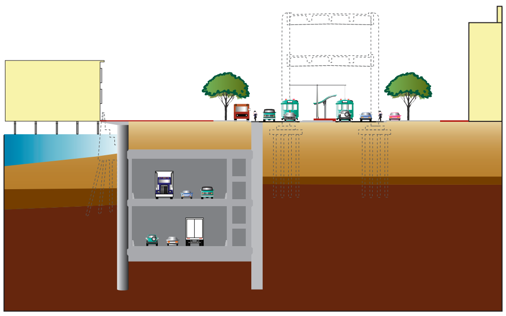
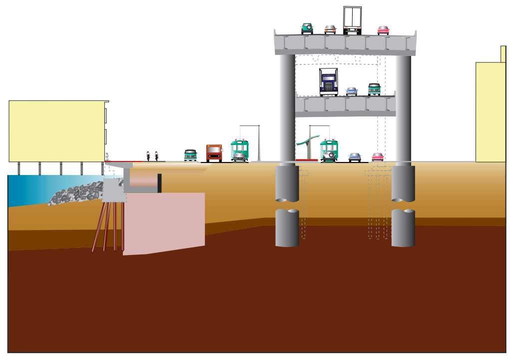
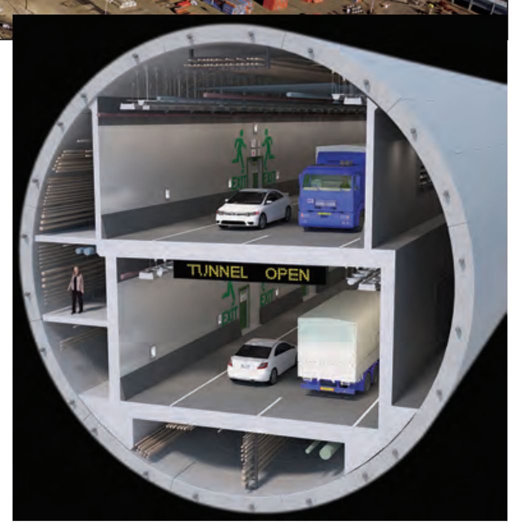
ALASKAN WAY VIADUCT REPLACEMENT PROJECT
Final Environmental Impact Statement

APPENDIX N Wildlife, Fish, and Vegetation Discipline Report







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U.S. Department of Transportation
Federal Highway Administration

Washington State Department of Transportation

City of Seattle

JULY 2011

Alaskan Way Viaduct Replacement Project

Final EIS

Wildlife, Fish, and Vegetation Discipline Report

The Alaskan Way Viaduct Replacement Project is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

Parsons Brinckerhoff

999 Third Avenue, Suite 3200
Seattle, WA 98104

In association with:

Coughlin Porter Lundeen, Inc.
EnviroIssues, Inc.
GHD, Inc.
HDR Engineering, Inc.
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William P. Ott Construction Consultants

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List of Exhibits

ACRONYMS AND ABBREVIATIONS

μg/L	micrograms per liter
BMP	best management practice
City	City of Seattle
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FHWA	Federal Highway Administration
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PGIS	pollutant-generating impervious surface
project	Alaskan Way Viaduct Replacement Project
Program	Alaskan Way Viaduct and Seawall Replacement Program
SODO	South of Downtown
SR	State Route
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WWTP	wastewater treatment plant

Chapter 1 INTRODUCTION AND SUMMARY

1.1 Introduction

This discipline report was prepared in support of the Final Environmental Impact Statement (EIS) for the Alaskan Way Viaduct Replacement Project (project). The Final EIS and all of the supporting discipline reports evaluate the Viaduct Closed (No Build Alternative) in addition to the three build alternatives: the Bored Tunnel Alternative (preferred), the Cut-and-Cover Tunnel Alternative, and the Elevated Structure Alternative. The designs for both the Cut-and-Cover Tunnel Alternative and the Elevated Structure Alternative have been updated since the 2006 Supplemental Draft EIS (WSDOT et al. 2006) to reflect that the section of the viaduct between S. Holgate Street and S. King Street is being replaced by a separate project, and the roadway alignment at Washington Street no longer intrudes into Elliott Bay. All three build alternatives are evaluated with tolls and without tolls.

The Federal Highway Administration (FHWA) is the lead federal agency for this project, primarily responsible for compliance with the National Environmental Policy Act (NEPA) and other federal regulations, as well as distributing federal funding. Per the NEPA process, FHWA was responsible for selecting the preferred alternative. FHWA has based its decision on the information evaluated during the environmental review process, including information contained in the 2010 Supplemental Draft EIS (WSDOT et al. 2010) and previous evaluations in 2004 and 2006. After issuance of the Final EIS, FHWA will issue its NEPA decision, called the Record of Decision (ROD).

The 2004 Draft EIS (WSDOT et al. 2004) evaluated five build alternatives and a No Build Alternative. In December 2004, the project proponents identified the Cut-and-Cover Tunnel Alternative as the preferred alternative and carried the Rebuild Alternative forward for analysis as well. The 2006 Supplemental Draft EIS (WSDOT et al. 2006) analyzed two alternatives—a refined Cut-and-Cover Tunnel Alternative and a modified rebuild alternative called the Elevated Structure Alternative. After continued public and agency debate, Governor Gregoire called for an advisory vote to be held in Seattle. The March 2007 ballot included an elevated structure alternative (differing in design from the current Elevated Structure Alternative) and a surface-tunnel hybrid alternative. The citizens voted down both alternatives.

After the 2007 election, the lead agencies committed to a collaborative process (referred to as the Partnership Process) to find a solution to replace the viaduct along Seattle's central waterfront. In January 2009, Governor Gregoire, King County Executive Sims, and Seattle Mayor Nickels announced that the agencies had reached a consensus and recommended replacing the aging viaduct with a bored tunnel, which is being evaluated in this Final EIS as the preferred alternative.

1.2 Overview of Build Alternatives

The Alaskan Way Viaduct Replacement Project is one of several independent projects developed to improve safety and mobility along State Route (SR) 99 and the Seattle waterfront from the South of Downtown (SODO) area to Seattle Center. Collectively, these individual projects are referred to as the Alaskan Way Viaduct and Seawall Replacement Program (the Program). See Exhibit 1-1.

Exhibit 1-1. Other Projects Included in the Alaskan Way Viaduct and Seawall Replacement Program

Project	Bored Tunnel Alternative	Cut-and-Cover Tunnel Alternative	Elevated Structure Alternative
Independent Projects That Complement the Bored Tunnel Alternative			
Elliott Bay Seawall Project	X	Included in alternative	Included in alternative
Alaskan Way Surface Street Improvements	X	Included in alternative	Included in alternative
Alaskan Way Promenade/Public Space	X	Included in alternative	Included in alternative
First Avenue Streetcar Evaluation	X	Included in alternative	Included in alternative
Elliott/Western Connector	X	Function provided[1]	Function provided[1]
Transit enhancements	X	Not proposed[2]	Not proposed[2]
Projects That Complement All Build Alternatives			
S. Holgate Street to S. King Street Viaduct Replacement Project	X	X	X
Mercer West Project	X	X	X
Transportation Improvements to Minimize Traffic Effects During Construction	X	X	X
SR 99 Yesler Way Vicinity Foundation Stabilization	X	X	X
S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project	X	X	X

1. These specific improvements are not proposed with the Cut-and-Cover Tunnel and Elevated Structure Alternatives; however, these alternatives provide a functionally similar connection with ramps to and from SR 99 at Elliott and Western Avenues.
2. Similar improvements included with the Bored Tunnel Alternative could be proposed with this alternative.

This Final EIS evaluates the cumulative effects of all the build alternatives; however, direct and indirect environmental effects of these independent projects within the Program will be considered separately in independent environmental documents.

The S. Holgate Street to S. King Street Viaduct Replacement Project, currently under construction as a separate project, was designed to be compatible with any of the three viaduct replacement alternatives analyzed in this Final EIS.

1.2.1 Bored Tunnel Alternative

The Bored Tunnel Alternative (preferred alternative) includes replacing SR 99 with a bored tunnel and associated improvements, such as relocating utilities located on or under the viaduct, removing the viaduct, decommissioning the Battery Street Tunnel, and making improvements to the surface streets in the tunnel's south and north portal areas.

The Bored Tunnel Alternative would replace SR 99 between S. Royal Brougham Way and Roy Street with two lanes in each direction.

Beginning at S. Royal Brougham Way, SR 99 would be a side-by-side surface roadway that would descend to a cut-and-cover tunnel. At approximately S. King Street, SR 99 would then become a stacked bored tunnel, with two southbound travel lanes on the top and two northbound travel lanes on the bottom.

The bored tunnel would continue under Alaskan Way S. to approximately S. Washington Street, where it would curve slightly away from the waterfront and then travel under First Avenue beginning at approximately University Street. At Stewart Street, it would extend north under Belltown. At Denny Way, the bored tunnel would travel under Sixth Avenue N., where it would transition to a side-by-side surface roadway at about Harrison Street.

Access and exit ramps in the south would include a southbound on-ramp to and northbound off-ramp from SR 99 that would be built in retained cuts and feed directly into a reconfigured Alaskan Way S. with three lanes in each direction. Alaskan Way S. would have one new intersection, with the new east-west cross street at S. Dearborn Street.

The Bored Tunnel Alternative also includes reconstructing a portion of the east-west S. King Street and widening the East Frontage Road from S. Atlantic Street to S. Royal Brougham Way to accommodate truck turning movements. Railroad Way S. would be replaced by a new one-lane roadway on which northbound traffic could travel between S. Dearborn Street and Alaskan Way S.

Access from northbound SR 99 and access to southbound SR 99 would be provided via new ramps at Republican Street. The northbound off-ramp to Republican Street would be provided on the east side of SR 99 and routed to an intersection at Dexter

Avenue N. Drivers would access the southbound on-ramp via a new connection with Sixth Avenue N. on the west side of SR 99.

Surface streets in the north portal area would be reconfigured and improved. The street grid between Denny Way and Harrison Street would be connected by restoring a section of Aurora Avenue just north of the existing Battery Street Tunnel portal. John, Thomas, and Harrison Streets would be connected as cross streets.

1.2.2 Cut-and-Cover Tunnel Alternative

Under the Cut-and-cover Tunnel Alternative, a six-lane stacked tunnel would replace the existing viaduct between S. Dearborn Street and Pine Street. At Pine Street, SR 99 would transition out of the tunnel near the Pike Street Hillclimb and cross over the BNSF Railway tracks on a side-by-side aerial roadway. Near Lenora Street, SR 99 would transition to a retained cut extending up to the Battery Street Tunnel portal. SR 99 would travel under Elliott and Western Avenues. The southbound on-ramp from Elliott Avenue and the northbound on-ramp at Western Avenue would be rebuilt. The northbound on-ramp from Bell Street and the southbound off-ramp at Battery Street and Western Avenue would be closed and used for maintenance and emergency access only.

The Battery Street Tunnel would be retrofitted to improve seismic safety. The existing tunnel safety systems would be updated. Improvements would include widening of the south portal, a new fire suppression system, updated ventilation, and new emergency egress structures near Second, Fourth, and Sixth Avenues.

From the north portal of the Battery Street Tunnel, SR 99 would be lowered in a retained cut to about Mercer Street, with improvements and widening north to Aloha Street. Broad Street would be closed between Fifth and Ninth Avenues N., allowing the street grid to be connected. Mercer Street would continue to cross under SR 99 as it does today. However, it would be widened and converted from a one-way to a two-way street, with three lanes each way and a center turn lane.

Access to and from SR 99 would be provided at Denny Way and Roy Street. In the northbound direction, drivers could exit at Republican Street.

The Cut-and-Cover Tunnel Alternative would replace the existing Elliott Bay Seawall with the west wall of the tunnel. Alaskan Way would be rebuilt with this alternative.

1.2.3 Elevated Structure Alternative

The Elevated Structure Alternative would replace the existing viaduct mostly within the existing right-of-way. The Elevated Structure Alternative would replace the Elliott Bay Seawall between S. Jackson and Broad Streets.

In the central section of Seattle's downtown, the Elevated Structure Alternative would replace the existing viaduct with a stacked aerial structure along the central waterfront. The SR 99 roadway would have three lanes in each direction, with wider lanes and shoulders than the existing viaduct.

The existing ramps at Columbia and Seneca Streets would be rebuilt and connected to a new drop lane. This extra lane would improve safety for drivers accessing downtown Seattle on the midtown ramps.

The existing SR 99 roadway would be retrofitted, starting between Virginia and Lenora Streets up to the Battery Street Tunnel's south portal. SR 99 would travel over Elliott and Western Avenues to connect to the Battery Street Tunnel. This aerial structure would transition to two lanes as it enters the Battery Street Tunnel, and the third northbound lane would drop to Western Avenue. The Battery Street Tunnel would be upgraded with new safety improvements, which include a fire suppression system, seismic retrofitting, and access and egress structures. The vertical clearance would be increased to about 16.5 feet throughout the length of the tunnel.

Unlike the Cut-and-Cover Tunnel Alternative, the Elevated Structure Alternative would not widen the south portal of the Battery Street Tunnel.

The Elliott and Western Avenue ramps would be rebuilt, and the existing southbound off-ramp at Battery Street and Western Avenue and the northbound on-ramp from Bell Street would be closed and used for maintenance and emergency access only. The southbound on-ramp from Elliott Avenue and the northbound on-ramp at Western Avenue would be rebuilt.

