SUPPLEMENTAL DRAFT ENVIRONMENTAL IMPACT STATEMENT
and SECTION 4(F) EVALUATION
SR 520 BRIDGE REPLACEMENT AND HOV PROGRAM

DECEMBER 2009

SR 520: I-5 to Medina Bridge Replacement and HOV Project

Ecosystems Discipline Report

Washington State
Department of Transportation

U.S. Department of Transportation
Federal Highway
Administration

SR 520: I-5 to Medina Bridge Replacement and HOV Project Supplemental Draft EIS

Ecosystems

Discipline Report

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Acronyms and Abbreviations

AB	aquatic bed
Ballard Locks	Hiram M. Chittenden Locks
BMP	best management practice
CTC	Concrete Technology Corporation
the City	City of Seattle
db	decibel
dBA	A-weighted decibel
dbh	diameter at breast height
DPS	distinct population segment
Ecology	Washington State Department of Ecology
EIS	environmental impact statement
EM	emergent
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FHWA	Federal Highway Administration
FO	forested
FR	Federal Register
GIS	geographic information system
GPS	global positioning system
HCT	high-capacity transit
HGM	hydrogeomorphic (classification)
HOV	high occupancy vehicle
I-5	Interstate 5
L1AB, L2AB	lacustrine aquatic bed (wetland)
LWD	large woody debris
mg/L	milligrams per liter
MOHAI	Museum of History and Industry
NAVD 88	North American vertical datum 1988
NEPA	National Environmental Policy Act

NMFS	National Marine Fisheries Service
NOAA Fisheries	National Atmospheric and Oceanic Administration, National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
OW	open water
PEM	palustrine emergent (wetland)
PFO	palustrine forested (wetland)
PGIS	pollution-generating impervious surfaces
PHS	Priority Habitats and Species
ppb	parts per billion
PSS	palustrine scrub-shrub (wetland)
RCW	Revised Code of Washington
RMS	root mean square
SDEIS	Supplemental Draft Environmental Impact Statement
SEPA	State Environmental Policy Act
SMC	Seattle Municipal Code
SPUI	single-point urban interchange
SR	State Route
SS	scrub-shrub
TDA	threshold discharge area
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington State Department of Fish and Wildlife
WRIA	water resource inventory area
WSCC	Washington State Conservation Commission
WSDOT	Washington State Department of Transportation

1. Introduction

Why are ecosystems considered in an environmental impact statement?

An ecosystem is a biological community interacting with its physical and chemical environment as an integrated, dynamic unit. Ecosystems consist of living organisms, including humans, and the environment they inhabit. Understanding this relationship is integral to the environmental review process. Various federal, state, and local regulations, including the National Environmental Policy Act (NEPA) and the Washington State Environmental Policy Act (SEPA), require that the effects of a proposed project on ecosystem structure, function, and process be evaluated in an environmental impact statement (EIS). This discipline report presents three important ecosystem resources—wetlands, fish and aquatic resources, and wildlife and habitat. Water is integral to these resources and is also a key driver for many other physical and chemical processes, especially those related to stormwater. Because of its complexity, a discussion of water resources is presented separately in the Water Resource Discipline Report (WSDOT 2009a).

This report is organized into sections by ecosystem resource (wetlands, fish and aquatic resources, and wildlife and habitat). The proposed mitigation is discussed at the end of each resource section, and references are provided at the end of the report.

What are the key points of this report?

The study area for the Interstate 5 (I-5) to Medina: Bridge Replacement and High Occupancy Vehicle (HOV) Project, proposed by the Washington State Department of Transportation (WSDOT), contains a number of important wetland, fish and aquatic, and wildlife resources that are essential to the health and sustainability of the natural ecosystem. With the exception of stormwater runoff, the magnitude of adverse effects on ecosystems would be greater under the 6-Lane Alternative than under the No Build Alternative.

The 6-Lane Alternative would affect ecosystem conditions and functions in several ways that vary with the design options and suboptions. Some of the effects would be beneficial (such as the removal of unused highway ramps, the providing of stormwater

treatment facilities, the addition of sound walls, and the raising of the height of overwater structures). However, there would also be negative effects, such as the filling and shading of wetlands and aquatic habitats by the wider overwater structures and construction of the bridge support piers. Project effects include construction and operational effects. Construction effects would occur from work bridges, falsework, detour bridges, staging areas, and construction access roads that are built and used during the construction period. Operational effects derive from the permanent structures.

Construction effects are effects that would occur while the new bridge, roadways, ancillary facilities, and any mitigation features are being built.

Operational effects are effects that would occur while the new bridge, roadways, ancillary facilities, and any mitigation features are in use.

Where effects on wetlands, fish, and aquatic resources are unavoidable, a mitigation plan would be implemented to compensate for or replace the resources that are lost or affected, in accordance with applicable local, state, and federal regulations. Mitigation plans would also help to offset any construction-related effects on these resources by, for example, revegetating shoreline areas that were disturbed during construction.

Wetlands

- Some of the wetlands along the corridor would be filled, cleared, or shaded under the 6-Lane Alternative options and suboptions.
- Under all the options of the 6-Lane Alternative, construction work bridges and work platforms would affect wetlands due to vegetation clearing for construction access, fill for bridge support structures, or shading of vegetation during the construction period. Clearing of wetlands would remove branches and tree trunks, but would generally leave the soil intact. Shading would block sunlight, which could reduce plant growth and vigor. In addition, the reduced rain under the bridge would limit or retard plant growth in wetlands in which rain is an important source of water.
- In general, Option K would have more effects from construction than Options A and L. Option K would have the most area of wetlands cleared and filled. Option K also would have the greatest amount of shade effects from construction. Options A and L would have approximately the same amount of clearing and fill from construction shade effects. When the suboptions are included, only the suboptions for Option A would increase the amount of wetlands cleared and filled or shaded; when the

Comparison of Wetland Effects from Construction (in acres)

Type of Effect	Wetland	Wetland Buffer
Clear and Fill		
Option A	0.6	2.8
Suboptions	0.1	0.4
Option K	1.1	3.2
Suboptions	-	-
Option L	0.5	2.8
Suboptions	<0.1	-
Shade		
Option A	6.4	0.2
Suboptions	0.4	<0.1
Option K	8.1	0.6
Suboptions	-	-
Option L	6.4	0.2
Suboptions	-	-

suboptions are included, Option A would still have less clear and fill and shade effects from construction than Option K, but would have more effects than Option L.

- The amount of buffer cleared and filled from construction would be the largest with Option K. Options A and L would result in the same amount of buffer cleared and filled from construction activities. Only the suboptions for Option A would increase the amount of clearing and fill of buffers; when the suboptions are included, Option A would have the same amount of clearing and fill of wetland buffers from construction as Option K.
- Option K would have the most shading of buffers from construction; Options A and L would have the same amount of buffer shaded from construction.
- Implementing erosion and sediment control measures, spill prevention plans, and other best management practices (BMPs) would minimize construction effects. After construction of the project, the wetlands affected by construction activities would be revegetated.

Comparison of Wetland Effects from Operation (in acres)

Type of Effect	Wetland	Wetland Buffer
Fill		
Option A	0.1	0.7
Suboptions	<0.1	0.1
Option K	1.8	5.4
Suboptions	<0.1	<0.1
Option L	0.3	1.5
Suboptions	<0.1	<0.1
Shade		
Option A	3.2	0.9
Suboptions	0.1	-
Option K	2.8	0.1
Suboptions	-	-
Option L	4.3	1.3
Suboptions	<0.1	-

- When both fill and shade are considered, Option A would have the least amount of area affected by project operation. Options K and L would have the same number of acres affected by operation of the project.
- Wetland fill from Option K would be substantially more than Options A and L; this is primarily the result of the low bridge profile in the west approach area.
- Option L would have the greatest shade effects from operation, and Option K would have the least.
- Project operation of Option K would fill the largest area of buffers, followed by Option L, then Option A. Option L, however, would have the most effects on buffers from shading, and Option K would have the least effect.
- Most of the operational effects on wetlands would be due to shading from the bridge roadway. While the shaded wetlands would continue to function, the reduced light levels underneath the bridge could limit or retard plant growth, which could alter water quality, change the type and/or quality of the habitat, and potentially reduce wildlife use of the wetlands. In addition, the

reduced rain under the bridge could limit or retard plant growth in wetlands in which rain is an important source of water.

- WSDOT has engaged several regulatory agencies in collaborative technical working groups to assist in the development of appropriate mitigation for project effects. WSDOT has also assembled a team of scientists to prepare formal mitigation plans required for project permitting. These mitigation plans incorporate field investigations, scientific research, and the collective knowledge from the technical working group and mitigation team. An Initial Wetland Mitigation Report will be prepared in the fall of 2009.

Fish and Aquatic Resources

- For fish and aquatic resources, the amount of lost aquatic habitat would primarily result from the new in-water columns supporting the elevated or floating bridge structures.
- Operation of the project would result in a larger area with reduced habitat functions compared to existing conditions. The reduced functions would primarily be due to increased shading by the larger overwater structures. While the shaded aquatic habitat would continue to function, the reduced light levels could affect aquatic plant growth and, therefore, the quality of the habitat for fish.
- The 6-Lane Alternative would result in substantial water quality benefits from stormwater treatment compared to the existing highway and bridge surfaces, which currently discharge untreated stormwater directly to the lake.
- Between the options and suboptions for the 6-Lane Alternative, the magnitude of effect varies rather than the type of effect. The construction activities and structures that would result in effects to fish and aquatic resources are somewhat similar for each option.
- Most of the proposed bridge structures under the options would be similar or higher than the existing bridge structures. The higher sections would somewhat offset the potential shading effects of the wider structures, while the effects would likely be substantially greater for those sections that remain at about the same height as the existing structures.

