic, and the amount of hazardous materials leaked from vehicles while in traffic and spilled during vehicle accidents. Alternatively, improved roadways may increase traffic volume, creating the potential for increased vehicular accidents that over time may result in the accumulation of contaminants in the soil, sediment, surface water, and/or groundwater.	Post-construction operation is generally expected to improve potential environmental impacts with increased traffic flow and safety. WSDOT will notify Washington State Department of Ecology (Ecology) and Washington State Patrol in the event of an accidental spill during the operational phase. Ecology serves as the state's Incident Command for emergency spills and. as such, responds to spills within highway rights-of-way.	Colman Dock
	Maintenance	Additional operational impacts may include minerals associated with deicing activities.	Chemicals used to maintain existing roadways are applied in accordance with manufacturers' specifications, in a manner that designed to minimize harm to the environment.	Colman Dock
	Cumulative Impacts to the Environment	**Cumulative Impacts[3]** are impacts to the environment that result from incremental impacts of a project when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes those actions. "Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" and eventually lead to a measurable environmental change.		
	In-situ Soil and Sediment Contamination	Transportation projects typically have a positive impact on the environment because the project work typically removes and properly disposes of contaminated media. This eliminates potential contaminant sources and removes contamination that might otherwise have remained in the environment and continued to migrate. Paving work can cap contamination and prevent the spread of contaminants through infiltrating stormwater. Capping of contaminated sediment can prevent exposure to biota living in shallow sediment and the water column.	As contaminated media are either cleaned up or capped during project construction, there is an improvement in environmental quality and an increase in economic development. This leads to the overall beneficial cumulative effect to the area.	Colman Dock
	Stormwater	Impacts of hazardous materials and waste from normal operations would primarily be associated with runoff of contaminants entrained in stormwater. Contaminants likely to be in stormwater runoff include petroleum products, metals, and automobile engine coolants such as ethylene glycol.	Stormwater collection and treatment features (e.g., catch basins and oil/water separators) allow for the detention of contaminants within surface runoff from impervious surfaces. These facilities should be designed to collect and retain pollutants from traffic operations and improve water quality.	Colman Dock
Construction Impacts		**Construction Impacts are direct impacts to the project including construction delays and increased costs**		
	General	Construction delays and increased costs often result from unexpected encounters of contamination. Delays are typically caused by segregating and containing contaminants, coordinating sample collection, waiting for laboratory results, identifying a permitted disposal facility, completing the disposal facility's waste profile sheet, and coordinating haul and disposal. Increased costs result from payments to the Contractor during delay, payments to a qualified professional to obtain and analyze samples, laboratory charges, and expensive disposal fees. The subcategories below discuss the following specific types of construction impacts along with associated regulations. • Contaminated Soil and Water • Spills • Demolition • Worker Safety & Public Health	These mitigation measures apply to all the general impacts during construction. Additional mitigation measures apply to each subset of impacts. <u>Hazardous materials investigations</u> that identify known or suspected contaminated sites can allow WSDOT staff to determine how to avoid or minimize potential construction impacts. Hazardous materials investigations are conducted early in the environmental planning, design, and acquisition phase. Investigation reports allow WSDOT staff to make informed decisions regarding planning, acquisition, design, and/or construction options. The reports often indicate the type and severity of contaminants in the area. Even if contamination is not identified prior to construction, hazardous materials investigations are still an important resource during construction when contamination is unexpectedly encountered, because WSDOT staff know the historical land use of the site. These environmental reports are maintained in the Regional Environmental Office's project file. Hazardous materials investigations and environmental reports include, but are not limited to: • Hazardous Material Discipline Reports (Historical & record investigation for project corridors) • Site Reconnaissance / Windshield Surveys • Phase I Environmental Site Assessment (Historical & record Investigation for a site) • Phase II Environmental Site Assessment (Sampling) • Phase III Environmental Site Assessment (a.k.a. Remedial Investigation / Feasibility Study. Evaluates cleanup options & costs) • ACM/LBP Surveys <u>Alternative construction design or techniques</u> are used to avoid contaminated areas or minimize quantity of material generated. For example, different footing designs can lessen the area and depth of excavation to minimize the quantity of wasted soil generated. Another example is using driven piles where concrete is tremied into place to limit the volume of dewatering.	Colman Dock