The Alaskan Way surface street would be rebuilt as part of the Elevated Structure Alternative. The southbound lanes would be built in a similar location as the existing roadway, and the northbound lanes would be constructed underneath the viaduct.

Aurora Avenue would be modified from the north portal of the Battery Street Tunnel from Denny Way to Aloha Street. Aurora Avenue would be lowered in a side-by-side retained cut roadway from the north portal of the Battery Street Tunnel to about Mercer Street and would be at-grade between Mercer and Aloha Streets. Ramps to and from Denny Way would provide access to and from SR 99 similar to today. The street grid would be connected over Aurora Avenue at Thomas and Harrison Streets. Mercer Street would be widened and converted to a two-way street with three lanes in each direction and a center turn lane. It would continue to cross under Aurora Avenue as it does today.

1.3 Summary of Effects

This discipline report describes the evaluation of potential project-related effects on the fish, wildlife, and vegetation in the study area based on information currently available. For a more detailed description of the Alaskan Way Viaduct Replacement Project and the project alternatives, see Appendix B, Alternatives Description and Construction Methods Discipline Report.

The Bored Tunnel Alternative does not include replacement of the seawall, except as a separate Program element. Most of the alignment for the bored tunnel is located farther to the east, away from the waterfront, unlike the Cut-and-Cover Tunnel Alternative which replaces the seawall the west tunnel wall. The City of Seattle (City) owns the Elliott Bay Seawall and is responsible for its replacement as an independent project. Both the Cut-and-Cover Tunnel and Elevated Structure Alternatives include replacement of the Elliott Bay Seawall along the central waterfront. The seawall needs to be replaced because it is deteriorating and its structural integrity is at risk.

Potential adverse effects of the build alternatives on fish, wildlife, and vegetation species would result from human disturbance and potential temporary and localized sedimentation and turbidity in Elliott Bay during construction of the seawall, and this is discussed as a cumulative effect in Chapter 7 of the Final EIS. The replacement of the Elliott Bay Seawall would also affect the nearshore habitat in Elliott Bay. Although the seawall would be replaced with a new structure landward of the existing seawall, the subsequent removal of the existing seawall could temporarily affect water quality and habitat conditions in the area. However, best management practices (BMPs) will be used to minimize these effects and other construction effects.

Potential operational effects of the project alternatives on fish and wildlife species occurring along the Seattle waterfront would likely be slightly improved or similar to existing conditions, because the area is already the site of heavy vehicle traffic and intense human activity, and the project would not substantially alter the extent or intensity of these uses. Potential indirect effects of the project may include changes to invertebrate and algal resources along the waterfront due to long-term alterations of stormwater management, which could slightly alter sediment and water quality conditions in the nearshore environment.

Cumulative effects are those that, when combined with the effects of past, present, and reasonably foreseeable future projects, may have an additive effect on the environment. Cumulative effects will include continuation of the effects produced by the existing land use activities along the waterfront and the effects of lost or degraded intertidal habitat resulting from the presence of the existing seawall and extensive overwater piers. (See Chapter 7, Cumulative Effects Analysis, of the Final EIS.)

Effects on juvenile salmonids migrating and rearing along the Seattle shoreline would largely be avoided by the Bored Tunnel Alternative, except for any very minor effects that could result from the use of barges to transport construction material to and from the construction site. The other two build alternatives would also involve such activities, which would at an appropriate existing facility. As a result, it is assumed that no in-water or overwater construction activities would be required to allow barge loading or offloading activities for any of the alternatives, including the Viaduct Closed (No Build Alternative). In addition, although no in-water work is included for the Bored Tunnel Alternative and the Viaduct Closed (No Build Alternative), the separate Program element of replacing the Elliott Bay Seawall would require in-water work and has the potential to affect aquatic species in Elliott Bay. The seawall replacement is a program element of the Bored Tunnel Alternative that will be evaluated in a separate and independent environmental review process. However, as a program element, the seawall replacement is included as a cumulative effect discussed in Chapter 7 of the Final EIS.

This evaluation focused on the shoreline portion of the project area along the edge of Elliott Bay because of the concentration of fish, wildlife, and vegetation associated with this portion of the study area. The potential effects of each alternative vary according to their individual design. The primary differences between the build alternatives are as follows:

- All of the build alternatives are expected to improve the water quality of runoff discharged from the project area by reducing the overall amount of pollutant-generating impervious surface (PGIS) area, relative to existing conditions. In addition, peak flow control would be added in some project areas to potentially reduce the frequency and volume of overflows from the combined sewer system. In addition, basic stormwater quality treatment would be provided for PGIS draining to separated stormwater and low-flow diversion systems.
- The Bored Tunnel Alternative would minimize the potential effects on natural resources in the area, compared to the other build alternatives, because a substantial portion of the construction would occur underground.
- The Bored Tunnel Alternative does not include the replacement of the Elliott Bay Seawall and, therefore, does not include any in-water work. The City's Elliott Bay Seawall Project will occur as a separate project, subject to its own environmental review process.
- Both the Elevated Structure and the Cut-and-Cover Tunnel Alternatives would require extensive in-water construction activities, including the removal and replacement of the existing seawall. These alternatives would also include the construction and removal of a temporary ferry access bridge and pedestrian walkways between piers.

- The Cut-and-Cover Tunnel Alternative would move the new seawall landward of the existing seawall in the Pier 48 to Colman Dock area, thereby adding to the overall amount of biologically productive shallow-water habitat. This was discussed in the 2006 Supplemental Draft EIS (WSDOT et al. 2006).
- The Elevated Structure Alternative would also eliminate the previously identified project encroachment on the nearshore habitat in the Pier 48 to Colman Dock area, resulting in a net gain in nearshore habitat versus the previously estimated loss indicated in the 2006 Supplemental Draft EIS (WSDOT et al. 2006).
- The Elevated Structure Alternative would replace the existing gravity wall section of seawall in a location up to 10 to 12 feet landward (depending on the location) of the existing seawall face and remove the piles in the pile-supported sidewalk sections. This would result in substantially greater increases in nearshore habitat than those resulting from the Cut-and-Cover Tunnel Alternative.
- The current seawall replacement approach to isolating the construction areas from the nearshore marine habitat would minimize the use of temporary sheet pile walls, which would likely require removal of the existing riprap at the base of the seawall. This approach would also minimize the amount of marine habitat isolated during the construction process.

Chapter 2 METHODOLOGY

This chapter outlines the procedures used to evaluate the potential environmental effects of the build alternatives and the Viaduct Closed (No Build Alternative) and describes possible mitigation measures for avoiding or minimizing adverse effects or enhancing environmental quality.

Resource agencies with permitting or regulatory authority for the biota and habitat in the study area include the National Marine Fisheries Service (NMFS), the U.S. Fish and Wildlife Service (USFWS), the U.S. Army Corps of Engineers, the U.S. Environmental Protection Agency, the Washington Department of Fish and Wildlife (WDFW), the Washington State Department of Ecology (Ecology), the Washington Department of Natural Resources, and the City.

2.1 Existing Conditions Information

Data collected from published sources on existing conditions of fish, wildlife, and vegetation resource in the study area were used to characterize and assess potential effects from the proposed project. Project engineers provided information on the physical aspects of the project that could potentially alter the existing habitat characteristics and the biota of the study area. Several previous field surveys and reconnaissance surveys also were used as part of the overall project evaluation process (Parametrix 2002; Taylor Associates 2006).

Numerous investigations have been conducted by the Port of Seattle, the City, local tribes, and other entities to identify characteristics of juvenile salmon and the habitat they use as they migrate through or rear in the study area. Information on the timing, habitat characteristics, prey resources used; potential predators; and other factors was obtained from published and unpublished sources.

Overall habitat conditions identified in the 2004 Draft EIS included information from both existing data sources and several reconnaissance surveys conducted as part of the overall project. Conditions have not changed substantially since the publication of the 2004 Draft EIS, the 2006 Supplemental Draft EIS, and the 2010 Supplemental Draft EIS (WSDOT et al. 2004, 2006, and 2010). These previous EISs provide physical and biological habitat data that describe the existing baseline conditions for the analysis and discuss the potential project-related effects. They also identify the species of fish, wildlife, and vegetation known or likely to occur within the study area.

The following federal regulations or statutes apply to fish, wildlife, and vegetation protection in the study area:

- Clean Water Act, Sections 401 and 404
- Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act
- Bald and Golden Eagle Protection Act
- Migratory Bird Treaty Act
- Rivers and Harbors Act
- National Pollutant Discharge Elimination System (NPDES)
- Coastal Zone Management Act

State and local regulations that apply to fish, wildlife, and vegetation include the State Hydraulic Code, the Shoreline Management Act, the Growth Management Act, the State Waste Discharge Individual Permit for Process and Storm Water, local sensitive/critical area ordinances, and applicable Seattle Municipal Code and King County Code requirements. The general goal of these regulations is to protect water quality, shorelines, aquatic habitat, wetlands, riparian areas, and associated terrestrial habitats, as well as the species that depend on these areas.

2.2 Endangered, Threatened, and Proposed Species and Habitat Occurrence

Section 7(a)(2) of the Endangered Species Act (ESA) requires federal agencies to consult with NMFS and USFWS, as appropriate, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their critical habitat. In addition, 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 endangered and threatened species. *Conservation* is defined as the use of all methods and procedures that are necessary to bring any endangered or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary.

Species listed under the ESA by NMFS and USFWS were obtained from the NMFS and USFWS websites (NMFS 2011a; USFWS 2011a). These sources also identify habitat requirements of these species and specifically designated critical habitat. This information was used to assess the potential occurrence of ESA-listed or proposed species in the study area and the potential effects of project-related activities on the species or their critical habitat.

2.3 Essential Fish Habitat

The Magnuson-Stevens Act requires proposed projects with a federal nexus (such as federal funding or the need to obtain a federal permit) to evaluate potential effects on habitat of commercially managed fish populations, including some salmon, groundfish, and pelagic fish species. Essential fish habitat has been defined for the purposes of the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (NMFS 1999). NMFS (2002) has further added the following interpretations to clarify this definition:

- *Waters* include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and that may include areas historically used by fish where appropriate.
- *Substrate* includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- *Necessary* means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.
- *Spawning, breeding, feeding, or growth to maturity* covers the full life cycle of a species.

Project biologists compiled lists of salmon, groundfish, and pelagic species potentially affected by the proposed project and identified for protection under the Magnuson-Stevens Act. They evaluated these species to determine those that are likely to use shoreline habitat within the study area. These analyses are provided in the 2004 Draft EIS, the 2006 Supplemental Draft EIS, or the 2010 Supplemental Draft EIS (WSDOT et al. 2004, 2006, and 2010).

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Chapter 3 STUDIES AND COORDINATION

In addition to the surveys of habitat and species use conducted throughout the EIS process, the evaluation of fish, wildlife, and vegetation included coordination with the following agencies, organizations, and Native American tribes:

- City of Seattle
- Confederated Bands and Tribes of the Yakama Nation
- Duwamish Tribe (non-federally recognized)
- Jamestown S'Klallam Tribe
- King County
- Lower Elwha Klallam Tribe
- Muckleshoot Indian Tribe
- National Marine Fisheries Service
- Port Gamble S'Klallam Tribe
- Port of Seattle
- Snoqualmie Indian Tribe
- Suquamish Tribe
- Seattle Aquarium
- The Tulalip Tribes
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Fish and Wildlife Service
- University of Washington, Fisheries Research Institute
- Washington Department of Fish and Wildlife
- Washington Department of Natural Resources
- Washington State Department of Ecology
- Water Resource Inventory Area (WRIA) 8 and 9 Steering Committees

The following specific information was obtained from agencies and existing information sources:

- Species listed under the ESA
- Priority Habitats and Species Program (WDFW) and Washington Natural Heritage Program (Washington Department of Natural Resources)

- Species habitat requirements, life stages, and timing within the study area
- Habitat descriptions

The resulting updated information consists of the following:

- Designated critical habitat for the southern resident killer whale
- Documentation for the ESA listing of steelhead as a threatened species
- Documentation for the ESA listing of three Puget Sound rockfish as threatened or endangered species
- Review of ongoing evaluations of habitat enhancements of the Elliott Bay Seawall
- Potential effects of project construction and operation on species
- Identification of appropriate avoidance, minimization, and conservation measures to limit project effects on aquatic species
- Appropriate mitigation for project effects

Chapter 4 AFFECTED ENVIRONMENT

This chapter describes the predominant species and relevant habitat conditions within the study area that would potentially be affected by the project. These specifically include any ESA-listed species and their critical habitat; species protected under other legislation, such as the Magnuson-Stevens Act; and other prominent aquatic, wildlife, and vegetation species that would potentially be affected by the project.

Many groups of biota use the shoreline and aquatic habitats in the study area. Elliott Bay supports a rich community of resident and transient fish species, including several species and stocks of anadromous salmonids. Resident fish species commonly observed in the shoreline area along the Elliott Bay Seawall include surfperch, bay pipefish, shiner perch, sculpin, greenling, various flatfishes, and a limited number of lingcod (Parametrix 2004). WDFW Priority Habitats and Species maps (WDFW 2011) indicate that no forage fish spawning occurs within at least a mile of the study area. The following sections summarize the status and use of the study area by fish, marine invertebrates, marine mammals, birds, and other wildlife species.