- Shading over shallow, nearshore habitats, including Union Bay and the Arboretum, would likely have greater potential effects than shading in the deeper, open lake environment. The nearshore generally provides areas of greater habitat complexity to support a diverse biological community. Therefore, increased shading in these areas would have a greater potential to affect a variety of species, such as altering fish behavior or habitat use. However, shading could also reduce the densities of invasive aquatic vegetation, which could result in slight improvements to water quality conditions and habitat use.
- Both the permanent and the construction structures would require pile driving and other in-water construction activities. Pile driving could affect nearby fish behavior or potentially cause fish mortality from the high sound pressure levels from impact pile driving hammers. Appropriate and available construction BMPs would be used to minimize the effects of pile driving. Effects on fish habitat could also occur through temporary increases in turbidity and shade, and habitat loss would occur due to piling placement for construction work structures.
- Implementing erosion and sediment control measures, spill prevention plans, and other BMPs would minimize construction effects. After construction of the project, the temporarily affected aquatic habitat areas would be restored or would recover naturally.
- In cooperation with resource agencies, WSDOT would develop plans for habitat construction, improvements, or restoration to mitigate the effects of bridge construction, the increased width of shoreline and open-water crossings, and direct physical impacts from construction activities. An Initial Mitigation Report was prepared in the fall of 2009. Detailed plans would be included in permit applications for construction of the I-5 to Medina: Bridge Replacement and HOV Project.

Wildlife and Habitat

- All of the 6-Lane options and suboptions could affect wildlife and wildlife habitat by permanently removing vegetation, increasing shading, adding noise disturbance from increased highway operations, and reducing barriers to animal movement. Specific effects on wildlife would vary throughout the corridor.

- The new roadway would displace some high-quality wildlife habitat (including wetlands and large trees) in the project corridor. The roadway would reduce cover, nesting, and foraging habitat for some species.
- At least two of the options for the 6-Lane Alternative include sound walls along the majority of the corridor, which would reduce disturbance in the adjacent habitats. Noise from construction activities and pile driving could affect bird species, including nesting and foraging bald eagles near the Washington Park Arboretum. The levels of construction noise and the distance of the construction areas from bald eagle and other nest sites (and other sensitive wildlife habitats) would be similar for all options and suboptions. Construction duration would be approximately the same for all options and suboptions, and construction would occur in excess of 900 feet from the nearest known bald eagle nest.
- Transport of the pontoons is not likely to affect marine wildlife found in the waters of the outer Washington coast, the Strait of Juan de Fuca, and Puget Sound.

The key elements of the 6-Lane Alternative design options and suboptions with the potential to affect ecosystem resources in the study area are summarized in Exhibit 1-1.

Exhibit 1-1. Key Elements and Potential Effects on Ecosystems of the 6-Lane Alternative, Design Options, and Suboptions

Project Element	What It Involves	How It Could Affect Ecosystems
SR 520 Corridor		
Operation of the Portage Bay and Evergreen Point bridges and approach structures	Would widen the roadway. Would generally maintain or increase height of the bridges across Portage and Union bays. Would require large-diameter columns (drilled shafts) to be installed, but would increase the spacing between columns. Would remove existing unused highway ramps (shade and impervious surface). Would add sound walls along highway corridor.	Would cause a net increase in pollution-generating impervious surface. Would remove riparian vegetation. Would fill and shade wetlands and buffers. Would fill and shade fish and wildlife habitat. Would shade open-water, shoreline, and vegetated areas, but may also allow more indirect light penetration under the structure because of increased height and fewer support piers. Would remove foraging, rearing, and nesting habitat for wildlife in the vicinity of the Washington Park Arboretum. Would expose previously shaded areas to sunlight. Would reduce noise in habitat near the corridor.

Exhibit 1-1. Key Elements and Potential Effects on Ecosystems of the 6-Lane Alternative, Design Options, and Suboptions

Project Element	What It Involves	How It Could Affect Ecosystems
Construction work bridges, platforms, detour bridges, staging areas, and temporary access roads	Construction would require extensive in-water work in Portage Bay, Union Bay, and Lake Washington. Would require driving piles in wetlands, aquatic habitats, and open-water areas of Portage Bay, Union Bay, and Lake Washington. Would expand the overwater structures outside of the footprint of the proposed bridge—typically at least 30 feet on either side of the alignment. Would use barges in shallow and deep-water areas to stage construction—up to 100 feet long perpendicular to the alignment. Would involve use of materials, methods, and equipment with the potential for spills, leaks, and construction dewatering, etc.	Would disturb and displace aquatic habitat during construction. Would remove vegetation, including potential perch trees for wintering bald eagles. Would temporarily clear, fill, and shade wetlands and buffers. These would be restored after construction. Would create noise disturbance (from pile driving, etc.), which could affect the health and behavior of fish and wildlife species, including special status fish and wildlife species such as Chinook salmon, bull trout, steelhead, and bald eagles. Would displace foraging, rearing, and nesting habitat for wildlife in the vicinity of the Washington Park Arboretum during construction. Would create additional shading of open-water areas and shorelines, altering the aquatic habitat during construction. Would temporarily reduce water quality (increased turbidity), increasing the potential risk to fish and wildlife during construction.
Stormwater treatment facilities	Would treat roadway runoff before discharging to Union or Portage bays and Lake Washington (stormwater is currently not treated). Would add high-efficiency pavement sweeping and modified catch basins to enhance the treatment of stormwater entering Lake Washington.	Would reduce sediment loads and treat pollutants in runoff water entering receiving waters, including wetlands, benefiting fish, wildlife, and aquatic organisms (Lake Union, Portage Bay, Union Bay, and Lake Washington). Would result in some fill of wetlands and buffers.
Roadway restriping and transition into the Eastside Transit and HOV Project improvements	Would require restriping and reconfiguration within the roadway area.	Would have no effect.
Bridge maintenance facility	Would add overwater structure (dock) along shoreline. Would remove two adjacent residential docks. Would require in-water work. Would include a wave barrier along about half of the dock.	Would create additional shading of open-water areas and shorelines, altering the aquatic habitat during construction Would reduce water quality temporarily (increased turbidity), increasing the potential risk to fish and wildlife during construction. The wave barrier would alter the wave and water circulation patterns, which could alter substrate conditions in a potential sockeye spawning area.

Exhibit 1-1. Key Elements and Potential Effects on Ecosystems of the 6-Lane Alternative, Design Options, and Suboptions

Project Element	What It Involves	How It Could Affect Ecosystems
Pontoon Construction and Transport		
Evergreen Point Bridge pontoons	Would require transporting the pontoons from the Grays Harbor area through the Hiram M. Chittenden Locks (Ballard Locks). Some minor disturbance of lake bottom sediments would occur when installing anchors and cables to hold the bridge pontoons in place.	Unlikely to displace marine mammals during pontoon transport. Could potentially introduce or spread invasive species attached to pontoons. Would produce temporary turbidity in deeper water areas of Lake Washington when installing anchors.

What is the I-5 to Medina: Bridge Replacement and HOV Project?

The Interstate 5 (I-5) to Medina: Bridge Replacement and High-Occupancy Vehicle (HOV) Project is part of the State Route (SR) 520 Bridge Replacement and HOV Program (SR 520 Program) (detailed in the text box below) and encompasses parts of three main geographic areas—Seattle, Lake Washington, and the Eastside. The project area includes the following:

- Seattle communities: Portage Bay/Roanoke, North Capitol Hill, Montlake, University District, Laurelhurst, and Madison Park
- Eastside communities: Medina, Hunts Point, Clyde Hill, and Yarrow Point
- The Lake Washington ecosystem and associated wetlands
- Usual and accustomed fishing areas of tribal nations that have historically used the area's aquatic resources and have treaty rights

The SR 520 Bridge Replacement and HOV Project Draft Environmental Impact Statement (EIS), published in August 2006, evaluated a 4-Lane Alternative, a 6-Lane Alternative, and a No Build Alternative. Since the Draft EIS was published, circumstances surrounding the SR 520 corridor have changed in several ways. These changes have resulted in decisions to forward advance planning for potential catastrophic failure of the Evergreen Point Bridge, respond to increased demand for transit service on the Eastside, and evaluate a new set of community-based designs for the Montlake area in Seattle.

What is the SR 520 Program?

The SR 520 Bridge Replacement and HOV Program will enhance safety by replacing the aging floating bridge and keep the region moving with vital transit and roadway improvements throughout the corridor. The 12.8-mile program area begins at I-5 in Seattle and extends to SR 202 in Redmond.

In 2006, WSDOT prepared a Draft EIS—published formally as the SR 520 Bridge Replacement and HOV Project—that addressed corridor construction from the I-5 interchange in Seattle to just west of I-405 in Bellevue. Growing transit demand on the Eastside and structure vulnerability in Seattle and Lake Washington, however, led WSDOT to identify new projects, each with a separate purpose and need, that would provide benefit even if the others were not built. These four independent projects were identified after the Draft EIS was published in 2006, and these now fall under the umbrella of the entire SR 520 Bridge Replacement and HOV Program:

- I-5 to Medina: Bridge Replacement and HOV Project replaces the SR 520 roadway, floating bridge approaches, and floating bridge between I-5 and the eastern shore of Lake Washington. This project spans 5.2 miles of the SR 520 corridor.
- Medina to SR 202: Eastside Transit and HOV Project completes and improves the transit and HOV system from Evergreen Point Road to the SR 202 interchange in Redmond. This project spans 8.6 miles of the SR 520 corridor.
- Pontoon Construction Project involves constructing the pontoons needed to restore the Evergreen Point Bridge in the event of a catastrophic failure and storing those pontoons until needed.
- Lake Washington Congestion Management Project, through a grant from the U.S. Department of Transportation, improves traffic using tolling, technology and traffic management, transit, and telecommuting.