[2] *See* 40 CFR 1508.8(b) (NEPA implementing regulations)
[3] *See* 40 CFR 1508.7 (NEPA implementing regulations)

WSDOT Standard Hazardous Material Impacts and Mitigation Measures (tailored to this project) – continued

Impact Type		Impact	Mitigation Measure	Impacted Site Identification
Construction Impacts		**Construction Impacts are direct impacts to the project including construction delays and increased costs**		
			WSDOT Standard Specifications Section 1-07.5 requires the Contractor to comply with Environmental Regulations and current rules of resource agencies. The Contractor is required to prevent spreading or contributing to existing contamination and appropriately dispose waste material in a manner consistent with federal, state, and local regulations. Section 1-07.04(2) of the Standard Specifications requires the Contractor to take precautions and perform any necessary work to provide and maintain a safe and healthful worksite in accordance with applicable laws. Sections 1- 07.15 and 8.01 require the Contractor to prepare and implement a project-specific Temporary Erosion and Sediment Control Plan, which addresses prevention of wind dispersion of soil and water pollution during construction. Section 1-07.15(1) requires the Contractor to prepare and implement an SPCC Plan, which addresses both spills from hazardous materials use (including petroleum) and specific measures to prevent release or further spreading of materials in areas with identified preexisting contamination. GSPs and SPs can be added to the construction contract when site-specific circumstances warrant special measures that can be contractually enforced. GSPs are used when the contamination is predicted but not known. SPs are project-specific and used for known contamination. GSPs and SPs can inform the Contractor of known or potential contaminants and the investigative reports that are available for the Contractor's review. Once informed, the Contractor is responsible for safely and responsibly managing contamination in accordance with all federal, state, and local laws. GSPs and SPs can include specific requirements related to containment, removal, and disposal of hazardous materials, USTs, and contaminated soil and water. GSPs and SPs can also establish certification requirements of personnel, notification procedures, and documentation requirements. WSDOT Manuals provide policy and procedures for hazardous materials encountered during construction. The *Environmental Procedures Manual* (31-11), Chapter 620.08 provides policy and procedures for identifying, handling and disposing of hazardous materials encountered during construction. The *Construction Manual* (M41-01), Section 1-2.2K provides guidance and procedures to ensure environmental compliance during construction. These publications are contained at http://www.wsdot.wa.gov/fasc/EngineeringPublications/library.htm. Proper planning and training should be conducted for projects likely to encounter contamination. Planning should address the project-specific needs (e.g., limited space constraints preventing ability to stockpile contaminated soil) to identify specific techniques and training requirements needed to effectively manage the hazardous materials generated during construction. Training should include key construction staff and project inspectors to recognize hazardous materials and understand appropriate protocols for safely isolating, containing, characterizing, and properly disposing of hazardous materials, and for securing disposal documentation. WSDOT Hazardous Materials and Solid Waste Program staff is available to provide construction support by giving guidance and recommendations for general hazardous materials management procedures. When resources are not available, the WSDOT project office can direct and manage environmental consultants in coordination with regional offices. This enables efficient work with the least amount of impact to construction schedule and budget as possible. WSDOT On-call environmental consultants are available to provide hazardous materials management support. Services include, but are not limited to: contaminant screening to identify and segregate potentially contaminated media; sampling; laboratory results QA/QC and interpretation; recommendations for proper management, reuse, or disposal options; preparation of waste profile forms; and assisting with waste manifesting and tracking. A contract with an environmental consultant should be established prior to the start of construction for projects that are expected to encounter contaminants.	