Overall habitat conditions identified in the 2004 Draft EIS, the 2006 Supplemental Draft EIS, and the 2010 Supplemental Draft EIS are based on information from both existing data sources and several site-specific reconnaissance surveys that provided additional information on habitat conditions and species use of the study area (WSDOT et al. 2004, 2006, and 2010). A review of the available information indicates that habitat conditions remain similar to those described in these previous EISs. No substantial physical changes have occurred along the waterfront to suggest that the use of the habitat by these species has changed.

This chapter provides the physical and biological habitat data that constitute the existing baseline conditions for the evaluation of potential project-related impacts on fish, wildlife, and vegetation.

4.1 Study Area

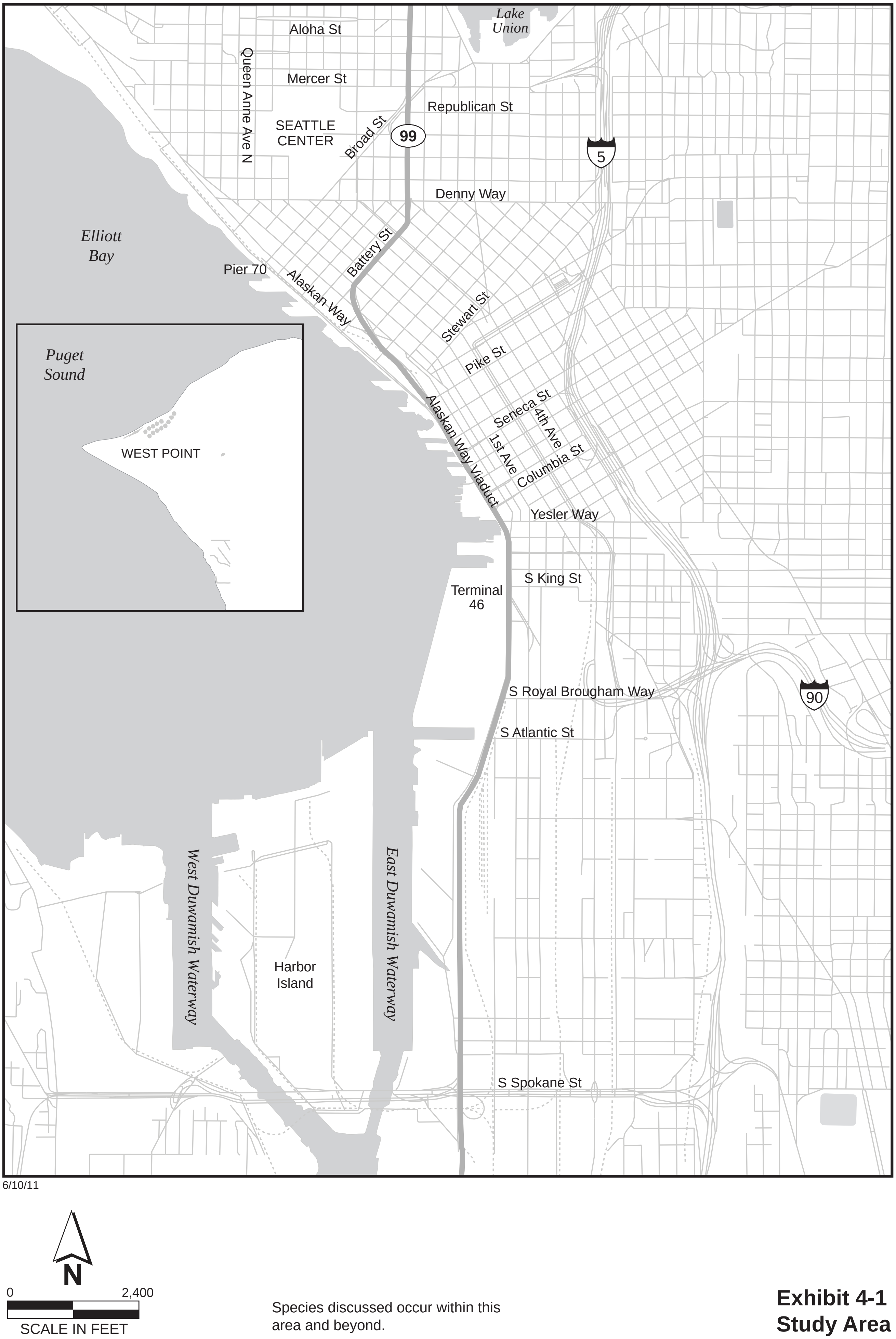
The fish, wildlife, and vegetation that would potentially be affected by the project occur in an urban environment resulting from the development of the shoreline and upland areas in Seattle. Because of the extensive urban development in the study area, the natural resources are concentrated along the Seattle shoreline and Elliott Bay, which support numerous fish and wildlife species. However, the Seattle shoreline has undergone substantial development, including the original construction of the existing Elliott Bay Seawall at a location seaward of the natural shoreline, the filling of intertidal and shallow subtidal areas landward of the seawall, and construction of piers over substantial portions of the remaining shallow-water habitat.

The southern limit of the project area for all the build alternatives is S. Royal Brougham Way. The southern project limit overlap the project limits for the S. Holgate Street to S. King Street Viaduct Replacement Project. The project area for the Bored Tunnel Alternative extends north to Roy Street, and the project area for the Cut-and-Cover Tunnel and Elevated Structure Alternatives extends to Aloha Street.

The study area includes the areas that would be affected directly or indirectly by construction activities, including the immediate construction and associated staging areas, stormwater runoff and dewatering process areas, and the replacement of a major portion of the Elliott Bay Seawall (seawall replacement would be part of the Cut-and-Cover Tunnel and Elevated Structure Alternatives, but not the Bored Tunnel Alternative). The study area also includes any areas that would be affected directly or indirectly by project operations, including some nearshore areas adjacent to stormwater discharge outfalls in Elliott Bay and Lake Union (refer to Appendix O, Surface Water Discipline Report).

The study area includes heavily urbanized upland habitat near the proposed project area and the nearby shoreline and open-water habitats of Elliott Bay and Lake Union (see Exhibit 4-1). This extensive development throughout the area has eliminated nearly all the natural habitat in the area, except for occasional street trees and maintained landscaped areas. These habitat areas support typical urban wildlife species.

The condition of the aquatic portion of the study area has not changed substantially since the 2006 Supplemental Draft EIS was published. The study area still extends from the mouth of the Duwamish River East Waterway to Broad Street (Township 24N, Range 4E, Section 32). In the late 1800s through the early 1900s, the existing central waterfront was filled and bulkheads were built. The waterfront in the study area is predominantly used for commercial and transportation purposes. The shoreline habitat provided along the Seattle waterfront is highly modified from its natural historical condition. Vertical bulkheads in the intertidal zone and extensive overwater pier structures are the least suitable habitat type for anadromous salmonids and many other species of interest. Despite the highly modified conditions along the waterfront, the area is an important migratory and rearing corridor for juvenile salmonids, particularly the major salmon runs of the Green-Duwamish River. Juvenile salmon produced in other watersheds also use habitat on the Elliott Bay shoreline for rearing.



Species discussed occur within this area and beyond.

Exhibit 4-1
Study Area

The study area encompasses the following project elements for all the build alternatives:

- Removal of the existing viaduct structure
- Replacement of SR 99 through the existing viaduct corridor with a tunnel or elevated structure
- Modification of the surface streets in the area to accommodate the other project elements
- Decommissioning or retrofitting of the existing Battery Street Tunnel
- Use of an existing shoreline facility to transport construction material to and from the construction site
- Replacement or accommodation of the replacement of the Elliott Bay Seawall

Although some stormwater runoff from the north end of the study area drains to Lake Union, which supports numerous freshwater and anadromous fish species of the greater Lake Washington watershed, much of it is conveyed to the West Point wastewater treatment plant (WWTP) and subsequently discharged to Puget Sound. The lake represents a transitional area between the fresh waters of the Lake Washington watershed and the marine waters of Puget Sound for anadromous fish. Lake Union has been listed on Ecology's 303(d) Category 5 list for exceeding the criteria for aldrin (an insecticide), fecal coliform bacteria, lead, and total phosphorus (Ecology 2010). It has also exceeded the sediment bioassay criteria. Lake Union is designated by Ecology as core summer habitat for aquatic life uses, excellent primary contact recreation, water supply uses, wildlife habitat, harvesting, commerce and navigation, boating, and aesthetic values (Washington Administrative Code, Chapter 173-210A [WAC 173-201A]).

The sediments in Lake Union are generally soft and contain substantial organic material. As microorganisms in the sediment break down this organic material, they consume much of the oxygen in the deeper part of the lake, reducing the concentrations of dissolved oxygen to near zero by the end of the summer. The lack of oxygen and the warm surface water temperatures in the summer limit the habitat available for coldwater fish species such as salmon and trout, providing habitat that is more suitable for warm-water species such as bass, northern pikeminnow, and crappie. The extensive historical industrial land uses around the lake also have contributed to increased contamination in the substrate.

Despite the extensive urban development and commercial uses along the Seattle shoreline, Elliott Bay is designated by Ecology as an excellent marine water body that should be protected for salmonid and other fish migration, rearing, and spawning; shellfish rearing and spawning; shellfish harvesting; primary contact recreation; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values (WAC 173-201A, Ecology 2006). However, Elliott Bay is also included on Ecology's 303(d) Category 5 list for exceeding fecal coliform criteria (Ecology 2010). Detailed information on water and sediment quality is provided in Attachment A of Appendix O, Surface Water Discipline Report.

A variety of fishes, invertebrates, marine algae, and wildlife species either live within or use the shoreline habitat within the study area for a portion of their life cycle, including some ESA-listed species. As defined by the Magnuson-Stevens Act, essential fish habitat is identified for some commercial species that are likely to occur within the study area. A general review of commercially managed fish populations and habitat that are likely to occur in the project vicinity and would potentially be affected by the project is provided in the following sections.

4.2 Marine Fishes and Invertebrates

The numerous marine fish species that occur along the Seattle shoreline in the study area are similar to those that occur throughout Elliott Bay and Puget Sound (Exhibit 4-2). They include the ESA-listed anadromous fish species Puget Sound Chinook salmon, steelhead, and bull trout (Exhibit 4-3). At times, the Seattle waterfront is a migration corridor and rearing area for these and other juvenile anadromous salmonids, as well as other species. Elliott Bay is a migratory route for large numbers of anadromous salmonids originating from the Green-Duwamish River Watershed and other central Puget Sound river basins (City of Seattle 2003; Brennan et al. 2004). Nearshore marine areas of Elliott Bay are designated as critical habitat for Chinook salmon, bull trout, and steelhead (USFWS 2005; NMFS 2005, 2011b). Elliott Bay is also expected to support the three Georgia Basin rockfish species recently listed under the ESA: bocaccio, canary rockfish, and yelloweye rockfish. Although there are some references to the recently listed Pacific eulachon occurring in Puget Sound, there are no known spawning populations and only rare instances of individual fish occurrences (NMFS 2010a).

Exhibit 4-2. Functional Groupings of Fish Species Occurring in Elliott Bay

Functional Group[1]	Common Name[1]	Scientific Name
Salmonids	Chinook salmon[2, 3]	*Oncorhynchus tshawytscha*
	Coho salmon[2]	*Oncorhynchus kisutch*
	Chum salmon	*Oncorhynchus keta*
	Cutthroat trout	*Oncorhynchus clarki*
	Steelhead[3]	*Oncorhynchus mykiss*
	Bull trout[3]	*Salvelinus confluentus*
Forage fishes	Surf smelt	*Hypomesus pretiosus pretiosus*
	Pacific sand lance	*Ammodytes hexapterus*
	Pacific herring	*Clupea harengus pallasi*
	Pacific eulachon[3]	*Thaleichthys pacificus*

Exhibit 4-2. Functional Groupings of Fish Species Occurring in Elliott Bay (continued)

Functional Group[1]	Common Name[1]	Scientific Name
Other nearshore Fishes	Bay pipefish	*Syngnathus griseolineatus*
	Tube-snout	*Aulorhynchus flavidus*
	Three-spine stickleback	*Gasterosteus aculeatus*
	Six-gill shark	*Hexanchus griseus*
	Spiny dogfish	*Squalus acanthias*
Surfperch	Striped seaperch	*Embiotoca lateralis*
	Pile perch	*Rhacochilus vacca*
	Shiner perch	*Cymatogaster aggregata*
	Kelp perch	*Brachyistius frenatus*
Flatfish	English sole[2]	*Pleuronectes (Parophrys) vetulus*
	Starry flounder[b]	*Platichthys stellatus*
	Rock sole[2]	*Pleuronectes (Lepidopsetta) bilineata*
	Sand sole[2]	*Psettichthys melanostictus*
	Pacific sanddab[2]	*Citharichthys sordidus*
Other demersal fishes	Pacific staghorn sculpin	*Leptocottus armatus*
	Fluffy sculpin	*Oligocottus snyderi*
	Padded sculpin	*Artedius fenestralus*
	Buffalo sculpin	*Enophrys bison*
	Great sculpin	*Myoxocephalus polyacanthocephalus*
	Greenling	*Hexagrammos* spp.
	Lingcod[2]	*Ophiodon elongatus*
	Rockfish[2]	*Sebastes* spp.
	Spotted ratfish[2]	*Hydrolagus colliei*
	Prickleback	*Stichaeidae* spp.
	Northern clingfish	*Gobiesox maeandricus*
	Wolf eel	*Anarrhichthys ocellatus*
Gunnels	Penpoint gunnel	*Apodichthys flavidus*
	Saddleback gunnel	*Pholis ornata*
	Crescent gunnel	*Pholis laeta*
	Rockweed gunnel	*Xererpes fucorum*

1. Phylogenetic conventions and common names according to the American Fisheries Society
2. Species with designated essential fish habitat
3. Species listed under the Endangered Species Act

Exhibit 4-3. Federal ESA-Listed Species Potentially Occurring in the Study Area

	Common Name	Scientific Name	Listing Status
Fishes	Chinook salmon	*Oncorhynchus tshawytscha*	Threatened
	Steelhead	*Oncorhynchus mykiss*	Threatened
	Bull trout	*Salvelinus confluentus*	Threatened
	Pacific eulachon	*Thaleichthys pacificus*	Threatened
	Canary rockfish	*Sebastes pinniger*	Threatened
	Yelloweye rockfish	*Sebastes ruberrimus*	Threatened
	Bocaccio	*Sebastes paucispinis*	Endangered

Exhibit 4-3. Federal ESA-Listed Species Potentially Occurring in the Study Area (continued)

	Common Name	Scientific Name	Listing Status
Wildlife	Southern resident killer whale	*Orcinus orca*	Endangered
	Humpback whale	*Megaptera novaeangliae*	Endangered
	Steller sea lion	*Eumetopias jubatus*	Threatened
	Marbled murrelet	*Brachyramphus marmoratus*	Threatened

Sources: Taylor Associates 2006; Parametrix 2002.
ESA = Endangered Species Act

In addition to the federal ESA-listed species identified in Exhibit 4-3, a number of Washington State species of concern are identified as occurring in King County and also could potentially occur in the study area (Exhibit 4-4).