To respond to these changes, the Washington State Department of Transportation (WSDOT) and the Federal Highway Administration (FHWA) initiated new projects to be evaluated in separate environmental documents. Improvements to the western portion of the SR 520 corridor—known as the I-5 to Medina: Bridge Replacement and HOV Project (the *I-5 to Medina project*)—are being evaluated in a Supplemental Draft EIS (SDEIS); this discipline report is a part of that SDEIS. Project limits for this project extend from I-5 in Seattle to 92nd Avenue NE in Yarrow Point, where it transitions into the Medina to SR 202: Eastside Transit and HOV Project (the *Medina to SR 202 project*). Exhibit 1-2 shows the project vicinity.

Exhibit 1-2. Project Vicinity Map

What are the project alternatives?

As noted above, the Draft EIS evaluated a 4-Lane Alternative, a 6-Lane Alternative (including three design options in Seattle), and a No Build Alternative. In 2006, following Draft EIS publication, Governor Gregoire identified the 6-Lane Alternative as the state's preference for the SR 520 corridor, but urged that the affected communities in Seattle develop a common vision for the western portion of the corridor. Accordingly, a mediation group convened at the direction of the state legislature to evaluate the corridor alignment for SR 520 through Seattle.

The mediation group identified three 6-lane design options for SR 520 between I-5 and the floating span of the Evergreen Point Bridge; these options were documented in a Project Impact Plan (Parametrix 2008). The SDEIS evaluates the following:

- No Build Alternative
- 6-Lane Alternative
  - Option A
  - Option K
  - Option L

These alternatives and options are summarized below. The 4-Lane Alternative and the Draft EIS 6-lane design options have been eliminated from further consideration. More information on how the project has evolved since the Draft EIS was published in 2006, as well as more detailed information on the design options, is provided in the Description of Alternatives Discipline Report (WSDOT 2009b).

What is the No Build Alternative?

Under the No Build Alternative, SR 520 would continue to operate between I-5 and Medina as it does today: as a 4-lane highway with nonstandard shoulders and without a bicycle/pedestrian path. (Exhibit 1-3 depicts a cross section of the No Build Alternative.) No new facilities would be added to SR 520 between I-5 and Medina, and none would be removed, including the unused R.H. Thomson Expressway ramps near the Washington Park Arboretum. WSDOT would continue to manage traffic using its existing transportation demand management and intelligent transportation system strategies.

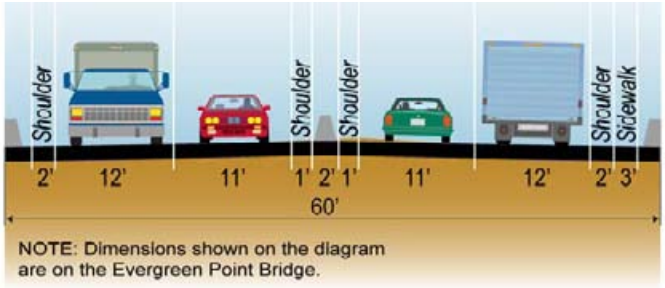
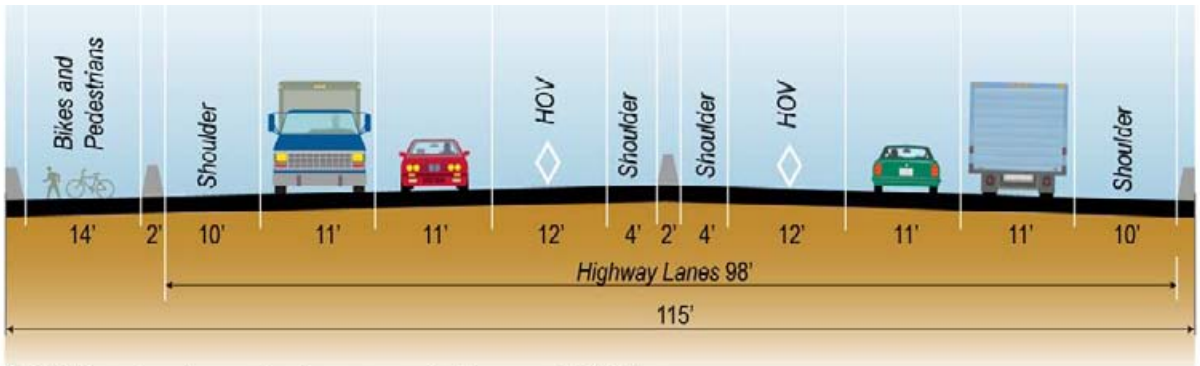


Exhibit 1-3. No Build Alternative Cross Section

The No Build Alternative assumes that the Portage Bay and Evergreen Point bridges would remain standing and functional through 2030 and that no catastrophic events, such as earthquakes or extreme storms, would cause major damage to the bridges. The No Build Alternative also assumes completion of the Medina to SR 202 project as well as other regionally planned and programmed transportation projects. The No Build Alternative provides a baseline against which project analysts can measure and compare the effects of each 6-Lane Alternative build option.

What is the 6-Lane Alternative?

The 6-Lane Alternative would complete the regional HOV connection (3+ HOV occupancy) across SR 520. This alternative would include six lanes (two 11-foot-wide outer general-purpose lanes and one 12-foot-wide inside HOV lane in each direction), with 4-foot-wide inside and 10-foot-wide outside shoulders (Exhibit 1-4). The proposed width of the roadway would be approximately 18 feet narrower than the one described in the Draft EIS, reflecting public comment from local communities and the City of Seattle.



NOTE: Dimensions shown on the diagram are on the Evergreen Point Bridge.

Exhibit 1-4. 6-Lane Alternative Cross Section

SR 520 would be rebuilt from I-5 to Evergreen Point Road in Medina and restriped and reconfigured from Evergreen Point Road to 92nd Avenue NE in Yarrow Point. A 14-foot-wide bicycle/pedestrian path would be built along the north side of SR 520 through the Montlake area and across the Evergreen Point Bridge, connecting to the regional path on the Eastside. A bridge maintenance facility and dock would be built underneath the east approach to the Evergreen Point Bridge.

The sections below describe the 6-Lane Alternative and design options in each of the three geographical areas the project would encompass.

Seattle

Elements Common to the 6-Lane Alternative Options

SR 520 would connect to I-5 in a configuration similar to the way it connects today. Improvements to the I-5/SR 520 interchange would include a new reversible HOV ramp connecting the new SR 520 HOV lanes to existing I-5 reversible express lanes. WSDOT would replace the Portage Bay Bridge and the Evergreen Point Bridge (including the west approach and floating span), as well as the existing local street bridges

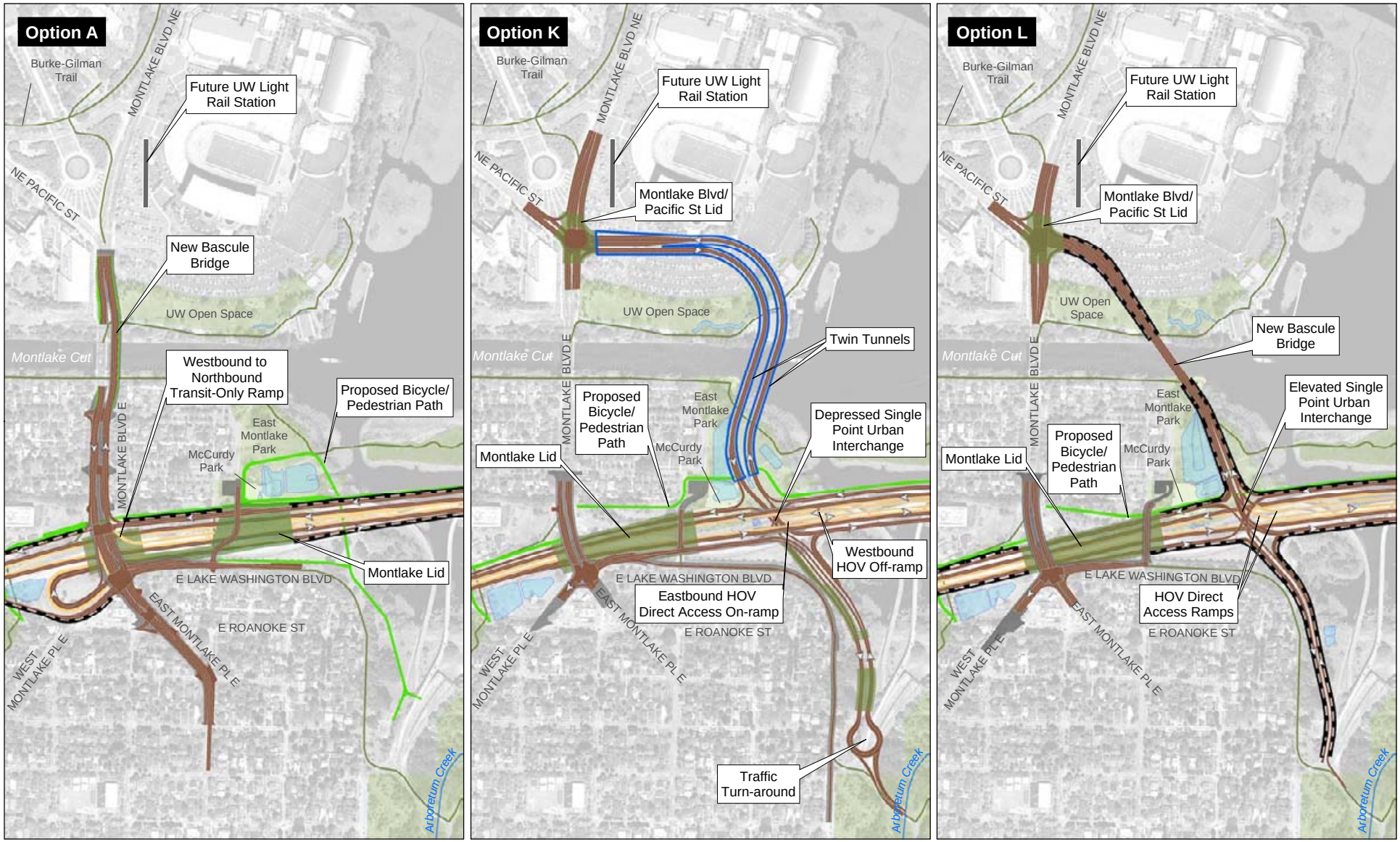
across SR 520. New stormwater facilities would be constructed for the project to provide stormwater retention and treatment. The project would include landscaped lids across SR 520 at I-5, 10th Avenue East and Delmar Drive East, and in the Montlake area to help reconnect the communities on either side of the roadway. The project would also remove the Montlake freeway transit station.