	In-situ Soil and Sediment Contamination	Construction delays and increased costs often result from unexpected encounters of contaminated media. Delays related to stockpiling contaminated soil, coordinating sample collection, waiting for laboratory results, identifying a permitted disposal facility, completing the disposal facility's waste profile sheet, and coordinating haul and disposal. Increased costs result from payments to the Contractor during the delay, payments for containment supplies, payments to a qualified professional to obtain and analyze samples, laboratory charges, and expensive disposal fees. Construction (staging) activities may be impacted depending upon the need to alter their proximity due to contaminated media, USTs, etc.	Prior to Construction: Hazardous materials investigations conducted early in the project development phase can identify known and potentially contaminated sites within a project corridor. The reports often indicate the type and severity of contaminants in the area. These investigations identify known or suspected contaminated sites and allow WSDOT staff to make informed decisions regarding planning, acquisition, and design and/or construction options. These environmental reports are maintained in the Regional Environmental Office's project file. Mitigation measures for contaminated soil and sediment include pre-construction planning to define the areas where contamination may be encountered, design changes to minimize contaminated media that must be managed, and implementing practical cleanup alternatives for contaminated soil and sediment. Mitigation includes incorporating GSPs and project-specific SPs, which makes the Contractor responsible for being prepared to appropriately handle contaminated material with minimal delays. Proper planning and training should be conducted for projects likely to encounter contamination. Planning should address the project-specific needs (e.g., limited space constraints preventing ability to stockpile contaminated soil) to identify specific techniques and training requirements needed to effectively manage the hazardous materials generated during construction. Training should include key construction staff and project inspectors to recognize hazardous materials and understand appropriate protocols for safely isolating, containing, characterizing, and properly disposing of hazardous materials, and for securing disposal documentation. Contaminated Media Management Plans (CMMPs) are developed when significant amounts of known contaminated soil and sediment requires excavation or dewatering. CMMPs establish specific handling and disposal procedures and chains or responsibility to effectively manage contaminated soil and sediment as it is encountered in order to minimize schedule delays and excessive costs. A comprehensive CMMP would address field screening methods, notification requirements, soil stockpile management, and sampling and disposal requirements. During Construction: For encounters of known or unknown contaminated soil or groundwater, project offices are directed to contact their WSDOT Hazardous Materials Specialist. A WSDOT Hazardous Materials Specialist or other contracted qualified environmental professional will provide the project office direction and technical support. Internal notification to WSDOT Hazardous Materials Specialists also ensures that the appropriate follow-up work (should contamination be left in place) is conducted in accordance with Model Toxics Control Act (MTCA) regulations. WSDOT's policy and procedures for identifying, handling, disposing of, and documenting contamination encountered during construction is contained in EPM Chapter 620.08. Timely, proper management of contaminated media can prevent spreading contaminants to clean soil, surface waters, and the air and can reduce construction delays and cost increases. Alternative construction techniques may need to be employed to minimize earthwork occurring near any of the above-mentioned liability issues. WSDOT and/or its contractors would be responsible for proper management of any regulated hazardous wastes.	