Exhibit 4-4. Washington State Species of Concern Potentially Occurring in the Study Area

Common Name			
Fishes	Black rockfish	Brown rockfish	Canary rockfish
	China rockfish	Copper rockfish	Greenstriped rockfish
	Quillback rockfish	Redstripe rockfish	Tiger rockfish
	Widow rockfish	Yellowtail rockfish	Pacific cod
	Pacific hake	Pacific herring	River lamprey
	Walleye pollock		
Birds	Common loon	Common murre	Peregrine falcon
	Purple martin	Western grebe	Bald eagle
	Brandt's cormorant		
Mammals	Dall's porpoise	Gray whale	Harbor seal
	Pacific harbor porpoise	California sea lion	Townsend's big-eared bat

The most common marine invertebrate species known to occur in the nearshore waters of Elliott Bay and the Seattle shoreline are identified in Exhibit 4-5.

Exhibit 4-5. Marine Invertebrates Commonly Occurring Along the Seattle Waterfront

Common Name	Scientific Name
Dungeness crab	*Cancer magister*
Red rock crab	*Cancer productus*
Kelp crab	*Cancer gracilis*
Yellow shore crab	*Hemigrapsus oregonensis*
Purple shore crab	*Hemigrapsus nudus*
Hairy crab	*Telmessus cheiragonus*
Coon-stripe shrimp	*Pandalus danae*
Ochre sea star	*Pisaster ochraceus*

Exhibit 4-5. Marine Invertebrates Commonly Occurring Along the Seattle Waterfront (continued)

Common Name	Scientific Name
Sunflower sea star	*Pycnopodia helianthoides*
Common sea star	*Asterias forbesi*
Purple sun star	*Solaster endeca*
Sea anemone	*Metridium* sp.
Giant Pacific octopus	*Octopus dofleini*

Source: Taylor and Associates 2006.

Macroinvertebrates commonly occurring along the Seattle waterfront include sea stars, barnacles, crabs, and shrimp, some of which provide larvae consumed by juvenile salmonids (Taylor Associates 2006; Parametrix 2002). The giant Pacific octopus is occasionally found in the area, and the Seattle Aquarium releases several annually under the aquarium pier. A wide variety of small invertebrates also commonly occur on the macroalgae and open substrates typical of Elliott Bay and Puget Sound.

4.3 Wildlife

The condition of the upland portion of the study area has not changed substantially since the 2010 Supplemental Draft EIS was published. Extensive urban development has eliminated nearly all the natural wildlife habitat, resulting in relatively few species occurring in the upland portion of the study area. The most common species known to occur in downtown Seattle are identified in Exhibits 4-6 and 4-7.

Exhibit 4-6. Mammals That May Be Found Within Urban Habitat Along the Alaskan Way Viaduct Corridor

Common Name	Scientific Name	Common Name	Scientific Name
Common opossum	*Didelphis marsupialis*	Muskrat	*Ondatra zibethicus*
Little brown myotis	*Myotis lucifugus*	House mouse	*Mus musculus*
Yuma myotis	*Myotis yumanensis*	Pacific jumping mouse	*Zapus trimtatus*
California myotis	*Myotis californicus*	Norway rat	*Rattus norvegicus*
Silver-haired bat	*Lasionycteris noctivagans*	Black rat	*Rattus rattus*
Big brown bat	*Eptesicus fuscus*	Coyote	*Canis latrans*
Hoary bat	*Lasiurus cinereus*	Raccoon	*Procyon lotor*
Townsend's big-eared bat	*Plecotus townsendii*	Ermine	*Mustela erminea*
Long-eared myotis	*Myotis evotis*	Mink	*Mustela vison*
Domestic rabbit	*Oryctolagus cuniculus*	River otter	*Lutra canadensis*
Eastern gray squirrel	*Sciurus carolinensis*	Domestic dog	*Canis familiaris*
Deer mouse	*Peromyscus maniculatus*	Domestic cat	*Felis domesticus*

Exhibit 4-7. Birds Commonly Found in Moderately and Poorly Vegetated Urban Habitats of Seattle

Common Name			
House finch	Bewick's wren	Mallard	Golden-crowned kinglet
Double-crested cormorant	American goldfinch	Rock dove	Bufflehead
Great blue heron	American robin	Spotted towhee	Bushtit
Northern flicker	Glaucous-winged gull	Northern flicker	American wigeon
Downy woodpecker	Cedar waxwing	Song sparrow	Red-breasted nuthatch
Steller's jay	Ring-billed gull	Lesser scaup	Violet-green swallow
American crow	Spotted towhee	Green-winged teal	European starling
Black-capped chickadee	American coot	House sparrow	

The shoreline and open-water areas of Elliott Bay continue to support wildlife (Exhibit 4-8). Marine mammal species that occur along the shoreline of Elliott Bay include the harbor seal and the California sea lion. These marine mammals feed on flatfish, rockfish, cod, squid, and octopus. Marine mammals occasionally feed on adult and juvenile salmon, although salmon are not a major part of their diet (Osborne et al. 1988; Olesiuk et al. 1995; Yurk and Trietes 2000). Gray whales and Dall's porpoise could potentially occur within Elliott Bay, but they are typically not observed close to the urban shoreline area.

Exhibit 4-8. Marine Mammals Potentially Occurring in Elliott Bay

Common Name	Scientific Name
Harbor seal	*Phoca vitulina*
California sea lion	*Zalophus californianus*
Steller sea lion	*Eumetopias jubatus*
Southern resident killer whale	*Orcinus orca*
Dall's porpoise	*Phocoenoides dalli*
Gray whale	*Eschrichtius robustus*
Pacific harbor porpoise	*Phocoena phocoena*

The marbled murrelet, Steller sea lion, and southern resident killer whale are the three ESA-listed species addressed. Although the study area occurs within the known range of marbled murrelets, the nearest nesting area is in the Cascade Mountains, approximately 30 miles from the study area (USFWS 2011b). Puget Sound Ambient Monitoring Program surveys found low concentrations of marbled murrelets off West Point in the summer (Nysewander et al. 2005), but there are no documented records of marbled murrelets in inner Elliott Bay. Substantial boating activity along the Seattle waterfront likely discourages marbled murrelets from using this area, but they could potentially be present in the project vicinity.

Steller sea lions have been sighted only occasionally in southern Puget Sound (Jeffries et al. 2000). They have been observed occasionally on buoys off Toliva Shoal, south of Steilacoom, on buoys off McNeil and Eagle Islands, and in Dalco Passage (Gearin et al. 1999).

Killer whales commonly occur in Puget Sound, but they occur infrequently in Elliott Bay (City of Seattle 2009). However, critical habitat for southern resident killer whales is designated for marine water in Elliott Bay greater than 20 feet deep, relative to extreme high water (NMFS 2010b).

A variety of waterfowl use the nearshore habitat of Elliott Bay (including the Seattle shoreline) and Lake Union (Exhibit 4-9). Many of these species occur in the nearshore area only occasionally or seasonally, while others (such as several of the gulls) are nearly always present.

Exhibit 4-9. Waterfowl and Water-Related Birds Potentially Occurring Along the Seattle Shoreline

Common Name			
Common loon	Double-crested cormorant	Common goldeneye	Herring gull
Yellow-billed loon	Brandt's cormorant	Bufflehead	California gull
Pacific loon	Pelagic cormorant	American coot	Western gull
Red-throated loon	Greater scaup	Hooded merganser	Bonaparte's gull
Western grebe	Lesser scaup	Red-breasted merganser	Ring-billed gull
Red-necked grebe	Black scoter	Pigeon guillemot	Mew gull
Horned grebe	Surf scoter	Belted kingfisher	Glaucous-winged gull
Eared grebe	White-winged scoter	Great blue heron	Barrow's goldeneye
Shorebirds			

4.4 Vegetation

Since the 2006 Supplemental Draft EIS, no new information has become available on the marine macrophytes (algae) and riparian vegetation that could potentially be affected by the project. Species that commonly or sometimes are found along the Seattle waterfront are listed in Exhibit 4-10.

Exhibit 4-10. Marine Macrophytes (Algae) Observed Along the Seattle Waterfront

Type/Common Name	Scientific Name	Occurrence
Green Algae		
Sea hair	*Enteromorpha intestinalis*	Common
Sea lettuce	*Ulva fenestrata*	Common
Sea cellophane	*Monostroma grevillei*	Common

Exhibit 4-10. Marine Macrophytes (Algae) Observed Along the Seattle Waterfront (continued)

Type/Common Name	Scientific Name	Occurrence
Red Algae		
Crisscross network	*Polyneura latissima*	Common
Red ribbon	*Palmaria mollis (palmata)*	Common
Bull-kelp laver	*Porphyra nereocystis*	Common
Turkish towel	*Chondracanthus exasperatus*	Common
Splendid iridescent seaweed	*Mazzaella splendens*	Common
Winged rib	*Delesseria decipiens*	Occasional
Violet sea fan	*Callophyllis violacea*	Occasional
Turkish washcloth	*Mastocarpus papillatus*	Occasional
Sea spaghetti	*Gracilaria sjoestedtii* or *G. pacifica*	Occasional
Brown Algae		
Sugar kelp	*Laminaria saccharina*	Common
Wireweed	*Sargassum muticum*	Common
Seersucker	*Costaria costata*	Common
Rockweed	*Fucus gardneri (distichus)*	Common
Ribbon kelp	*Alaria marginata*	Common
Bull kelp	*Nereocystis luetkeana*	Occasional

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Chapter 5 OPERATIONAL EFFECTS AND MITIGATION

The alignments for the Cut-and-Cover Tunnel Alternative that were analyzed in the 2004 Draft EIS and the 2006 Supplemental Draft EIS encroached on Elliott Bay in the Pier 48 to Colman Dock area. However, the current alignment for the Cut-and-Cover Tunnel does not intrude into Elliott Bay and would not adversely affect the nearshore environment along the central waterfront as the 2004 and 2006 tunnel alternatives were expected to. The Bored Tunnel Alternative would not replace the seawall as part of the project; the seawall would be replaced as a separate and independent project, as part of the larger overall Program.

Some beneficial and adverse operational effects are expected to occur due to changes in the physical characteristics of the habitat and habitat buffers along the project corridor. The changes in water quality in the marine environment are expected to be the primary effects on the natural resources in the study area. The evaluation of these effects depends primarily on potential changes in stormwater volumes and stormwater treatment facilities or procedures along the corridor (see Appendix O, Surface Water Discipline Report). Under the Cut-and-Cover Tunnel Alternative and the Bored Tunnel Alternative, removal of the Alaskan Way Viaduct is likely to eliminate some roosting, perching, and nesting habitat for birds, as well as potential rearing habitat for other common urban wildlife species.

Indirect effects likely would be confined to potential changes in land use activities and population growth in the study area. However, because the area is already completely developed, changes in the natural environment likely would be limited. The build alternatives could result in a slight reduction in the number and duration of combined sewer overflow events from stormwater detention facilities. Detailed evaluations of stormwater management issues are provided in Appendix O, Surface Water Discipline Report.

This chapter includes the analysis of the non-tolled build alternatives to 2015 Existing Conditions.

5.1 Viaduct Closed (No Build Alternative)

Two potential scenarios are possible under the Viaduct Closed (No Build Alternative). The existing viaduct might remain in place, but it would be unusable, either because it has been closed due to age and unsafe conditions or a smaller earthquake event (Scenario 1) or because of a catastrophic failure due to a seismic event of similar or greater magnitude than the 2001 Nisqually earthquake (Scenario 2). The unplanned loss of use of the viaduct could occur in the relatively near future. Analysis of annual pollutant loads in stormwater under existing conditions indicates that the Viaduct Closed (No Build Alternative) would result in a reduction in pollutant loads of approximately 20 percent.