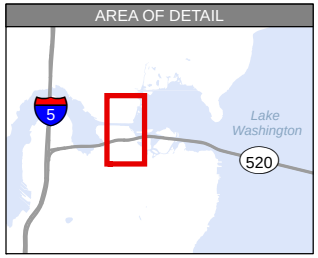
The most substantial differences among the three options are the interchange configurations in the Montlake and University of Washington areas. Exhibit 1-5 depicts these key differences in interchange configurations, and the following text describes elements unique to each option.

Option A

Option A would replace the Portage Bay Bridge with a new bridge that would include six lanes (four general-purpose lanes, two HOV lanes) plus a westbound auxiliary lane. WSDOT would replace the existing interchange at Montlake Boulevard East with a new, similarly configured interchange that would include a transit-only off-ramp from westbound SR 520 to northbound Montlake Boulevard. The Lake Washington Boulevard ramps and the median freeway transit stop near Montlake Boulevard East would be removed, and a new bascule bridge (i.e., drawbridge) would be added to Montlake Boulevard NE, parallel to the existing Montlake Bridge.

SR 520 would maintain a low profile through the Washington Park Arboretum and flatten out east of Foster Island, before rising to the west transition span of the Evergreen Point Bridge. Citizen recommendations made during the mediation process defined this option to include sound walls and/or quieter pavement, subject to neighborhood approval and WSDOT's reasonability and feasibility determinations.





- Potential Sound Wall
- Existing Regional Bicycle/Pedestrian Path
- Tunnel
- Lid or Landscape Feature
- Proposed Bicycle/Pedestrian Path
- Stormwater Facility
- General-Purpose Lane
- HOV, Direct Access, and/or Transit-Only Lane
- Future UW Light Rail Station
- Park

N

0 250 500 1,000 Feet

Source: King County (2006) Aerial Photo, King County (2005) GIS Data (Streams), City of Seattle (1994) GIS Data (Bike/Ped Trail), Seattle Bicycle Map (2008) GIS Data (Bike/Ped Trail) CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 1-5. **Options A, K, and L: Montlake and University of Washington Areas**

I-5 to Medina: Bridge Replacement and HOV Project

Suboptions for Option A would include adding an eastbound SR 520 on-ramp and a westbound SR 520 off-ramp to Lake Washington Boulevard, creating an intersection similar to the one that exists today but relocated northwest of its current location. The suboption would also include adding an eastbound direct access on-ramp for transit and HOV from Montlake Boulevard East, and providing a constant slope profile from 24th Avenue East to the west transition span.

Is it a highrise or a transition span?

A transition span is a bridge span that connects the fixed approach bridge to the floating portion of the bridge. The Evergreen Point Bridge has two transition spans, one at the west end of the floating bridge transitioning traffic on and off of the west approach, and one on the east end of the floating bridge transitioning traffic on and off of the east approach. These spans are often referred to as the "west highrise" (shown) and the "east highrise" during the daily traffic report, and the west highrise even has a traffic camera mounted on it.

Today's highrises have two characteristics—large overhead steel trusses and navigation channels below the spans where boat traffic can pass underneath the Evergreen Point Bridge. The new design for the floating bridge would not include overhead steel trusses on the transition spans, which would change the visual character of the highrise. For the SDEIS, highrise and transition span are often used interchangeably to refer to the area along the bridge where the east and west approach bridges transition to the floating bridge.

Option K

Option K would also replace the Portage Bay Bridge, but the new bridge would include four general-purpose lanes and two HOV lanes with no westbound auxiliary lane. In the Montlake area, Option K would remove the existing Montlake Boulevard East interchange and the Lake Washington Boulevard ramps and replace their functions with a depressed, single-point urban interchange (SPUI) at the Montlake shoreline. Two HOV direct-access ramps would serve the new interchange, and a tunnel under the Montlake Cut would move traffic from the new interchange north to the intersection of Montlake Boulevard NE and NE Pacific Street. SR 520 would maintain a low profile through Union Bay, make landfall at Foster Island, and remain flat before rising to the west transition span of the Evergreen Point Bridge. A land bridge would be constructed over SR 520 at Foster Island. Citizen recommendations made during the mediation process defined this option to include only quieter pavement for noise abatement, rather than the sound walls that were included in the 2006 Draft EIS. However, because quieter pavement has not been demonstrated to meet all FHWA and WSDOT avoidance and minimization requirements in tests performed in Washington State, it cannot be considered as noise mitigation under WSDOT and FHWA criteria. As a result, sound walls could be included in Option K. The decision to build sound walls depends on neighborhood interest, the

findings of the Noise Discipline Report (WSDOT 2009c), and WSDOT's reasonability and feasibility determinations.

A suboption for Option K would include constructing an eastbound off-ramp to Montlake Boulevard East configured for right turns only.

Option L

Under Option L, the Montlake Boulevard East interchange and the Lake Washington Boulevard ramps would be replaced with a new, elevated SPUI at the Montlake shoreline. A bascule bridge (drawbridge) would span the east end of the Montlake Cut, from the new interchange to the intersection of Montlake Boulevard NE and NE Pacific Street. This option would also include a ramp connection to Lake Washington Boulevard and two HOV direct-access ramps providing service to and from the new interchange. SR 520 would maintain a low, constant slope profile from 24th Avenue East to just west of the west transition span of the floating bridge. Noise mitigation identified for this option would include sound walls as defined in the Draft EIS.

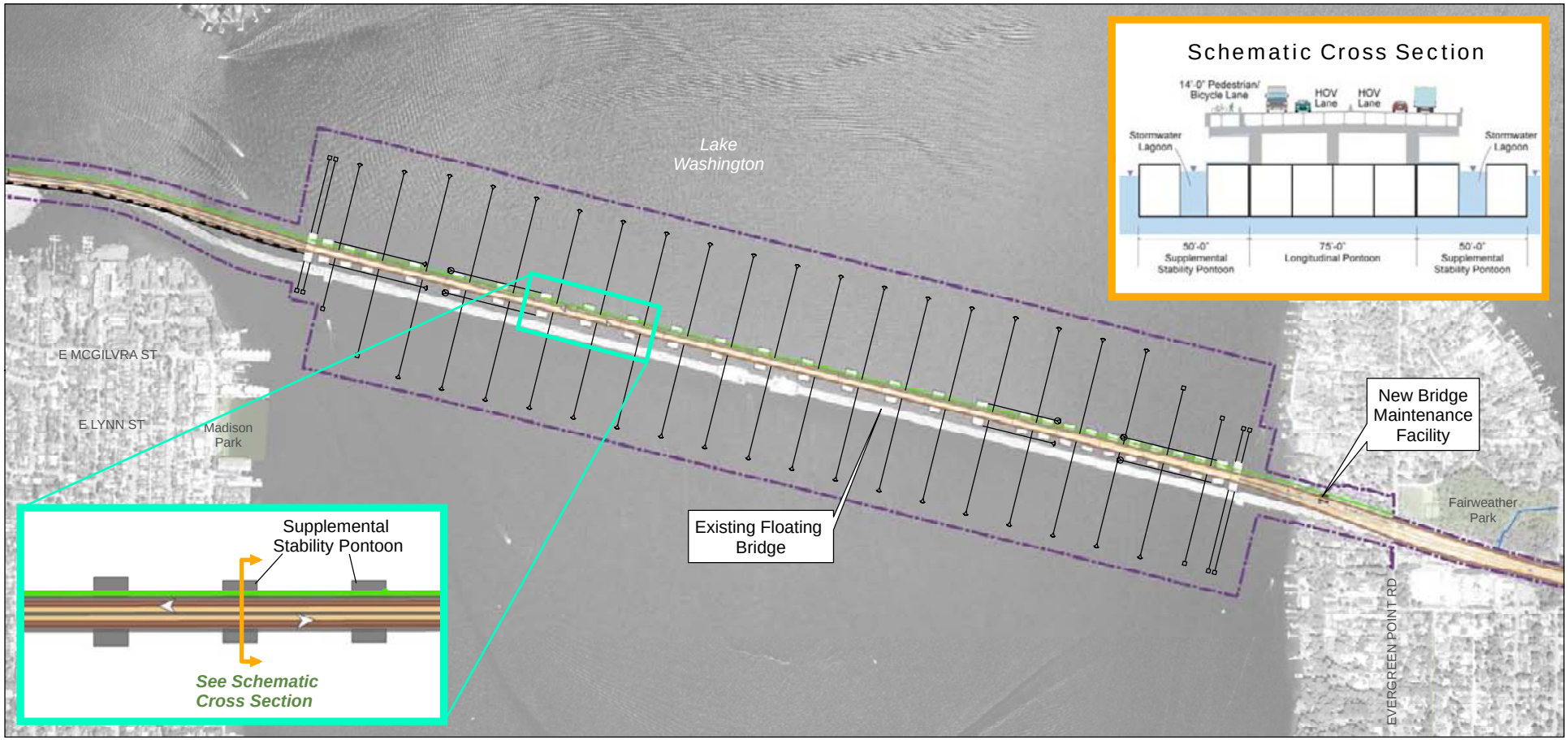
Suboptions for Option L would include adding a left-turn movement from Lake Washington Boulevard for direct access to SR 520 and adding capacity on northbound Montlake Boulevard NE to NE 45th Street.