WSDOT Standard Hazardous Material Impacts and Mitigation Measures (tailored to this project) – continued

Impact Type		Impact	Mitigation Measure	Impacted Site Identification
Construction Impacts		**Construction Impacts are direct impacts to the project including construction delays and increased costs**		
	Spills	Construction delays and increased costs may result in the event of a spill and cleanup work of hazardous materials that are used or generated during construction. Construction vehicles and equipment typically use gasoline, diesel, motor oil, transmission fluid, radiator coolant, brake fluid, and hydraulic oil. New construction work typically uses cement, asphalt, tar, paving oils, tack, and paint.	WSDOT project office will follow the internal notification procedures prescribed in the Construction Manual (M41-01.05) Section 1-2.2K(1) for the ECAP to report spills of hazardous materials. An SPCC Plan is also required for all WSDOT construction projects per Standard Specifications Section 1-07.15. Prior to beginning construction, the Contractor is required to prepare a project/site-specific plan to be used throughout the duration of the project. The plan must be updated to reflect actual site conditions and practices. Preventing a spill is the primary goal; however, the Contractor is expected to be prepared to minimize the impacts of a spill through immediate and appropriate response actions. The required elements of the SPCC plan includes: 1. Responsible Personnel 2. Spill Reporting 3. Project and Site Information 4. Potential Spill Sources 5. Preexisting Contamination 6. Spill Prevention and Response Training 7. Spill Prevention 8. Spill Response 9. Project Site Map 10. Spill Response Forms	
	Demolition	Increased costs and delays may result when demolition requires special handling and disposal of certain equipment, materials, or structures. Special demolition considerations can include: a) **ACMs** are likely to exist in buildings constructed prior to 1985. ACM poses risks to public and worker safety when disturbed for maintenance, renovation, and demolition of structures. If a survey is not completed prior to construction, the project may be delayed. b) **LBP** is likely to exist in structures built before 1978 and is typically found on steel bridge structures. LBP poses risks to environmental health and worker safety when disturbed for maintenance, renovation, and demolition of structures including bridges and buildings. If a survey is not completed prior to construction, the project may be delayed. c) **ASTs** and other containers (such as drums, cans, and bottles) that store hazardous materials d) **Universal Waste,** defined in Chapter 173-303 WAC, batteries, lamps, thermostats, and mercury-containing equipment e) **Creosote** or **Arsenic [a.k.a. Chromated Copper Arsenate (CCA)] treated wood**, such as railroad ties, telephone poles, and marine pilings f) **PCB-containing equipment** in aboveground utilities	Prior to demolition work, hazardous materials surveys with follow-up sampling (where required) should be conducted to identify equipment, materials, and structures that require special handling or disposal. A comprehensive building survey and sampling program helps limit the amount of material required for special removal and disposal. In addition, surveys help avoid the potential for environmental contamination and construction delays and promote worker health and safety. It is recommended that any demolition items (see list "Impact") that may be potential contaminant sources be clearly identified (locations and estimated quantities) and then appropriately handled, segregated, and removed for disposal as required by applicable regulations. **ACM** is often found in commercial and residential buildings constructed prior to 1985. A pre-demolition building survey, conducted by an Asbestos Hazard Emergency Response Act (AHERA)-certified building inspector would verify the presence of ACM and provide locations and estimated quantities requiring special handling and disposal in a report. If ACM is identified, mitigation would consist of removing these materials in compliance with regulations prior to building demolition and disposal in a legally permitted facility (i.e., lined landfill). Regulations include specific notification, work practice, packaging, labeling, and disposal requirements. Chapter 620.08 of the EPM provides additional mitigation measures details. **LBP** poses risks to environmental health and worker safety when disturbed for maintenance, renovation, and demolition of structures including bridges and buildings. Testing and documentation should be completed as early in the project design phase as possible to determine if special procedures and disposal that will result in increased costs will be required for existing LBP. LBP testing, abatement, or related activities in Washington are required to be licensed by the Lead-Based Paint Program located within the Department of Community, Trade and Economic Development (CTED). Performing