Under the Viaduct Closed (No Build Alternative), no immediate changes to existing conditions of the Elliott Bay Seawall would occur unless there is a catastrophic failure of the fill materials due to a major seismic event. If the existing seawall remains in place, it would continue to require periodic maintenance to ensure the continued stability and integrity of the structure until it is replaced by the City. Such routine maintenance would not measurably change conditions for fish, wildlife or vegetation in the area, although localized and temporary disturbances of habitat and biota would occur to varying degrees, depending on the nature of the specific maintenance activity. For example, stabilizing loose seawall material would likely result in little or no effect on the natural resources in the area, while the emergency repair or replacement of a collapsed seawall section would likely result in substantially greater effects. The seawall would eventually be replaced with a new wall, likely constructed landward of the existing wall.

5.1.1 Scenario 1 – Sudden Unplanned Loss of SR 99

Under Scenario 1, the existing Alaskan Way Viaduct would continue to function as habitat for a limited number of avian species that have adapted to such conditions, although most other species would continue to be unable to inhabit or use the area. However, most of the existing natural habitat in the study area occurs in Elliott Bay, which is not substantially affected by the viaduct, other than the effects of stormwater runoff from the viaduct. Under this scenario, untreated stormwater would continue to be released to Elliott Bay, as it is under existing conditions, until the roadway is closed. After the roadway closure, the runoff would continue, but the sources of stormwater pollutants would have been removed, resulting in improved water quality conditions in aquatic habitat in the study area.

In addition to decreasing the stormwater effects, Scenario 1 would result in no potential effects associated with demolition activities: no project-related increases in airborne contaminants (particularly concrete dust) and no project-related increases in aquatic turbidity due to inadvertent surface water runoff that reaches aquatic habitat in the study area. The Elliott Bay Seawall would continue to be maintained until it is eventually replaced by the City.

5.1.2 Scenario 2 – Catastrophic Failure and Collapse of SR 99

As discussed in Appendix P, Earth Discipline Report, there is a high liquefaction hazard along the downtown Seattle waterfront, which could result in substantial damage to the viaduct and/or the Elliott Bay Seawall during a major earthquake.

Ruptures of water and sewer lines would result in additional material and sewage washing into Elliott Bay. It is probable that stormwater and untreated sewage would be discharged directly to Elliott Bay at various locations. Fuel tanks and other sources of contamination along the waterfront also would likely be damaged and release contaminants to Elliott Bay. Any existing contaminated sediments currently located in the nearshore areas of Elliott Bay could become resuspended.

After these structures and systems are repaired, the water quality conditions are expected to improve if the extensive PGIS area on the viaduct is no longer used for traffic. All of these events would disturb natural resources in the area, at least temporarily, but they are expected to improve conditions in the long term.

All marine biota at the failure locations would be either displaced or destroyed. Large motile biota such as fish and some crabs could leave the area, whereas most invertebrates and algae, along with some of the fish and crabs, would likely be destroyed. Loss of fish is most likely to occur if the catastrophic failure includes the collapse or severe damage to the existing seawall. Although planning efforts are currently underway for the City's Elliott Bay Seawall Project, failure of the existing seawall is still possible before the completion of the seawall construction. The changes to amounts of fill and shaded areas that would occur with this project's design are not yet determined. Therefore, any analysis of potential impacts associated with this scenario would be speculative because the degree of habitat alteration associated with the reconstruction cannot yet be defined.

Any emergency repairs to the damaged areas would be constructed over a period of months with the use of standard BMPs to protect water quality. No actions to restore habitat functions are likely to be included in an emergency replacement of the damaged seawall sections.

5.2 Bored Tunnel Alternative

The Bored Tunnel Alternative would be built deep beneath downtown Seattle along most of its alignment, substantially minimizing potential disturbances to the limited natural resources that currently exist in this urbanized setting. The confined setting of the bored tunnel and its limited overlap with natural habitat or species would have far fewer potential effects on fish, wildlife, and vegetation relative to the potential effects of the other build alternatives. As with the Viaduct Closed (No Build Alternative), no immediate changes to the conditions of Elliott Bay would occur, until the seawall is replaced by the City's Elliott Bay Seawall Project. Therefore, the operational effects of the Bored Tunnel Alternative would be similar to those described for the Viaduct Closed (No Build Alternative).

The analysis of potential operational effects of the Bored Tunnel Alternative assumes that applicable PGIS areas will be retrofitted with water quality BMPs selected from the *Highway Runoff Manual* (WSDOT 2008) and required by the Seattle stormwater code. In general, stormwater runoff from streets and highways, particularly in urban environments, contains pollutants that can affect the quality of the receiving water body. Such pollutants (e.g., copper, zinc, cadmium, chromium; polycyclic aromatic hydrocarbons [PAHs], and suspended solids) vary by the amount and type of PGIS, traffic volumes and average speed, duration and intensity of a storm event, time of year, antecedent weather conditions, and several other factors. Of these, the pollutants of greatest concern to fish and other aquatic species are total suspended solids (TSS), dissolved and total zinc, and dissolved and total copper.

Dissolved copper is known to affect neurological and behavioral responses of trout and salmon at very low concentrations, and salmonids are believed to avoid waters containing copper at concentrations as low as 2.3 micrograms per liter (μg/L) (Sprague 1964). Low concentrations of copper can also reduce the olfactory response (ability to smell) of fish, potentially affecting their ability to locate prey, avoid predators, avoid areas with other contaminants, and navigate (Pacific EcoRisk 2007). Sandahl et al. (2007) reported a 50 percent reduction in olfactory signal response and a 40 percent reduction in predator avoidance response in salmonids exposed to increases in dissolved copper as low as 2.0 μg/L above a background concentration of 0.3 μg/L. Like copper, dissolved zinc can have potentially adverse effects on fish behavior. Sprague (1968) reported that salmonids exhibited significant avoidance responses to increases in zinc concentrations of 5.6 μg/L above background concentrations of 3 to 13 μg/L.

In general, the Bored Tunnel Alternative is expected to either improve or maintain the water quality of stormwater runoff discharged from the study area, by respectively reducing or maintaining the overall amount of PGIS relative to existing conditions and discharging more stormwater to the combined sewer system. A detailed pollutant loading analysis is presented in Appendix O, Surface Water Discipline Report.

The overall volumes of stormwater runoff would not be increased by the Bored Tunnel Alternative, because 100 percent of the study area already consists of impervious surfaces. The road surface in the bored tunnel is not considered PGIS because it would not receive direct rainfall, except in the portal areas, which would still be considered PGIS. Therefore, the confined tunnel configuration would reduce the surface area that can intercept rainfall and reduce overall runoff volumes. The reduced volume of stormwater runoff is expected to allow greater efficiency and effectiveness in collecting and treating stormwater and controlling the discharged volumes to reduce the frequency and volume of combined sewer overflow events. As discussed in the *SR 99 Bored Tunnel Alternative – Summary Level Stormwater Report* (Rosewater GHD 2009), some stormwater is expected to enter the tunnel in each portal area, although this water would be collected and pumped to the combined sewer system. The potential benefits in terms of stormwater management are expected to generally improve the water quality and reduce the volume of water discharged to the existing storm drain system.

Analysis of annual pollutant loads in stormwater under existing conditions, indicate that existing pollutant loads would be reduced by approximately 50 percent under the Bored Tunnel Alternative, compared to 20 percent under the Viaduct Closed (No Build Alternative). These reductions would occur because basic stormwater treatment would be provided by discharging runoff from most of the study area to the combined sewer system and applying water quality BMPs selected from the *Highway Runoff Manual* (WSDOT 2008) to the remainder of the area. In accordance with the Seattle stormwater code, peak flow control would be provided in the north portal area, most likely by the installation of one or more detention facilities.

Under existing conditions and the Viaduct Closed (No Build Alternative), stormwater sub-basins discharge untreated runoff to Elliott Bay and Lake Union. With all the alternatives, sub-basins with combined sewer systems would continue to discharge runoff to the West Point WWTP for treatment before being discharged to Puget Sound. Detailed results of the analysis are provided in Appendix O, Surface Water Discipline Report.

Potential reductions in the frequency and/or volume of combined sewer system overflow events are also expected from the north portal area because of the use of one or more detention facilities to reduce the rate of discharge into the system. However, modeling results indicate that detention facilities would not reduce the potential frequency and/or volume of overflows from the combined sewer system from the south portal area. Therefore, an exemption from the peak flow control requirements has been granted by the City for the south portal area.

Overall, the Bored Tunnel Alternative likely would improve the quality of stormwater runoff discharged from the study area to Puget Sound. The improved quality of stormwater runoff is expected to slightly reduce the potential for effects on natural resources in the study area.

Despite the potential benefits of stormwater management provided by a tunnel configuration, the location of the project in a highly urbanized environment is expected to restrict the use of some stormwater treatment facilities, particularly those requiring relatively large areas, such as open stormwater detention ponds. This could limit the stormwater treatment options, or BMPs, to smaller-footprint options like bioswales and cartridge media filtration vaults. The evaluation of appropriate stormwater treatment options is provided in Appendix O, Surface Water Discipline Report.

5.2.1 South Portal

In the south portal area, the Bored Tunnel Alternative is not expected to result in a measurable decrease in the number and duration of combined sewer overflow events because of the limited space available to store or treat stormwater. However, more stormwater from this area would be directed to the combined sewer system, likely improving the quality of stormwater discharged to Puget Sound for small to intermediate storm events. During larger storm events, the volume and frequency of combined sewer overflow events would increase, although they would still likely be less than the volume and frequency under existing conditions. Overall, the Bored Tunnel Alternative is expected to result in slightly improved water quality in the area relative to existing conditions. Detailed evaluations of stormwater management issues are provided in Appendix O, Surface Water Discipline Report.

5.2.2 Central

The central section of the alignment for the Bored Tunnel Alternative would be located within the confines of the bored tunnel, thereby reducing the amount of rainfall that is intercepted by the roadway. The resulting reduction in the amount of stormwater runoff generated by this portion of the alternative alignment would potentially increase the volume of stormwater runoff that receives treatment. More stormwater from this area would be directed to the combined sewer system, likely improving the quality of stormwater discharged to Puget Sound. Detailed evaluations of stormwater management issues are provided in Appendix O, Surface Water Discipline Report.

5.2.3 North Portal

In the north portal area, the Bored Tunnel Alternative is expected to reduce the number and duration of combined sewer overflow events, because stormwater detention facilities would be provided at the north portal. These facilities would reduce the discharge rate to the combined sewer system. In addition, more stormwater from this portion of the study area would be directed to the combined sewer system, potentially improving the quality of stormwater discharged to Puget Sound and/or Elliott Bay for small to intermediate storm events. Detailed evaluations of stormwater management issues are provided in Appendix O, Surface Water Discipline Report.

5.3 Cut-and-Cover Tunnel Alternative

As with the Bored Tunnel Alternative, the water quality of the shoreline habitat is expected to improve somewhat with the Cut-and-Cover Tunnel Alternative. The quantity of stormwater discharged to the Seattle waterfront would remain the same as that under existing conditions, but the quality of stormwater might be improved as part of the project (see Appendix O, Surface Water Discipline Report).

The Cut-and-Cover Tunnel Alternative would replace the Elliott Bay Seawall in a location up to approximately 10 to 12 feet landward of the existing seawall. Replacing the existing seawall would result in a moderate increase in the volume and intertidal surface area of Elliott Bay, although the habitat would be primarily shaded by a sidewalk cantilevered over the new area of aquatic habitat. The new area would typically consist of intertidal riprap along the base of the new seawall. Under the Cut-and-Cover Tunnel Alternative, the seawall would be replaced from S. Jackson Street north to Broad Street. The benthic invertebrates and macroalgae living on the hard substrates and the soft substrate at the base of the seawall would be removed or displaced during the removal of the existing seawall and the placement of new riprap. The same species are expected to begin recolonizing the new substrate once each segment is completed. No substantive changes in substrate type are proposed. Therefore, the long-term conditions and species use of the shoreline habitat are expected to be similar to existing conditions.

Fish, invertebrates, and macroalgae currently inhabiting the intertidal and shallow subtidal habitat along the Seattle waterfront would likely continue to inhabit the same areas. The expansion of Elliott Bay by about 6,200 cubic yards would provide additional living space for the production of slightly more planktonic and pelagic organisms, although a substantial portion of the new habitat would be located under the piers along the waterfront. The shading provided by these piers is expected to substantially limit the productivity and utilization of this additional habitat.

Although the Cut-and-Cover Tunnel Alternative likely would have effects on the quality of stormwater discharged to Puget Sound similar to those of the Bored Tunnel Alternative, the direct effects of the Cut-and-Cover Tunnel Alternative on aquatic habitat could be greater. This could be due to the replacement of the existing seawall as part of the Cut-and-Cover Tunnel Alternative. The seawall replacement would require some in-water work to remove the existing seawall and place riprap after the new seawall is constructed, resulting in the potential for some direct effects on aquatic habitat compared to the Bored Tunnel Alternative, which would maintain the existing aquatic habitat.

5.3.1 South – S. Royal Brougham Way to S. King Street

Other than improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the southern portion of the study area.

5.3.2 Central – S. King Street Through Battery Street Tunnel

Other than improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the central portion of the study area.