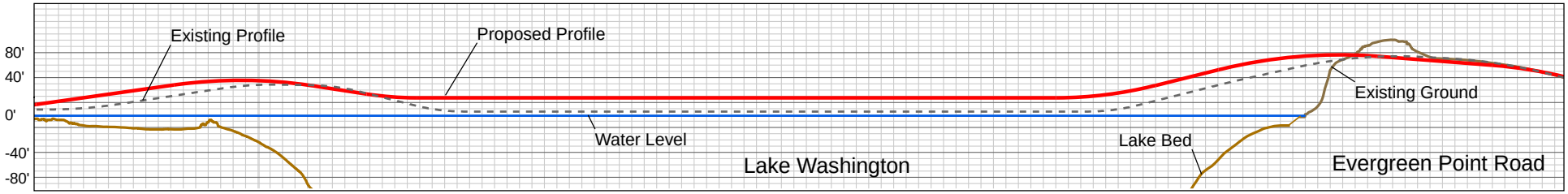
Lake Washington

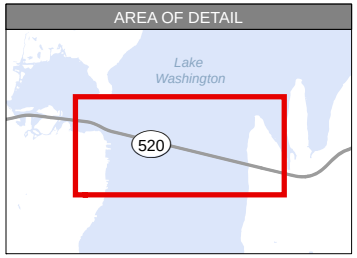
Floating Bridge

The floating span would be located approximately 190 feet north of the existing bridge at the west end and 160 feet north at the east end (Exhibit 1-6). Rows of three 10-foot-tall concrete columns would support the roadway above the pontoons, and the new spans would be approximately 22 feet higher than the existing bridge. A 14-foot-wide bicycle/pedestrian path would be located on the north side of the bridge.

The design for the new 6-lane floating bridge includes 21 longitudinal pontoons, two cross pontoons, and 54 supplemental stability pontoons. A single row of 75-foot-wide by 360-foot-long longitudinal pontoons would support the new floating bridge.







- Anchor and Cable
- Pontoons
- Limits of Construction
- Proposed Bicycle/Pedestrian Path
- General-Purpose Lanes
- HOV, Direct Access, and/or Transit-Only Lane
- Park

Source: King County (2006) Aerial Photo, CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

N

0 250 500 1,000 Feet

Exhibit 1-6. **6-Lane Alternative at the Evergreen Point Bridge (Common to All Options)**

I-5 to Medina: Bridge Replacement and HOV Project

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One 240-foot-long by 75-foot- wide cross-pontoon at each end of the bridge would be set perpendicularly to the longitudinal pontoons. The longitudinal pontoons would be bolstered by the smaller supplemental stability pontoons on each side for stability and buoyancy. The longitudinal pontoons would not be sized to carry future high-capacity transit (HCT), but would be equipped with connections for additional supplemental stability pontoons to support HCT in the future. As with the existing floating bridge, the floating pontoons for the new bridge would be anchored to the lake bottom to hold the bridge in place.

Near the east approach bridge, the roadway would be widened to accommodate transit ramps to the Evergreen Point Road transit stop. Exhibit 1-6 shows the alignment of the floating bridge, the west and east approaches, and the connection to the east shore of Lake Washington.

Bridge Maintenance Facility

Routine access, maintenance, monitoring, inspections, and emergency response for the floating bridge would be based out of a new bridge maintenance facility located underneath SR 520 between the east shore of Lake Washington and Evergreen Point Road in Medina. This bridge maintenance facility would include a working dock, an approximately 7,200-square-foot maintenance building, and a parking area.

Eastside Transition Area

The I-5 to Medina project and the Medina to SR 202 project overlap between Evergreen Point Road and 92nd Avenue NE in Yarrow Point. Work planned as part of the I-5 to Medina project between Evergreen Point Road and 92nd Avenue NE would include moving the Evergreen Point Road transit stop west to the lid (part of the Medina to SR 202 project) at Evergreen Point Road, adding new lane and ramp striping from the Evergreen Point lid to 92nd Avenue NE, and moving and realigning traffic barriers as a result of the new lane striping. The restriping would transition the I-5 to Medina project improvements into the improvements to be completed as part of the Medina to SR 202 project.

Pontoon Construction and Transport

If the floating portion of the Evergreen Point Bridge does not fail before its planned replacement, WSDOT would use the pontoons constructed and stored as part of the Pontoon Construction Project in the I-5 to Medina project. Up to 11 longitudinal pontoons built and stored in Grays Harbor as part of the Pontoon Construction Project would be

towed from a moorage location in Grays Harbor to Puget Sound for outfitting (see the sidebar to the right for an explanation of pontoon *outfitting*). All outfitted pontoons, as well as the remaining pontoons stored at Grays Harbor would be towed to Lake Washington for incorporation into the floating bridge. Towing would occur as weather permits during the months of March through October. Exhibit 1-7 illustrates the general towing route from Grays Harbor to Lake Washington, and identifies potential outfitting locations.

> **What is Outfitting?**
>
> Pontoon outfitting is a process by which the columns and elevated roadway of the bridge are built directly on the surface of the pontoon.

Exhibit 1-7. Possible Towing Route and Pontoon Outfitting Locations

The I-5 to Medina project would build an additional 44 pontoons needed to complete the new 6-lane floating bridge. The additional pontoons could be constructed at the existing Concrete Technology Corporation facility in Tacoma, and/or at a new facility in Grays Harbor that is also being developed as part of the Pontoon Construction Project. The new supplemental stability pontoons would be towed from the construction location to Lake Washington for incorporation into the floating bridge. For additional information about pontoon construction, please see the Construction Techniques Discipline Report (WSDOT 2009d).

Would the project be built all at once or in phases?

Revenue sources for the I-5 to Medina project would include allocations from various state and federal sources and from future tolling, but there remains a gap between the estimated cost of the project and the revenue available to build it. Because of these funding limitations, there is a strong possibility that WSDOT would construct the project in phases over time.

If the project is phased, WSDOT would first complete one or more of those project components that are vulnerable to earthquakes and windstorms; these components include the following:

- The floating portion of the Evergreen Point Bridge, which is vulnerable to windstorms. This is the highest priority in the corridor because of the frequency of severe storms and the high associated risk of catastrophic failure.
- The Portage Bay Bridge, which is vulnerable to earthquakes. This is a slightly lower priority than the floating bridge because the frequency of severe earthquakes is significantly less than that of severe storms.
- The west approach of the Evergreen Point Bridge, which is vulnerable to earthquakes (see comments above for the Portage Bay Bridge).

Exhibit 1-8 shows the vulnerable portions of the project that would be prioritized, as well as the portions that would be constructed later. The vulnerable structures are collectively referred to in the SDEIS as the Phased Implementation scenario. It is important to note that, while the new bridge(s) might be the only part of the project in place for a certain period of time, WSDOT's intent is to build a complete project that meets all aspects of the purpose and need.

The Phased Implementation scenario would provide new structures to replace the vulnerable bridges in the SR 520 corridor, as well as limited transitional sections to connect the new bridges to existing facilities. This scenario would include stormwater facilities, noise mitigation, and the regional bicycle/pedestrian path, but lids would be deferred until a subsequent phase. WSDOT would develop and implement all mitigation needed to satisfy regulatory requirements.