such activities without LBP certification from CTED is a violation of Chapter 365-230 WAC. Chapter 620.08 of the EPM provides additional mitigation measure details. Standard removal, testing, and disposal protocols of LBP on bridge structures are described WSDOT Standard Specifications Section 6.07.3 and EPM Chapter 6.08. Lead pipe or lead-painted metal can be recycled as scrap metal in accordance with WAC 173-303-071(3)(ff). If the material is not recycled, it must be evaluated to determine whether it requires management and disposal as a dangerous waste (per Chapter 173-303 WAC). Contractors are required to abide by WAC 296-62-07521 for general lead exposure health and safety. **Universal Waste** poses a risk to the worker health, public safety, and the environment if improperly handled and disposed. A pre-demolition building survey should be conducted prior to demolition to identify these regulated materials and ensure that they are properly handled and disposed in accordance with WAC 173-303-573. Additional information is available in the following Ecology Publications, which can be accessed by using the Publication number at: http://www.ecy.wa.gov/pubs.shtm: • The Universal Waste Rule, Publication 98-407 • The Universal Waste Rule for Batteries, Publication 98-407a • The Universal Waste Rule for Mercury-containing Equipment and Thermostats, Publication 98-407b • The Universal Waste Rule for Lamps, Publication 98-407c **Creosote or arsenic treated wood** may be reused even if the treated wood is designated as a hazardous/dangerous waste per a Toxics Characteristics Leaching Procedure (TCLP) test (See Chapter 173-303 WAC). However, its reuse must be utilized for its "intended end use" per 40 CFR 261.4(b)(9). This means that treated wood cannot be chipped or shredded for mulch and used in landscaping applications. Ecology encourages reuse of treated wood as a preferred management alternative. If reuse is not feasible, disposal facilities will most likely require sampling (TCLP test for arsenic) of treated wood to determine if it is designated as a Dangerous Waste (per Chapter 173-303 WAC). If not a Dangerous Waste, then the treated wood can be managed as a solid waste (per Chapter 173-304 WAC) and accepted into a Subtitle D landfill or a Waste-to- Energy incinerator (hog fuel). If the wood is designated as a Hazardous/Dangerous Waste, then disposal at a higher cost is required at a Subtitle C facility. Chapter 620.08 of the EPM provides additional mitigation measure details. **PCB-containing equipment**, particularly aboveground utilities, poses a risk to worker health, public safety, and the environment if improperly handled and disposed. A pre-construction survey should be completed to identify equipment of concern. PCB-containing equipment should be disposed of per federal and state regulations.	

WSDOT Standard Hazardous Material Impacts and Mitigation Measures (tailored to this project) – continued

Impact Type		Impact	Mitigation Measure	Impacted Site Identification
Construction Impacts		**Construction Impacts are direct impacts to the project including construction delays and increased costs**		
	Worker Safety & Public Health	Exposure of hazardous materials to construction workers and the public may result during excavation and management of contaminated media (e.g., soil, abandoned drums or containers) or from the misuse of hazardous substances used or generated on-site during construction activities. Typical exposures in these situations include ingestion, dermal contact, and/or inhalation. Contaminants including vapors that produce physical symptoms such as dizziness, irritated or burned skin and eyes, long-term serious injury, suffocation, and death may be present in excavations or drums. Minor spills of materials used in construction, such as fuels, lubricants, and hydraulic fluids, typically occur during construction operations. Exposure to such accidental release could damage skin, eyes, lungs, and other organs. Contaminants and vapors that are typical for WSDOT construction sites are primarily petroleum based, where concentrations are expected to be similar to exposures during fueling at public gas stations. Worker and public health and safety impacts are also a concern due to the explosion and fire hazards posed by ASTs, and abandoned drums or containers. Containers are an explosion hazard when vapors trapped within the tank reach explosive limits and detonate when ignited by a spark or some other incendiary device like a cigarette. Fire may produce irritating, corrosive, and/or toxic gases. Demolition work may release ACM, LBP, and/or bird guano. Inhalation and ingestion of LBP, ACM, and/or bird guano could have a damaging effect on workers' health. Common short-term symptoms of **lead** poisoning include abdominal pain, headaches, constipation, and aches in the joints. Exposure to high levels of lead poisoning can result in retardation, convulsions, coma, and death. The risks associated with low levels of contact with **asbestos** are not well established, so the EPA concludes there is no level of exposure below which the risks of contracting an asbestos-related disease are zero. Exposures to asbestos can result in long-term progressive illnesses including lung cancer, asbestosis, and mesothelioma. Histoplasmosis is an infectious disease caused by inhaling spores of a fungus called Histoplasma capsulatum found in **bird guano**. Construction delays and increased costs may result when the Contractor is unaware of site-specific circumstances that would warrant special employee safety training, certification and/or preparation of a site-specific Worker Health and Safety Plan.	