5.3.3 North – Denny Way to Aloha Street

Other than improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the northern portion of the study area.

5.4 Elevated Structure Alternative

The Elevated Structure Alternative would replace the existing Elliott Bay Seawall with a new landward seawall and a sidewalk cantilevered over the new aquatic habitat area along most of the seawall length from Colman Dock north to Myrtle Edwards Park. The changes in habitat that may result would be similar to the effects for the Cut-and-Cover Tunnel Alternative, but substantially less than with the Bored Tunnel Alternative, which does not include replacing the seawall.

Under the Elevated Structure Alternative, the water quality of the shoreline habitat would improve somewhat. The quantity of stormwater discharged to the Seattle waterfront would be similar to that for the Cut-and-Cover Tunnel, but improvements in stormwater quality would occur through a reduction in the amount of PGIS and basic stormwater quality treatment for PGIS draining to separated stormwater and low-flow diversion systems (see Appendix O, Surface Water Discipline Report). The improvement in stormwater quality would likely be less than that resulting from either of the tunnel alternatives because the replacement structure would continue to directly intercept rain, whereas much of the tunnel roadways would be underground.

Under the Elevated Structure Alternative, biota that currently inhabits the intertidal and shallow subtidal habitat along the Seattle waterfront would likely continue to inhabit the same areas. The replacement of the Elliott Bay Seawall with a new wall located landward of the existing seawall would result in the expansion of Elliott Bay by approximately 7,980 cubic yards. This expansion of the bay would provide additional living space for the production of slightly more planktonic and pelagic organisms, although a substantial portion of the new habitat would be located under the piers along the waterfront. This increase in habitat area would be similar to the habitat gains under the Cut-and-Cover Tunnel Alternative that would be associated with the replacement of the existing seawall.

5.4.1 South – S. Royal Brougham Way to S. King Street

Other than the improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the southern portion of the study area.

5.4.2 Central – S. King Street Through Battery Street Tunnel

Other than the improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the central portion of the study area.

5.4.3 North – Denny Way to Aloha Street

Other than the improvements in stormwater management along the entire alignment, project operations are not expected to measurably or differentially affect the natural resources in the northern portion of the study area.

5.5 Mitigation and Habitat Enhancement

Potential options for mitigation and habitat enhancement were identified initially through coordination with resource agencies for the Cut-and-Cover Tunnel and Elevated Structure Alternatives (due to the concurrent Elliott Bay Seawall replacement process). Specific measures for mitigation and habitat enhancement would be identified through additional coordination with agencies and tribes, evaluation of potential project effects, and development of the project design. Actions to enhance juvenile salmon rearing and migrating functions would likely provide some benefits for these species, particularly those listed as threatened or endangered.

In general, the Bored Tunnel Alternative is expected to either improve or maintain the water quality of stormwater runoff discharged from the study area, by respectively reducing or maintaining the overall amount of PGIS relative to existing conditions and discharging more stormwater to the combined sewer system. This would be a beneficial effect for fish and aquatic species and their habitat. With the Bored Tunnel Alternative, the Elliott Bay Seawall would not be replaced; therefore there would be no disturbance of aquatic habitat.

Nevertheless, in its Biological Opinion, NMFS outlined the following terms and conditions related to stormwater management to avoid effects on fish, aquatic, and wildlife species and habitat:

- WSDOT will ensure compliance with the biological effects thresholds for dissolved copper and dissolved zinc at the established points of compliance in Elliott Bay and Lake Union. The threshold for dissolved copper is 2.0 μg/L more than background concentrations that do not exceed 3.0 μg/L. The threshold for dissolved zinc is 5.6 μg/L more than background concentrations that are between 3.0 and 13.0 μg/L.

- If the final stormwater design differs from the design evaluated in the Biological Opinion, WSDOT will evaluate pollutant loadings and concentrations for that design to determine whether they differ significantly from those considered in the consultation. If the predicted pollutant loadings or concentrations exceed those addressed in the Biological Opinion, WSDOT will provide NMFS a description of the design change(s) and a revised stormwater analysis.
- WSDOT will implement the programmatic approach to stormwater monitoring, as outlined in the *Programmatic Monitoring Approach for Highway Stormwater Runoff in Support of Endangered Species Act (ESA) Section 7 Consultation* dated June 2009. If the results of this program trigger any of the relevant reinitiation requirements, WSDOT will notify NMFS immediately.

Although the Cut-and-Cover Tunnel and Elevated Structure Alternatives would likely have limited effects on the natural resources in the area, there is the potential for affecting water quality as a result of changes in the stormwater systems and the replacement of the Elliott Bay Seawall. However, these alternatives are expected to either improve or maintain the water quality of stormwater runoff discharged from the study area by either reducing or maintaining the overall amount of PGIS relative to the existing conditions.

More discussion on stormwater quality and related effects is found in Chapter 6, Construction Effects and Mitigation. A detailed pollutant loading analysis is discussed in Appendix O, Surface Water Discipline Report.

With the Cut-and-Cover Tunnel Alternative or the Elevated Structure Alternative, replacing the seawall by first constructing a new seawall landward of the existing wall would result in a slight increase in aquatic habitat once the existing seawall has been removed. However, the habitat would continue to be bordered by a vertical wall with riprap at the base, which would have limited natural functions (Williams and Thom 2001).

Chapter 6 CONSTRUCTION EFFECTS AND MITIGATION

The Bored Tunnel Alternative would replace the Alaskan Way Viaduct with a tunnel alignment more to the east, rather than the more westerly alignment of the cut-and-cover tunnel. Both the Cut-and-Cover Tunnel Alternative and the Elevated Structure Alternative include the replacement of the Elliott Bay Seawall as an element of the project, which would require some in-water work and would result in construction effects. For a more detailed description of this project element, see Appendix B, Alternatives Description and Construction Methods Discipline Report.

The Bored Tunnel Alternative does not include the replacement of the existing seawall, thereby reducing the in-water construction activities compared to the other alternatives. The Cut-and-Cover Tunnel Alternative would place the new seawall face landward of the existing seawall face, thereby returning a narrow strip of previously filled area to the Elliott Bay aquatic habitat. The Elevated Structure Alternative would place the new seawall approximately 10 to 12 feet landward of the existing pile-supported gravity seawall face and remove the existing seawall to the top of the existing pile-supports. This would return a substantial portion of the previously filled area to aquatic habitat. However, a cantilevered sidewalk would extend out over, and partially shade, this newly exposed habitat, thereby somewhat reducing the overall potential benefits.

6.1 Effects Common to All Build Alternatives

6.1.1 Construction Effects

Construction effects on natural resources in the study area would most likely be associated with construction noise, handling the excavation spoils and the stockpiling and dewatering processes in the tunnel or excavation areas, and controlling erosion and potential pollutant sources to minimize effects on the natural resources in the area. The potential effects would be minimized by implementing appropriate BMPs, which would include monitoring for contamination and proper disposal of contaminated waste materials, as discussed in Appendix Q, Hazardous Materials Discipline Report.

Although nighttime construction activities would require additional lighting, the study area already has substantial light sources, which increase the ambient light conditions along the waterfront. The increased ambient light conditions already likely affect the use of both the upland and aquatic nearshore habitat. Therefore, the additional task lighting needed during construction is not expected to measurably change the overall ambient light conditions or habitat use in the study area. However, specific BMPs would be implemented to further reduce the potential for adverse lighting effects. These could include using lights with visors, louvers, or screens to shield the sources of light to minimize the effects on fish. Other practices would be to direct the lights away from the water whenever practical, and minimizing the use of lights in areas other than the immediate work zones, where lighting is not needed for safety.

Potential effects on surface water quality could result from construction activities such as construction staging, inadvertent leaks or spills from construction equipment, material transport, earthwork, paving, excavation spoils that may be stockpiled, and storm drainage and/or combined sewer utility work. If not properly controlled by the use of temporary construction BMPs, construction-related pollutants can increase turbidity and affect other water quality parameters, such as the amount of available oxygen in the water. In addition, pH can be altered if runoff contacts curing concrete, which could have serious effects on aquatic species. Such changes could reduce the use of these waters by aquatic species but are unlikely to be severe enough to result in direct or indirect mortality.

Fugitive dust from concrete demolition activities can also increase pH levels in project-related discharge water. Changes in pH could have serious effects on aquatic species, including damage to outer surfaces like gills, eyes, and skin, and an inability to dispose of metabolic wastes. The pH of water also influences cell functions, particularly with respect to maintaining and regulating gas, water, and ion balances. It also plays an important role in determining the bioavailability of other contaminants. However, given the expected short-lived nature of a pulse of low pH from construction area runoff, and the overall sizes of Elliott Bay and Lake Union, brief reductions in the pH of discharge water are not expected to impair aquatic species. Water from the study area would be monitored and treated in accordance with the specifications of any required discharge permit (e.g., King County Wastewater Discharge Authorization or Permit) before discharge, ensuring that discharged waters have a pH that meets the state water quality criteria before they are discharged to the existing storm drainage and combined sewer systems.

Soil improvements, drilled shafts, and slurry wall construction would involve the mixing of existing soil with cement and/or bentonite slurry. The mixing would create spoils, which would need to be dewatered on site before being disposed of at an off-site location. Water recovered during the dewatering process would also be treated to meet the appropriate permit requirements before being discharged to the existing storm drainage and combined sewer system. Additional construction effects associated with spoils removal and hazardous materials are discussed in Appendix Q, Hazardous Materials Discipline Report.

Water from dewatering activities would be discharged to the existing combined sewer system. Therefore, detention of this water may be necessary to meet the requirements of the King County Wastewater Discharge Authorization or Permit and to avoid overwhelming these conveyance systems. Depending on the volumes and timing, if discharging dewatering flows to the combined sewer system is infeasible, off-site disposal would be required (see Appendix O, Surface Water Discipline Report, and Appendix Q, Hazardous Materials Discipline Report).

Dewatering activities and suspended sediment discharges can result in increased turbidity, altered concentrations of dissolved oxygen, and altered pH. If sediment is not adequately contained, increased turbidity can distress fish and aquatic organisms in the vicinity and affect fish physiology, their behavior, and their use of habitat. Physiological effects include gill trauma, altered blood sugar levels, and impaired osmoregulatory function. Behavioral effects include altered foraging and predation risk behavior. Effects on habitat use include habitat avoidance and reduced habitat functions and productivity (Meehan 1991). Similar effects on other aquatic species in nearshore habitats are also expected, although the potential for effects would decrease with increasing distance from shore. Furthermore, these effects are expected to be temporary and unlikely to be measurable. The implementation of a temporary erosion and sediment control plan and a spill prevention, control, and countermeasures plan is expected to minimize the intensity or extent of turbidity in study area waters. Any required discharge permit (e.g., King County Wastewater Discharge Authorization or Permit) would identify specific BMPs for ensuring that the discharged waters meet the state water quality criteria.

Both Elliott Bay and Lake Union are flow-control-exempt water bodies, indicating that the volume of water discharged to these water bodies would not have a measurable effect on aquatic uses. These water bodies are very large relative to the volume of potential inputs from sources other than the natural drainage areas (e.g., Lake Washington or the Duwamish River). However, water quality in these water bodies could be affected by stormwater discharge during project construction, if any combined sewer overflow events occur. Such discharge would be subject to the requirements of the King County Wastewater Discharge Authorization or Permit or the NPDES permit, where applicable, to protect beneficial uses in the receiving water, including protection of aquatic species and habitat.

If not contained, runoff from construction areas could transport silt and sediment to receiving water. The highest probability for such effects during construction is typically at staging or excavation areas. Because these areas are generally located near natural water bodies, there is a greater potential to affect water quality as a result of spills during the refueling or servicing of equipment and stormwater runoff from stockpiled soil or other materials. However, it is assumed that appropriate BMPs would be effectively implemented to minimize or eliminate such occurrences.

Subsurface contaminants, including total petroleum hydrocarbons and trace organics, could migrate toward the excavation areas and increase pollutant concentrations in dewatering water (Parsons Brinckerhoff 2009). Any water found to be contaminated would have to be either treated to the acceptable standards of the King County Wastewater Discharge Authorization or Permit before being discharged to a City or King County conveyance system or disposed of at an approved off-site hazardous waste facility. Dewatering would likely continue throughout most of the construction activities that involve ground disturbance and excavation.

Contaminants in soils in the study area are likely to include metals and persistent organic toxins, which could be released to the aquatic environment through increased concentrations of suspended sediment in construction site runoff. The primary mechanisms for effects on aquatic organisms include ingestion of contaminants or particles to which contaminants have adsorbed and ingestion of prey that have been exposed to the contaminants. Exposure to these contaminants would likely result in largely sublethal effects, similar to those discussed above for turbidity, and on-site BMPs are expected to minimize or eliminate the release of these upland contaminants to the aquatic environment.

In addition, because the construction and excavation spoils could be transferred over water by barge, there is an increased risk of potential effects on Elliott Bay during material transfer from the study area. These effects would be due to barge and tug activities in the nearshore area, or potential inadvertent spills of excavation spoils during barge loading or transport activities. However, the implementation of avoidance and minimization measures is expected to substantially reduce or eliminate the risk of water quality or aquatic habitat effects.

All of the build alternatives would include the demolition of the existing Alaskan Way Viaduct, which is likely to generate substantial amounts of dust from cutting, sawing, crushing, and grinding the concrete structure (measures to control dust during construction and demolition are discussed in Appendix M, Air Discipline Report). The demolition would also generate substantial noise levels, which could disturb wildlife species, though most species in this dense urban area are generally tolerant of high noise levels.