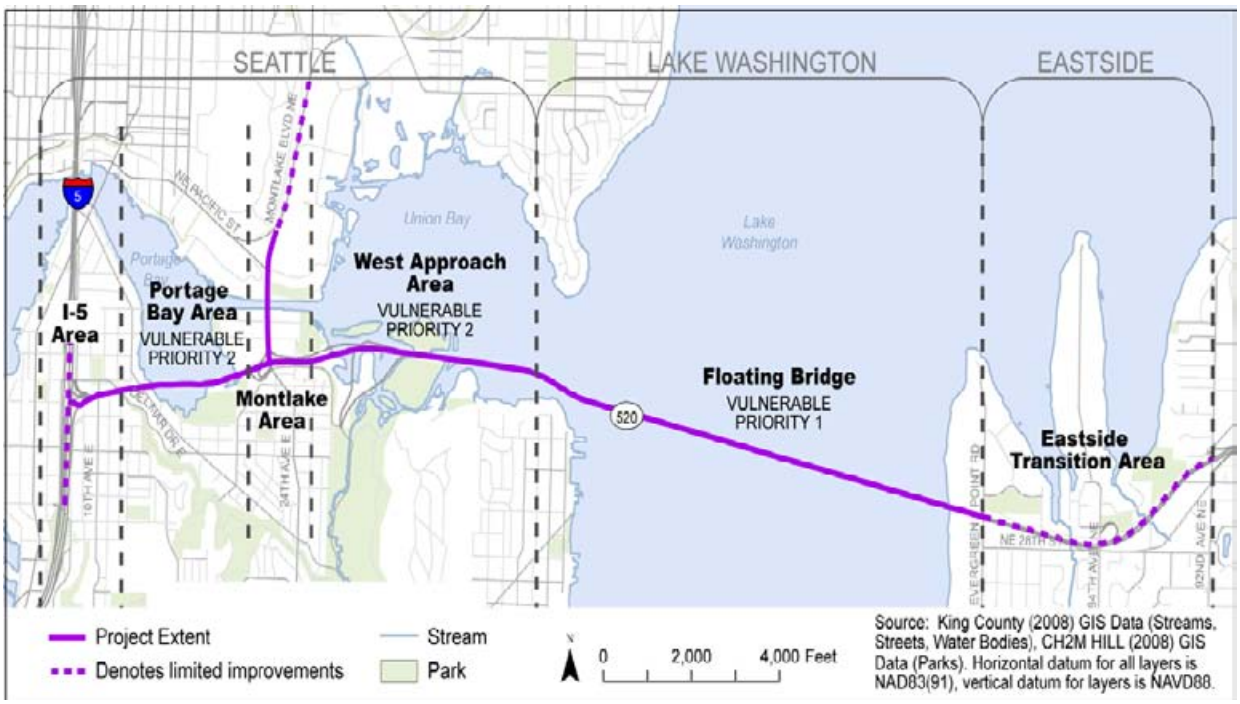


Exhibit 1-8. Geographic Areas along SR 520 and Project Phasing

To address the potential for phased project implementation, the SDEIS evaluates the Phased Implementation scenario separately as a subset of the "full build" analysis. The evaluation focuses on how the effects of phased implementation would differ from those of full build and on how constructing the project in phases might have different effects from constructing it all at one time. Impact calculations for the physical effects of phased implementation (for example, acres of wetlands and parks affected) are presented alongside those for full build where applicable.

2. Wetlands

Wetlands are transitional zones between aquatic environments and dry land. Their physical, biological, and chemical functions provide a wide variety of ecological benefits. For example, the capacity of wetlands to store water can reduce downstream flooding and trap sediments and other pollutants, improving overall water quality. Wetland vegetation also slows the movement of water, reducing streambank and shoreline erosion. In addition, wetlands can support diverse plant communities, which provide food and habitat for wildlife. Wetlands also provide educational and recreational opportunities for humans.

Affected Environment

How was the information on wetlands collected?

The study area includes the Seattle, Lake Washington, and Eastside area. The ecosystems analysts collected information on wetlands within the study area from a variety of sources. They consulted numerous digital and paper maps to determine the location of known and potential wetlands. Digital sources examined include aerial photographs, National Wetlands Inventory data, Seattle Geologic Survey, and current wetland mapping from local governments. The analysts further supplemented this information with data collected from the field.

The ecosystems analysts examined an approximately 200-foot area on either side of the project footprint (the study area for wetlands) to verify the location of previously mapped wetlands and to identify wetlands that do not appear in existing inventories. They also identified and delineated wetlands in the study area using the 1987 *Corps of Engineers Wetland Delineation Manual* (Environmental Laboratory 1987) and the *Washington State Wetland Identification and Delineation Manual* developed by the Washington State Department of Ecology (Ecology) (1997). These manuals outline an approach for identifying wetlands that involves determining whether wetland soils, plants, and hydrology are present. The *Interim Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region* developed by the U.S. Army Corps of Engineers (USACE) was not used because the wetland delineations occurred before the supplement was implemented.

Wetland vegetation is adapted to saturated soil conditions. The analysts evaluated each proposed alternative project sites for its dominant plants. The analysts then determined whether the vegetation met the wetland vegetation criterion based on the wetland indicator category assigned by the U.S. Fish and Wildlife Service (USFWS) (Reed 1988, 1993).

The wetland hydrology parameter is present if there are indicators that the soil is inundated or saturated to the surface long enough during the growing season to support a water-adapted plant community. Indicators of wetland hydrology include surface inundation or ponding, saturated soils, drainage patterns, watermarks on vegetation, and water-stained leaves.

Generally, an area must have hydric soils to be a wetland. Hydric soils have an identifiable color pattern, which occurs if the soil is saturated, flooded, or ponded for long periods. Low-chroma colors (those that are dull and gray) and mottles of bright color (known as redoximorphic features) typically form within the soil matrix. Other important indicators of wetland soils include accumulations of organic matter at the surface and a sulfur odor. The ecosystems analysts excavated soil pits and used Munsell color charts (GretagMacbeth 1994) to describe soil colors.

Analysts designated each wetland with a unique alphanumeric identifier consisting of a two-letter abbreviation of the watershed location, a single letter for direction (north or south of SR 520), and a number. Analysts flagged the wetland boundaries in the field, and licensed land surveyors surveyed the wetlands. This information was incorporated into geographic information system (GIS) format and stored in a project database. The ecosystems analysts supplemented these survey data with aerial photographs in order to interpret and map wetland boundaries beyond the delineation study area.

How were the wetlands classified and rated?

For the purposes of this study, the ecosystems analysts used two wetland classification systems and one rating system, as described next.

Cowardin Classification System

The first classification system used is defined in the *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979), also known as the Cowardin system, developed by USFWS.

The Cowardin system allows wetlands to be classified based on vegetation and hydrologic characteristics. Exhibit 2-1 summarizes the Cowardin classification system, which is illustrated in Exhibit 2-2.

Exhibit 2-1. Overview of Cowardin Classification System for Wetlands in the Study Area

Abbreviation	System[a]	Subsystem	Class
PEM	Palustrine (P)	Not applicable.	Emergent (EM)—Characterized by erect, rooted, herbaceous hydrophytes[b] present for most of the growing season in most years. Usually dominated by perennial plants.
PSS	Palustrine (P)	Not applicable.	Scrub-Shrub (SS)—Areas dominated by woody vegetation less than 6 meters (20 feet) tall. Species include true shrubs, young trees (saplings), and trees or shrubs that are small or stunted.
PFO	Palustrine (P)	Not applicable.	Forested (FO)—Characterized by woody vegetation that is 6 meters (20 feet) tall or taller.
POW	Palustrine (P)	Not applicable.	Open Water (OW)—Unvegetated, open water.
L1AB/L2AB	Lacustrine (L)	Limnetic (L1)—All open-water/deepwater habitats within the lacustrine system; many small lacustrine systems have no limnetic subsystem. Littoral (L2)—All wetland habitats in the lacustrine system. Extends from shoreward boundary to 2 meters (6.6 feet) below annual low water or to the maximum extent of nonpersistent emergents, if these grow at depths greater than 2 meters (6.6 feet).	Aquatic Bed (AB)—Dominated by plants that grow on or below the water surface for most of the growing season.

Note: Definitions based on information from USFWS *Classification of Wetlands and Deepwater Habitats of the United States* (Cowardin et al. 1979).

[a] Palustrine: All freshwater, nontidal wetlands dominated by trees, shrubs, emergents, mosses, or lichens. Lacustrine: Wetlands and deepwater habitats with all of the following characteristics: occur in topographic depressions or dammed river channels; lacking trees, shrubs, and persistent emergents; are greater than 20 acres in size (Cowardin et al. 1979).

[b] Hydrophytes are plants adapted to living in saturated soils (Cowardin et al. 1979).