Hazardous materials investigations (as described above) identify known or potentially contaminated areas early in project. This allows WSDOT project staff to incorporate a GSP or SPs into the contract to notify the Contractor of site-specific conditions. Copies of hazardous materials investigations are made available to the Contractor. When WSDOT informs the Contractor of these conditions, the Contractor is required to train the workers to recognize hazardous conditions in the work place and train them how to respond to and report such conditions. The Washington State Department of Labor and Industries requires that personnel receive proper training for working with hazardous materials and donning appropriate personal protective equipment. Depending on the nature of any contamination encountered during construction activities, worker safety training (such as 24- or 40-hour HAZWOPER training) may be required of personnel working on the site under Chapter 296-62 WAC. The Contractor must protect workers and the public from potential safety and health impacts. The Occupational Safety and Health Act (OSHA) establishes requirements for site safety procedures, worker training, and worker safety and health standards for employees engaged in work related to or potential exposure to hazardous materials/substances. The WSDOT Standard Specifications (applicable to all projects) Section 1-07.04(2) requires the Contractor to take precautions and perform any necessary work to provide and maintain a safe and healthful worksite in accordance with applicable laws. In addition to health and safety training, workers should be trained in procedures to prevent hazardous materials from migrating off-site and coming into contact with the public. Erosion and dust controls should be maintained on-site at all times during construction, and any materials suspected to contain lead or asbestos should be abated by professionals trained in the removal and disposal of these materials. According to the National Institute for Occupational Safety and Health, before an activity is started that may disturb any material that might be contaminated by Histoplasma capsulatum, workers should be informed in writing of the personal risk factors that increase an individual's chances of developing histoplasmosis. Such a written communication should include a warning that individuals with weakened immune systems are at greatest risk of developing severe and disseminated histoplasmosis if they become infected. These people should seek advice from their health care provider about whether they should avoid exposure to materials that might be contaminated with Histoplasma capsulatum.	

WSDOT Standard Hazardous Material Impacts and Mitigation Measures (tailored to this project) – continued

Impact Type		Impact	Mitigation Measure	Impacted Site Identification
WSDOT Liability				
	Acquisition – Cleanup Liability	WSDOT can inherit cleanup liability when 1) it acquires a contaminated site, 2) construction activities spread or cause contamination to become worse, or 3) final project construction prevents or obstructs a potentially liable party from conducting remedial activities. RCW 70-105D.040 identifies persons liable for a facility/property as: 1) the current or past facility owner/operator; 2) anyone who arranged for disposal/treatment of hazardous substances at the site; 3) anyone who transported hazardous substances for disposal/treatment at the site, unless it could legally receive the materials at the time of transport; or 4) anyone who sells a hazardous substance with written instructions for its use, where abiding by the instructions resulted in contamination. In situations where there is more than one liable party, each party is jointly and severally liable for costs associated with cleanup of a site and cost to repair damages to natural resources. Cleanup liability can become an expensive immediate or long-term cost. As a property owner, WSDOT would be liable for the cleanup of on-site contaminated soil and groundwater. Liability issues for sites with contamination can also extend beyond the property boundaries if contamination migrated off-site through soils or groundwater. In addition, WSDOT would be responsible for the removal of any stored or abandoned hazardous materials remaining on-site at the time of acquisition. WSDOT would incur the costs for characterization, cleanup, disposal, and potential long-term monitoring. WSDOT generally would not incur liability for groundwater contamination that has migrated into the project footprint as long as the agency does not acquire the source of the contamination. Any contaminated groundwater that has entered into the project footprint may create an impact to construction activities as described in further sections of this discipline study.	