All of the build alternatives would include the use of a shoreline loading facility to deliver construction material, and barges to transport demolition debris and/or excavation spoils. These activities would occur at an existing facility (e.g., Terminal 46/Pier 46). Barge use is projected to average one barge trip per day, which means that the project's barge trips would add only a very small increment to the shipping activities in Elliott Bay and Puget Sound, with little potential to affect the aquatic environment. Most species in the nearshore areas of Elliott Bay are not likely to be particularly sensitive to vessel traffic because of the extensive traffic that already occurs in the area, and which has historically been occurring over the last 100 years or so.

The proposed disposal location for excavation spoils and demolition debris is the Mats Mats Quarry in Jefferson County. Barging is proposed for the transport of tunnel excavation spoils as an efficient and cost-effective transport method. Other construction and demolition materials would be transported by truck. The number of barge trips (one per day) to and from the disposal site would represent a very small increase in the total number of vessels navigating through the Puget Sound shipping lanes. These barge trips would not increase the overall noise or disturbance levels for species in these offshore marine areas. The potential risk of collisions with any marine mammals would also be negligible because of the slow towing speeds of the barges and the mobility of these species.

6.1.2 Mitigation

The primary mitigation activities associated with the project are construction BMPs for minimizing or eliminating effects on species or their habitat. WSDOT will implement standard construction BMPs to minimize or eliminate short-term construction effects, including spills of hazardous materials or discharge of sediment from the construction areas into Elliott Bay. All pollutants will be handled to avoid contaminating surface water in the study area. Materials that modify pH, such as cement, cement grindings, and cement saw cuttings, would be managed or isolated to minimize the transport of these materials by surface water runoff or other means to waterways in the area. WSDOT will ensure that all work activities comply with the necessary water quality requirements. BMPs would be developed and implemented as part of the following plans:

- Stormwater pollution prevention plan
- Temporary erosion and sediment control plan
- Spill prevention, control, and countermeasures plan
- Concrete collection, containment, and disposal plan
- Fugitive dust control plan (see Appendix M, Air Discipline Report)

Each of these plans would include performance standards based on state regulations, such as turbidity and TSS levels in stormwater discharged from construction staging and work areas. In addition to the implementation of these plans, stormwater runoff from active construction sites should be treated before being discharged, as necessary to comply with the requirements of the Washington

Administrative Code and applicable permits, such as King County Wastewater Discharge Authorization or Permit.

Construction-related runoff and dewatering water likely will be discharged to the combined sewer system for treatment at the West Point WWTP. Before being discharged to the combined sewer, stormwater runoff from active construction areas will need to be treated as necessary to comply with applicable permit requirements and project specifications or disposed of at an approved off-site hazardous waste facility. Monitoring also should be performed in accordance with the applicable standards. Specific measures for protecting water quality would be specified in the plans discussed above.

Depending on the volumes and timing, some dewatering discharges to the combined sewer system would be infeasible, and off-site disposal would be required. In addition, risk of potential ground settlement caused by dewatering would be mitigated by reinjecting water from the dewatering operation back into the ground. Excess water that is not used for injection would need to be treated and disposed of in the sanitary sewer or off site.

To the extent feasible, the construction dewatering systems would be designed to minimize any reduction in the water table. For a more detailed discussion, see Appendix P, Earth Discipline Report. This would reduce the volume of groundwater that requires treatment and disposal. It would also reduce the potential for mobilization and spreading of groundwater contaminants in the study area. In addition, ground treatment techniques such as freezing also may reduce the need for dewatering. However, adequate site investigation would be necessary to select and design the best ground treatment approaches.

Appropriate sediment control BMPs would be implemented to prevent the discharge of sediment from the disturbed construction areas into Elliott Bay. All work activities would comply with the necessary water quality requirements.

6.2 Bored Tunnel Alternative

Construction activities that could generate dust include the transport of spoils, such as tunnel spoils, utility relocations, grading and paving, and the transport of excavated soils from the portal areas. Such activities would occur over a prolonged period lasting an estimated 5.4 years, increasing the potential for dust to reach Elliott Bay and affect local water quality. However, the proximity of Elliott Bay and the groundwater elevation expected in the tunnel area would likely result in moist spoils material, which would minimize the potential to generate fugitive dust. In addition, the implementation of standard construction BMPs would minimize the extent of fugitive dust dispersal, thereby minimizing the potential effects on water quality and fish and wildlife species in the project vicinity. Such BMPs would include wetting down concrete during demolition, washing tires, and routinely sweeping streets.

Spoils from tunneling could be stockpiled on site for several days for dewatering before transport and appropriate disposal. The water extracted during the dewatering process would be treated as required and properly disposed of in accordance with environmental permits (see Appendix O, Surface Water Discipline Report). If stockpiling of the excavation spoils is necessary, the piles would be covered to minimize the dispersal of dust or runoff from rain events. Excavation spoils would be transported by barge and/or truck to an approved disposal site at Mats Mats Quarry, and potentially contaminated spoils would be tested and disposed of at approved upland facilities.

Aboveground construction activities would result in noise from heavy equipment, such as pile drivers, jackhammers, pavement breakers, hoe rams, auger drills, bulldozers, backhoe excavators, loaders, and haul trucks. Other construction equipment would include air compressors and electric generators. The noise from this construction equipment could disturb wildlife species in the area. Such disturbances are not unusual for the industrial waterfront area of Seattle; therefore, wildlife species would likely not be particularly disturbed. The potential for such disturbances would be reduced substantially after the cut-and-cover sections on either end of the bored tunnel are completed and the tunnel boring activities move underground. In addition, no in-water activities are associated with the tunnel construction process. Contrary to the other build alternatives, the Bored Tunnel Alternative would not include the replacement of the Elliott Bay Seawall. Therefore, there would be no need for the temporary access bridge between Pier 48 and the Seattle Ferry Terminal on Colman Dock, or the temporary over-water pedestrian walkways between Piers 54 and 55, and Piers 56 and Pier 57 to maintain access to waterfront businesses. This would eliminate any in-water pile-driving activities and the temporary shading of over 15,000 square-feet of nearshore shallow-water habitat during construction. Therefore, the Bored Tunnel Alternative would generally maintain the existing aquatic habitat in the study area.

The use and disturbance and of staging areas would potentially generate fugitive dust, since the activities would occur at the surface where dry exposed soils would occur. Concrete dust generated by the demolition of the viaduct has the potential to affect the water quality (e.g., pH and turbidity) in adjacent water bodies, if carried by winds. However, standard BMPs would be applied to minimize the potential and the extent of fugitive dust dispersal.

Some of the construction activities are likely to require the use of a nearshore loading and unloading facility to transport construction materials to the construction site and to remove excavation spoils. This operation would use existing facilities, and no in-water construction would be required.

6.2.1 South Portal

The south portal would be located in a highly industrialized area with limited habitat to support natural resources in the study area. Therefore, the potential effects of the Bored Tunnel Alternative are also likely to be limited. The concentration of construction activities around the south portal for constructing the bored tunnel would minimize the areal extent of potential effects on natural resources in the area and potentially allow greater efficiency and control of construction BMPs to minimize potential effects.

6.2.2 Central

The central portion of the bored tunnel alignment would be located underground, limiting the potential for direct effects of the associated construction activities on natural resources. The confined construction area would also allow greater control over construction BMPs, such as stormwater management, spill control, and noise reduction. This increased control and confined area would also improve the efficiency of the implemented BMPs as compared to aboveground activities. However, construction activities in the central area would also include the decommissioning of the Battery Street Tunnel and the demolition and removal of the existing viaduct.

Battery Street Tunnel Decommissioning

The decommissioning of the Battery Street Tunnel is not expected to measurably affect fish, wildlife, or vegetation in the study area. Decommissioning would likely consist of recycling some of the concrete rubble from the viaduct demolition as fill in the tunnel, capping both ends, and filling the voids with concrete pumped in from the street level above.

Viaduct Removal

The viaduct removal process includes demolition and removal activities. These activities would include vibrating, pulling, and dismantling the existing structures (including temporary structures built to support the demolition activities) for eventual disposal, reuse, or recycling. The demolition and removal activities would include the following:

- Breaking, crushing, grinding, and cutting of existing structures
- Removal and eventual disposal of debris material
- Potential salvage and recycling of reusable or recyclable materials

These activities, which would be similar for all of the build alternatives, have the potential to generate concrete dust, which in turn has the potential to affect the water quality (e.g., pH and turbidity) in adjacent water bodies (see Section 6.1.1). However, it is assumed that typical BMPs would be implemented to minimize the dispersal of construction debris.

Demolition of the existing viaduct would result in a substantial change in the noise levels along the central waterfront. The existing traffic noise, which is relatively constant in terms of volume and frequency, would be replaced with intermittent and sharper impact-generated noises from the demolition equipment during the approximately 9 months required for demolition. The characteristics of these impact-generated noises have a greater potential to affect wildlife species in the area than the relatively continuous traffic noise. However, the demolition noise would cease during nonworking hours and stop altogether once the viaduct has been removed and the debris has been hauled away.

The demolition process is also expected to generate measurable quantities of fugitive dust, which could temporarily affect habitat conditions in the area. The effects could include slight changes in water quality along the nearshore area: either direct effects from the dust settling on the water surface or indirect effects from stormwater runoff that reaches Elliott Bay. However, appropriate BMPs (e.g., spraying water on the demolition area) would be used to minimize and contain the amount of dust generated and dispersed. Any construction site dewatering that may be necessary would use treatment BMPs to reduce the potential for discharge of demolition dust directly to the bay. Regular street sweeping during construction would also reduce the dispersal of demolition dust from the study area.

Some of the viaduct demolition debris could be recycled as fill for the decommissioned Battery Street Tunnel, which would minimize debris transport activities. This reduction in debris transport would reduce the potential for indirect effects on natural resources by minimizing air pollutants, noise levels, and stormwater pollutant concentrations resulting from transport vehicles. On-site debris disposal would also minimize the spread of fugitive dust during the transport process. However, using the viaduct demolition debris as fill for the Battery Street Tunnel would likely require additional on-site handling of the demolition debris to generate material small enough to be efficiently placed in the tunnel. After some processing, some of the debris could be transported by barge, which would also reduce the number and distance of surface transport trips. It is assumed that the debris sorting for recycling purposes would occur at a permitted off-site location, except for the potential use of some of the debris to fill the Battery Street Tunnel. The BMPs for on-site debris sorting and recycling would be similar to those used during the viaduct demolition process.

Even with the implementation of appropriate BMPs, the viaduct removal process is expected to have some minor effects on fish and wildlife species in the area. However, these effects are expected to be temporary and minor and are not expected to affect the long-term conditions of the species or their habitat.

6.2.3 North Portal

The north portal would be located in a highly urbanized area with limited habitat to support natural resources in the study area. Therefore, the potential effects of the Bored Tunnel Alternative are also likely to be limited. The concentration of construction activities around the north portal for constructing the bored tunnel would minimize the areal extent of potential effects on natural resources in the area and potentially allow greater efficiency and control of construction BMPs to minimize potential effects.

6.2.4 Mitigation

The primary activity that could affect fish and other aquatic species is the operation of a barge landing facility along Terminal 46. This operation would use existing facilities, and no in-water construction would be required. However, if in-water or upland improvements to these existing facilities are needed to accommodate the construction activities associated with the project, these improvements would undergo separate environmental permitting processes by separate entities.

Construction effects on surface water would be avoided, minimized, and mitigated through the development and implementation of measures described in the following plans:

- Construction stormwater pollution prevention plan
- Temporary erosion and sediment control plan
- Spill prevention, control, and countermeasures plan
- Concrete containment and disposal plan

To address potential effects from fugitive dust from the demolition of concrete structures or spoils stockpiling, a fugitive dust control plan will be in place.

Each of these plans would include performance standards based on state regulations, such as turbidity and TSS levels in stormwater discharged from construction staging and work areas. In addition to the implementation of these plans, stormwater runoff from active construction sites should be treated before being discharged, as necessary to comply with the requirements of the Washington Administrative Code and/or the NPDES Construction Stormwater General Permit.

6.3 Cut-and-Cover Tunnel Alternative

Under the Cut-and-Cover Tunnel Alternative, construction activities that involve excavating and moving soils would be similar to those described for the Bored Tunnel Alternative, although these activities would be staged above ground throughout most of the construction process. As a result, these construction activities would potentially disturb wildlife species to a greater extent than those associated with the Bored Tunnel Alternative, for which a substantial portion of the activities would occur underground.

During the construction of the cut-and-cover trench, the amount of soil excavated and transported would greatly exceed the amount of loose soil generated by the tunneling process for the Bored Tunnel Alternative, increasing the potential to release dust and soils to the environment. Under the Cut-and-Cover Tunnel Alternative, such activities would be more extensive and prolonged, with major construction activities continuing for about 8.75 years. However, as discussed for the Bored Tunnel Alternative, appropriate BMPs would be implemented to minimize the extent of fugitive dust and soil dispersal and the potential effects on water quality and fish and wildlife species in the study area. Such BMPs would include covering piles of excavated material, wetting down concrete, washing tires of transport trucks, and routinely sweeping streets during demolition.