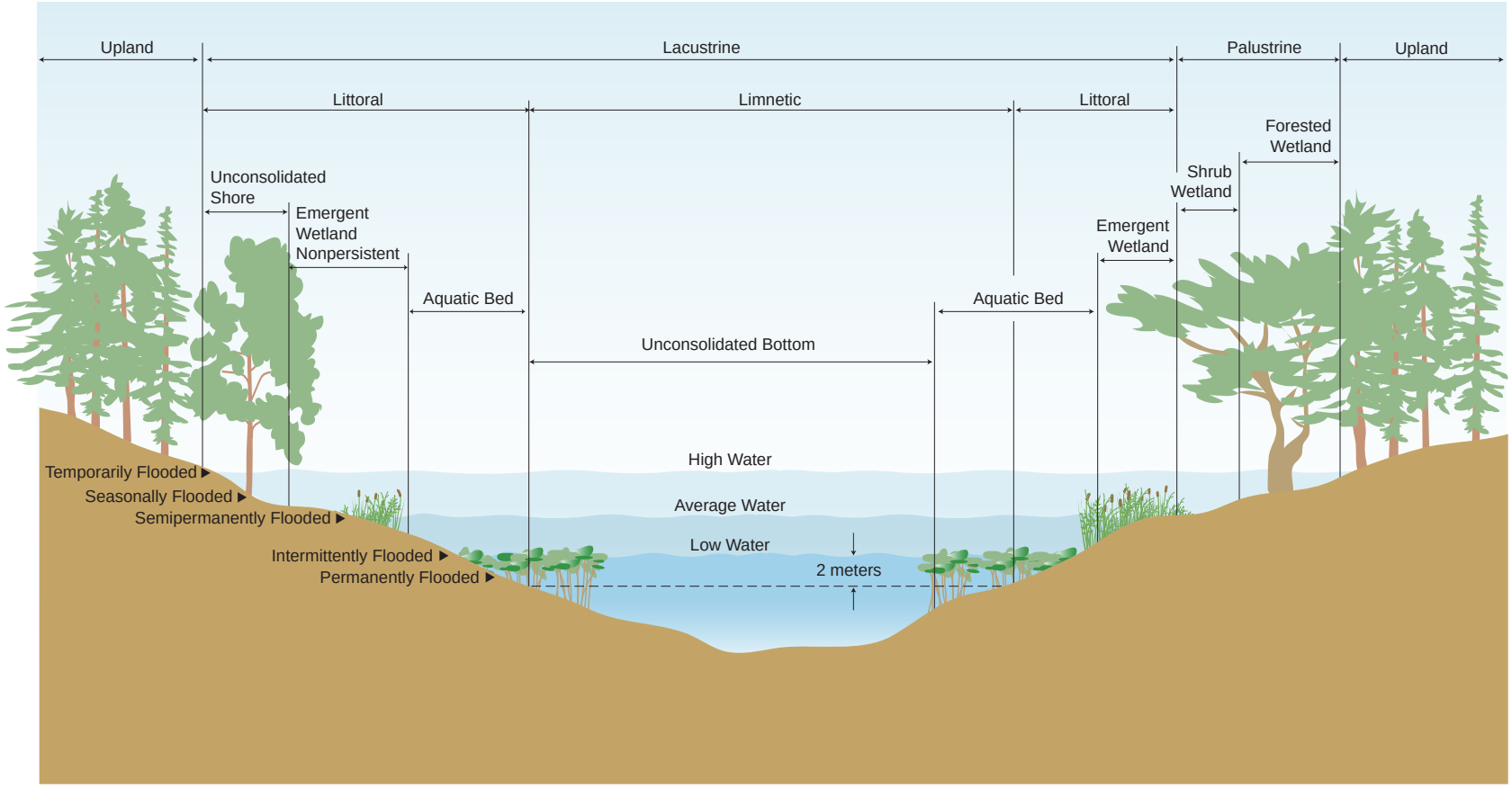


Exhibit 2-2. **Distinguishing Features and Examples of Habitats Using the Cowardin System**

I-5 to Medina: Bridge Replacement and HOV Project

According to the Cowardin system, wetlands are transitional lands between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water (Cowardin et al. 1979). The term "wetland" does not include deep, permanent water. The boundary between wetland and deep-water habitat in the palustrine and lacustrine systems lies roughly 6.6 feet below low water levels (Cowardin et al. 1979). Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live, whether or not they are attached to the substrate (Cowardin et al. 1979). Deepwater habitats are true aquatic environments, and the associated fish and wildlife using these habitats are discussed in the Fish and Aquatic Resources and Wildlife and Habitat sections of this report. Both wetlands and deepwater habitat occur within the study area for the proposed project.

HGM Classification System

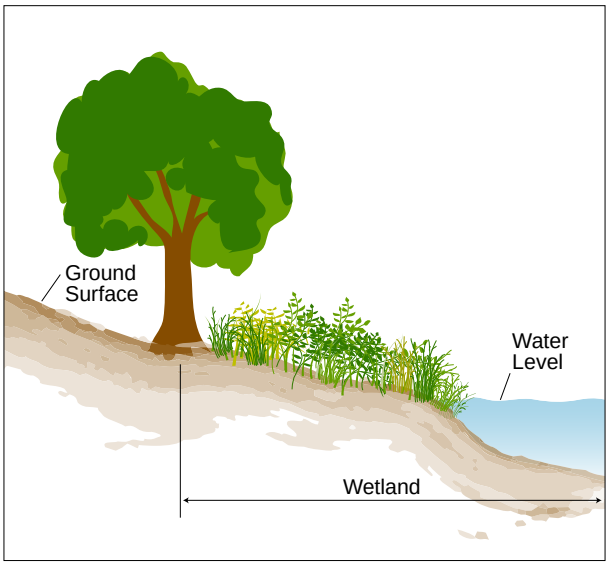
The second system used by the ecosystems analysts to classify wetlands in the study area considers landscape position, primary source of water, and the direction of water flow through the wetland. This classification system is referred to as hydrogeomorphic (HGM) classification, which is based on the methods defined in *A Hydrogeomorphic Classification for Wetlands* (Brinson 1993). Exhibit 2-3 summarizes the HGM classification system, which is illustrated in Exhibit 2-4.

Exhibit 2-3. Overview of the Hydrogeomorphic Classification System for Wetlands in the Study Area

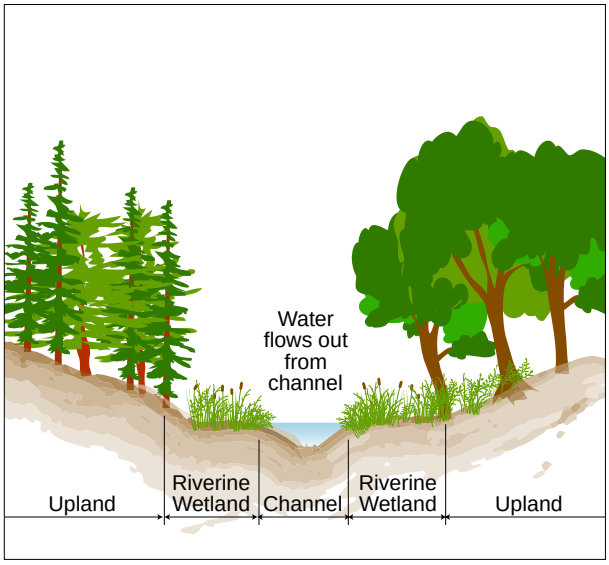
HGM Class	Primary Water Sources	Water Flow Properties
Depressional	Precipitation, groundwater	Vertical fluctuations
Riverine	Overbank flooding, groundwater, lateral flow, and precipitation	Unidirectional flow
Lake-fringe	Lateral flow and precipitation	Bidirectional
Slope	Precipitation, lateral flow, and groundwater	Unidirectional

Note: Based on A Hydrogeomorphic Classification of Wetlands (Brinson 1993)

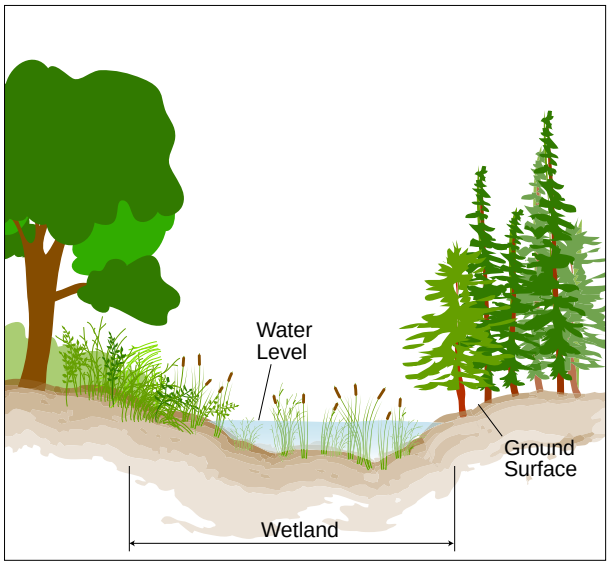
Depressional wetlands occur in topographic depressions. Dominant water sources are precipitation, groundwater discharge, and flow from adjacent uplands. Elevation contours are closed, thus allowing the accumulation of surface water. Depressional wetlands are either outflow or closed. Depressional outflow wetlands are those that have a surface water outlet (outflow) to a downgradient aquatic body.



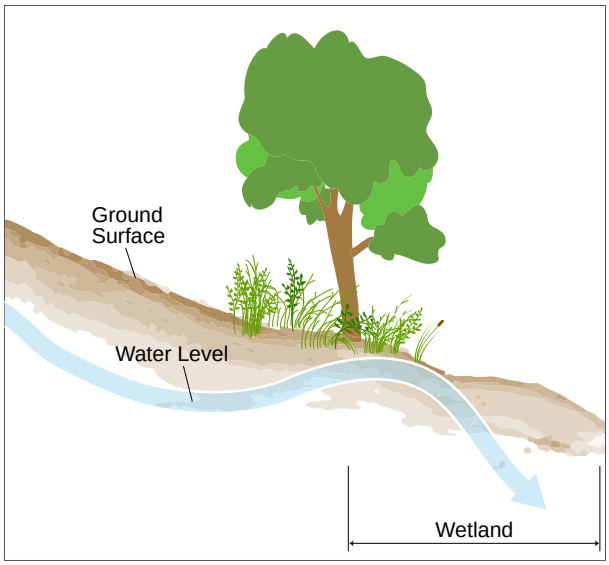
Lake-fringe Wetland



Riverine Wetland



Depressional Wetland



Slope Wetland

Exhibit 2-4. **Illustration of the Hydrogeomorphic Classification System**

I-5 to Medina: Bridge Replacement and HOV Project

Depressional closed wetlands are those that have no surface water outflow to channels, streams, or rivers.

Riverine wetlands occur in valleys associated with stream or river channels. They are in the active floodplain of a river and are linked to the river water dynamics. The primary source of water is frequent flooding (overbank flooding) from the stream or river.

Lake-fringe wetlands are vegetated wetlands adjacent to an area of open water that is larger than 20 acres and more than 6.6 feet deep over 30 percent of the open-water areas. The primary water source is the adjacent open water.

Slope wetlands occur on hill or valley slopes where groundwater surfaces and runs along the surface or immediately below the soil surface. Water flow is unidirectional, and there is no defined stream channel.