Hazardous materials investigations identify known or potentially contaminated sites early, which allow WSDOT project staff to avoid acquiring or excavating in contaminated sites. The preference is to avoid purchasing a contaminated site and avoid cleanup liability. However, there are options *prior to acquisition* to reduce liability risks when no feasible alternative or design option is available and WSDOT is forced to acquire and/or excavate contaminated property in order to complete a construction project. To manage potential cleanup liability risks, when necessary, WSDOT performs all appropriate inquiry prior to acquisition of and construction on potentially contaminated property. For WSDOT projects, "All appropriate inquiry" includes a site reconnaissance, and/or varied levels of Phase I and II Environmental Site Assessments generally following American Society for Testing and Materials (ASTM) standards 1527, 1528, and 1903. The type and level of environmental investigation is considered on a case-by-case basis in coordination with the WSDOT Hazardous Materials and Solid Waste Program. When USTs or contamination are identified prior to property acquisition, WSDOT should assign fair market property values that consider remediation costs and potential long-term (i.e., on-going monitoring and site management) cleanup costs. To limit potential liability risks prior to acquisition, WSDOT can use performance bonds, indemnifications, and other tools to minimize agency costs and cleanup liability. *For sites that may be substantially contaminated*, WSDOT must clearly demonstrate that "All Appropriate Inquiry" (per 40 CFR Part 312) had been undertaken to discover, investigate, and characterize the hazardous substance and, once discovered, that due care was exercised to prevent the release or spread of contamination. Demonstrating All Appropriate Inquiry per EPA's final rule establishes that WSDOT met specific regulatory requirements for conducting all appropriate inquiries into the previous ownership, uses, and environmental conditions of a property. This level of investigation should be considered only when WSDOT decides to acquire property that may be substantially contaminated and the responsible party is not performing cleanup or under an Agreed Order. Decisions regarding site cleanup should be made in coordination with the Hazardous Materials Program in order to ensure that the cleanup remedy will be "substantially equivalent of an Ecology conducted cleanup" to secure WSDOT's ability to recover cleanup costs from solvent companies who are potentially liable. Additional guidance regarding appraisal and acquisition guidance is presented in WSDOT's *Right-of-Way Manual* (M26-01), May 2006, Sections 4- 4.4 D & E and 6-5.14. These publications are available at: http://www.wsdot.wa.gov/fasc/EngineeringPublications/library.htm.	
	Spills	Hazardous materials spills that impact surface water, groundwater, sediment, or soils located within the project footprint may result in WSDOT and/or the Contractor incurring liability for an appropriate cleanup of the affected area and for environmental damages to state and federal agencies.	WSDOT project office will follow the internal notification procedures prescribed in the Construction Manual (M41-01.05) Section 1-2.2K(1) for the ECAP to report spills of hazardous materials. An SPCC Plan is also required for all WSDOT construction projects per Standard Specifications Section 1-07.15. The SPCC plan describes the process for prevention and response for spills of hazardous materials during construction.	
	Disposal	As an owner and/or generator, WSDOT could be subsequently liable for the cleanup of contaminated media disposed of at a non- permitted facility.	WSDOT maintains disposal documentation (i.e., lab data, sampling procedures, waste profile sheets, and disposal tickets) proving contaminated waste was properly characterized and disposed at a legally permitted facility. GSPs or project-specific SPs added to the construction contract require the Contractor to provide a copy of the shipping manifest or bill of lading indicating the amount of material hauled to disposal, and bearing the disposal site operator's confirmation for receipt of the material. Standard Specifications Section 2-03.3(7) requires the Contractor to provide the WSDOT Project Engineer the location of disposal sites and copies of required permits and approvals before any waste is hauled off the project. Additional policy and procedures for identifying, handling, disposing, and documenting contamination encountered during construction is contained in EPM Chapter 620.08.	