As with the Bored Tunnel Alternative, the spoils from excavations could be stockpiled on site for several days for dewatering. This process would include the collection and treatment of dewatering water before proper disposal (see Appendix O, Surface Water Discipline Report). These procedures would be similar to those described for the Bored Tunnel Alternative.

The Cut-and-Cover Tunnel Alternative would replace the Elliott Bay Seawall between Pine and Broad Streets using soil-strengthening methods, such as jet grouting and/or deep soil mixing. Waste material generated by soil strengthening such as grouting operations would be dewatered, and the water would be treated as required before discharge (see Appendix O, Surface Water Discipline Report). Appropriate BMPs would be implemented to minimize or eliminate the potential for grouting materials to enter the aquatic environment. The existing deteriorating seawall would then be replaced with a new L-wall support structure and new face panels. The existing sheet pile wall would be replaced with a new reinforced-concrete face between Denny Way and Aloha Street.

Between S. Jackson Street and S. Washington Street, soil improvements and new face paneling would replace the failing bulkhead at Pier 48. From S. Washington Street to Union Street, the seawall would be replaced with the west wall of the tunnel.

The new seawall would be constructed in approximately the same location between S. Jackson Street and Yesler Way. North of Yesler Way, the new seawall would gradually move toward the east. Between Yesler Way and Madison Street, the new seawall face would be approximately 10 to 12 feet behind (landward of) the existing seawall.

Constructing the new seawall landward of the existing structure would increase the shallow nearshore habitat for fish and invertebrates in Elliott Bay, supporting slightly more of the same fish, invertebrates, and algae that currently exist along the Seattle shoreline. In turn, this increased production could support a few more waterfowl, shorebirds, and other predator species. However, a substantial portion of this increased habitat would occur in areas with existing over-water structures (piers), thereby substantially reducing or eliminating the functional ecological value of this added habitat.

Construction of the new seawall with the Cut-and-Cover Tunnel Alternative would require the construction of a temporary access bridge over open-water habitat between Pier 48 (near S. Jackson Street) and the Seattle Ferry Terminal on Colman Dock to provide ferry access during construction (see Exhibit 6-1). This temporary bridge would be built during the first stage of construction and would be removed in the final stage; therefore, it would likely be in place between 6.0 and 7.75 years. Temporary construction impacts (pile driving and removal and shading of shallow-water habitat) over about 15,000 square feet of subtidal habitat would be associated with the construction of this structure. To help maintain pedestrian access along the waterfront, the project partners are also considering the feasibility of constructing temporary over-water pedestrian walkways between Piers 54 and 55, and Piers 56 and 57.

Any pile-driving activities needed to install these temporary over-water structures could potentially harm fish and aquatic species as a result of the underwater sound impulses generated by the pile driver, and disturb other wildlife species as a result of the airborne sound levels. Although the number of required piles would be minimized to the extent practicable and sound attenuation measures would be used to limit these potential underwater and airborne sound effects, some effects on aquatic species are expected. These activities and the appropriate BMPs would be evaluated and approved through the permitting process. The shading effects of these over-water structures would reduce or eliminate biological productivity under portions of the structures due to reductions in natural light. Shade has also been shown to affect fish distribution and behavior, because they tend to resist passing under structures that produce a sharp point of contrast in light conditions. These behavior alterations are a particular concern for juvenile salmonids, because they could result in increased predation or migration delays.

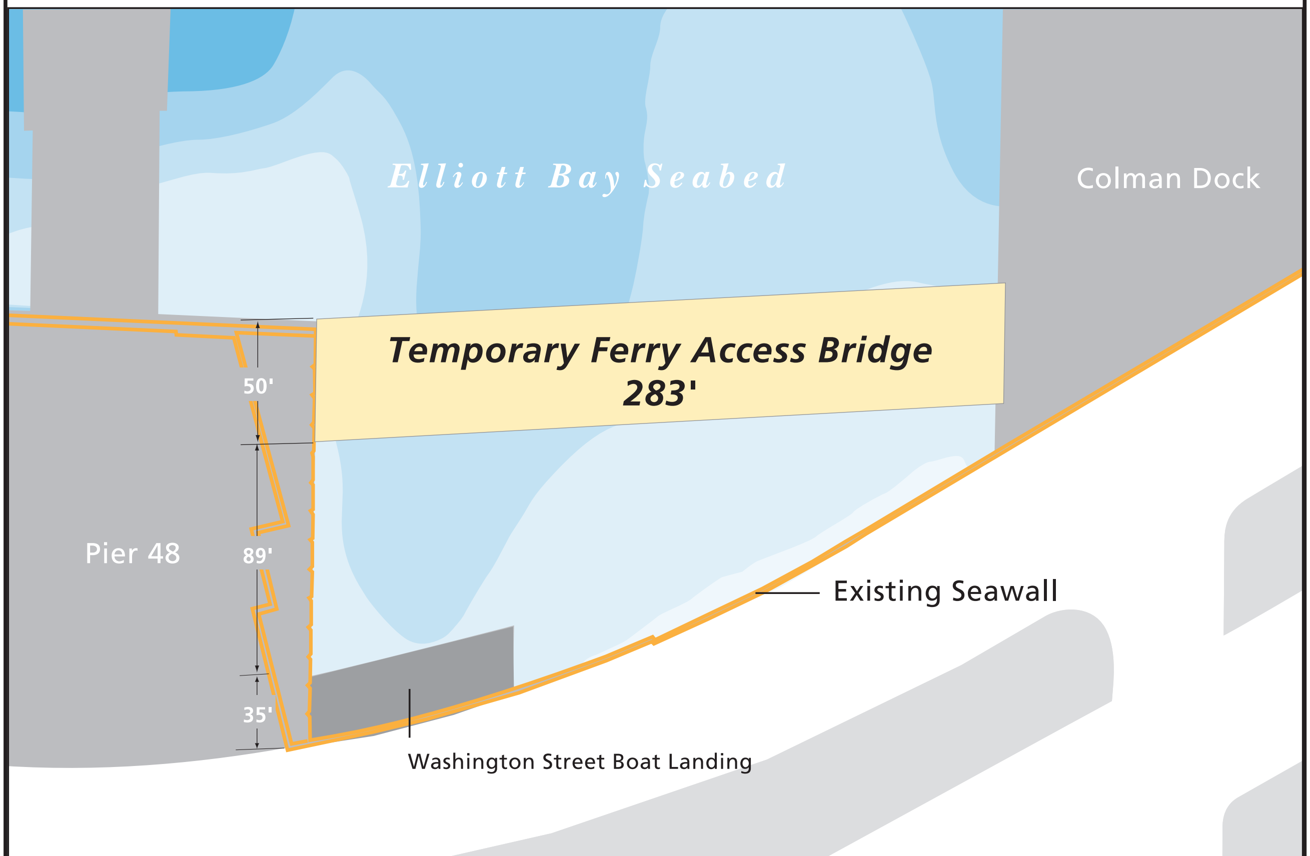

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Exhibit 6-1
Temporary Ferry Access Bridge

6.3.1 South

After the new seawall is completed, the old seawall would be removed, requiring some in-water work. This work would be performed primarily at low tide and with the use of appropriate BMPs (e.g., silt curtains) to minimize or eliminate effects on the nearshore habitat. Any marine organisms affected by the removal of the existing seawall would eventually be replaced by means of recolonization from adjacent habitat areas.

Construction activities in the southern portion of the alignment for the Cut-and-Cover Tunnel Alternative are not expected to measurably affect natural resources in the study area. Much of the work would occur in the highly urbanized corridor along the existing SR 99, and these areas provide no substantial habitat to support natural resources.

6.3.2 Central

Construction activities in the central portion of the alignment for the Cut-and-Cover Tunnel Alternative are not expected to measurably affect natural resources in the study area. Much of the work would occur in the highly urbanized corridor along the existing SR 99, and these areas provide no substantial habitat to support natural resources.

6.3.3 North

Construction activities in the northern portion of the alignment for the Cut-and-Cover Tunnel Alternative are not expected to measurably affect natural resources in the study area. Much of the work would occur in the highly urbanized corridor along the existing SR 99, and these areas provide no substantial habitat to support natural resources.

Battery Street Tunnel

Activities associated with retrofitting the Battery Street Tunnel are not expected to measurably affect natural resources in the study area. Much of the work would be confined to the inside of the tunnel or the tunnel portals, and these areas provide no substantial habitat to support natural resources.

6.3.4 Mitigation

The basic mitigation measures described for the Bored Tunnel Alternative would also apply to the Cut-and-Cover Tunnel Alternative. In addition, specific BMPs would be implemented to ensure that any in-water construction activities would result in little or no long-term effects on aquatic habitat. Any habitat loss or reduction in function would be replaced by means of appropriate mitigation measures, which would be established during the permitting process. The potential operation of a barge landing facility along the central or southern waterfront would be similar to what is proposed for the Bored Tunnel Alternative, and no in-water construction is expected to be required for these facilities. However, if in-water or upland improvements to these existing facilities are necessary for the project, they would undergo independent environmental review and be permitted separately.

The construction effects of the temporary access bridge to the Seattle Ferry Terminal on Colman Dock and the pedestrian walkways to maintain access to the businesses and other activities on the central waterfront piers would be mitigated by the eventual removal of these structures and the permanent increase in aquatic habitat provided by moving the Elliott Bay Seawall landward of the existing position. Standard in-water construction BMPs, such as silt curtains, sound attenuation measures, and cofferdams, would be used to reduce or eliminate the potential effects of in-water construction activities on aquatic species and habitat.

6.4 Elevated Structure Alternative

The Elevated Structure Alternative would also replace the seawall between S. Jackson and Broad Streets in the central waterfront section. Between S. Jackson Street and Yesler Way, the soils would be strengthened, and a new bulkhead would replace the existing bulkhead, which is failing. New face panels would be installed wherever feasible. Between S. Jackson Street and Yesler Way, the new seawall would be built in approximately the same location as the existing seawall.

From Madison Street to Union Street, the new seawall would be close to or slightly behind (landward of) the existing seawall. North of Union Street, soil strengthening would be needed to construct the new seawall structure, except for a section near Pier 66 that was replaced in the 1990s.

Between Pine and Broad Streets, the existing seawall would be replaced using soil strengthening methods and then constructing new wall support structures and new face panels approximately 10 to 12 feet landward of the existing seawall face.

Constructing the new seawall landward of the existing seawall and removing the existing seawall would increase the volume of nearshore shallow-water habitat between Colman Dock and Broad Street by about 7,232 cubic yards. Although this volume is greater than the volume that would result from the Cut-and-Cover Tunnel Alternative, much of the additional habitat would be located under existing docks and piers, limiting the overall benefits resulting from both alternatives. Constructing a new seawall would eliminate the risk of severe effects on nearshore habitat posed by a failure of the existing seawall. Even though these benefits would not result from the Bored Tunnel Alternative, that alternative would not directly affect the amount of aquatic habitat in the area.

6.4.1 South

This upland portion of the study area has no fish and very limited wildlife and vegetation. It includes a few street trees and urban wildlife that is compatible with a densely built industrial area. As a result, construction activities are not expected to measurably affect the conditions of wildlife or natural vegetation in the south area.

6.4.2 Central

This upland portion of the study area has no fish and very limited wildlife and vegetation. It includes a few street trees and urban wildlife that is compatible with an artificial industrial area. As a result, construction activities are not expected to measurably affect the conditions of wildlife or natural vegetation in the central area.

6.4.3 North

This upland portion of the study area has no fish and very limited wildlife and vegetation. It includes a few street trees and urban wildlife that is compatible with an artificial industrial area. As a result, construction activities are not expected to measurably affect the conditions of wildlife or natural vegetation in the north area.

6.4.4 Mitigation

The basic mitigation measures for the Elevated Structure Alternative would be the same as those described for the Cut-and-Cover Tunnel Alternative. Any habitat losses or reduction in functions would be replaced by means of appropriate mitigation measures, which would be developed during the permitting process. As with the Cut-and-Cover Tunnel Alternative, any barge landing operations would use existing facilities, and no in-water construction is expected to be required. However, if in-water or upland improvements to these existing facilities are necessary for the project, they would undergo independent environmental review and be permitted separately.

The effects of the temporary access bridge to the Seattle Ferry Terminal and the over-water pedestrian walkways would be similar to those for the Cut-and-Cover Tunnel Alternative (see Exhibit 6-1). These effects would be mitigated by the eventual removal of these structures and the permanent increase in aquatic habitat provided by moving the Elliott Bay Seawall landward of the existing position. Under the Elevated Structure Alternative, the increased habitat would be greater than it would be for the Cut-and-Cover Tunnel Alternative because the new seawall would be built slightly more landward than it would be for the tunnel alternative. Standard in-water construction BMPs, such as silt curtains, sound attenuation measures, and cofferdams, would be used to reduce or eliminate the potential effects of in-water construction activities on aquatic species and habitat.

Chapter 7 TOLLING

A range of tolling proposals was considered and analyzed. The considerations included using low, medium, or high tolls; varying the toll by time of day; applying a peak-only toll; tolling the tunnel segment only; or tolling the tunnel and the SR 99 corridor, by charging drivers who use the corridor to travel to or through downtown Seattle from points beyond the north and south portals of the tunnel. The analysis did not assume that transit or carpools would pay a toll.

Tolling is not expected to have any differential effects on fish, wildlife, or vegetation in the study area. The tolling operations would occur within an intensively developed urban area, with no increase in effects on the natural environment.

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