Wetland Rating System

Resource agencies and regulatory jurisdictions rate or categorize wetlands according to their relative rarity, sensitivity to disturbance, and quality of functions they provide. At the state level, wetlands are categorized according to the *Washington State Wetland Rating System for Western Washington* developed by Ecology (Hruby 2004), hereafter referred to as the Ecology rating system. As described in the following section, the Ecology rating system characterizes the wetlands capacity to provide water quality improvement, floodwater retention, and habitat functions.

Exhibit 2-5 summarizes these rating criteria for each wetland category used to rate the wetlands (Hruby 2004).

Wetland categories and rating scores from the Ecology rating system are used during the permit review process to establish standard buffer requirements, to determine allowable effects, and to establish replacement ratios for compensatory mitigation. The individual wetland ratings provided in this report are based on current data and regulations and would be refined (as appropriate) if the City of Seattle (the City) adopts new standards or if new information becomes available. Wetlands in the study area were rated according to the City's 2008 rating system, which defers to the Ecology rating system (Hruby 2004).

Exhibit 2-5. Washington State Department of Ecology Criteria for Wetland Rating Categories

		Rating Criteria
Category I	(a)	Include unique or rare wetland types (bog, estuary, mature/old-growth forested), or
	(b)	Are especially sensitive to disturbance, or
	(c)	Are relatively undisturbed and provide functions/values impossible to replace within a human lifetime, or
	(d)	Wetlands documented as high quality by the Natural Heritage Program, or
	(e)	Wetland with documented occurrence of state sensitive plant(s) by the Natural Heritage Program, or
	(f)	Perform the highest level of wetland functions (scoring >70 points).
Category II	(a)	Perform at a moderately high level of wetland functions (scoring 51 to 69 points), or
Category III	(a)	Perform with a moderate level of functions (scoring 30 to 50 points), or
Category IV	(a)	Are wetlands with lowest level of functions (scoring <30 points), frequently disturbed.

Source: Hruby (2004).

When wetland buffers are over water they overlap with open water areas discussed in the Fish and Aquatic Resources section in this report. The rating system and the City's corresponding standard buffer requirements within the study area are summarized in Exhibit 2-6.

Exhibit 2-6. Summary of Seattle Wetland Rating System[a] and Standard Buffer Requirements in the Study Area

Rating System	Ratings	Standard Buffer Requirements (in feet)[b]
Seattle Rating System Chapter 25.09.160	Category I	100, 110, or 200[c]
	Category II	100, 110, or 200[c]
	Category III	60 or 85[d]
	Category IV	0 or 50[e]

[a] Local critical areas ordinances and respective standard buffer widths may be revised in the future. WSDOT will apply the appropriate buffers during project permitting.

[b] These are standard buffer widths. Buffers can be reduced on a case-by-case basis.

[c] 110 feet for moderate level of habitat function; 200 feet for high level of habitat function.

[d] 85 feet for moderate or high level of habitat function.

[e] No buffer if the wetland is less than 1,000 square feet and is not part of a larger wetland system, nor abuts any Type 1-5 water.

A standard buffer is the area around a wetland that extends a designated distance from the wetland in order to protect the wetland. WSDOT included standard buffers landward of the wetlands. However, many of the wetlands abut open water areas. Open water areas do not function as buffers to protect the wetland; for this reason, open water areas are not described as wetland buffers. Open water areas do function as aquatic habitat, and effects to these areas are described in the Fish and Aquatic section of this report.

Wetland Functions

The ecosystems analysts also qualitatively characterized functions using Ecology's wetland rating system (Hruby 2004). The Ecology method uses a semi-quantitative scoring system for characterizing functions. The Ecology rating system considers functions as well as wetland scarcity and sensitivity to alteration.

Wetlands generally perform three types of functions. These functions are related to improving water quality (biogeochemical functions), maintaining the water regime in a watershed (hydrologic functions), and supporting food webs and providing habitat (habitat functions) (Sheldon et al. 2005).

The functions a wetland provides are determined by the characteristics of the wetland, the wetland's location within the landscape, the surrounding land use (such as urban, agricultural, or wilderness area), and the opportunity of the wetland to perform a given function (Hruby 2004). For this study, the upland habitats, buffers, and contiguous wetlands adjacent to the delineated wetlands were also considered in the characterization of functions because adjacent land uses affect the performance of wetland functions.

Wetland water quality and hydrologic functions include removing sediment and contaminants, providing storage for base flow to streams or groundwater, and attenuating flood flows. Performance of these functions is closely correlated to the size, shape, vegetative characteristics, presence of pollutants, and position of the wetlands within the watershed.

Wetland habitat functions are a wetland's ability to provide wildlife habitat. The capacity to perform these functions depends on the size of the wetland, the presence of multiple types of plant communities (such as emergent plants and forested areas), and the area of permanent water present in the wetland.

Mammals, birds, amphibians, and invertebrates all have different and specific habitat needs. For example, the quality of wetland invertebrate habitat depends on the mixture of open water and emergent vegetation, diverse plant assemblages, the presence of decaying wood, and a marked seasonal variation in water levels (Sheldon et al. 2005).

In addition to their ecological value, wetlands have value as a cultural resource. Documented educational and scientific use, public ownership, accessibility to humans for recreation, and use by tribes are indicators of the cultural value of a particular wetland.

What areas were assessed for wetlands?

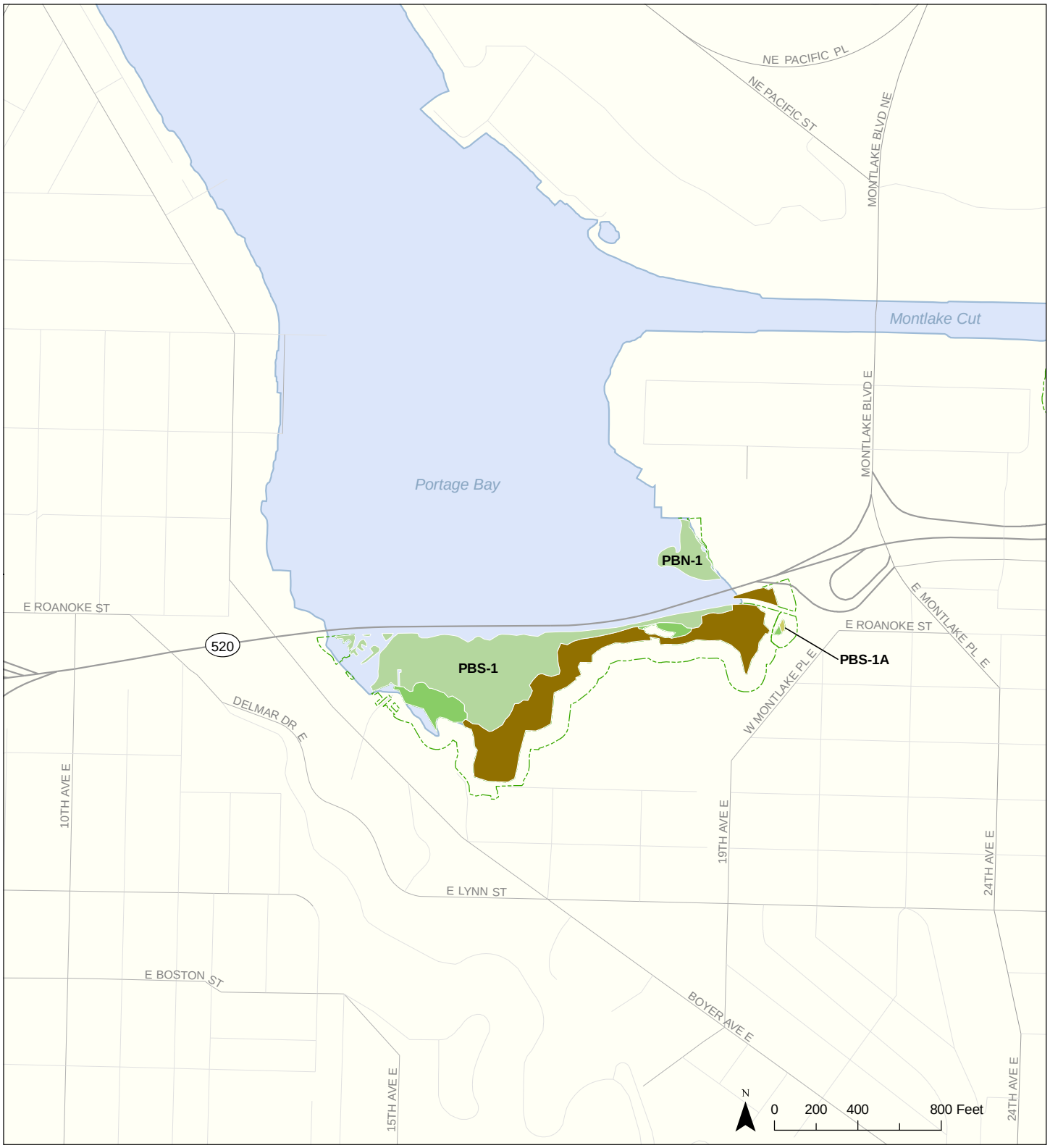
The study area includes the Seattle, Lake Washington, and Eastside areas. However, there are no wetlands in the vicinity of the bridge maintenance facility or relocated Evergreen Point Road transit stop, which mark the eastern extent of ground-disturbing activities associated with this project.

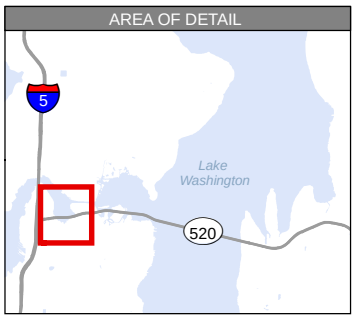
What are the existing wetland characteristics of the study area?

SR 520 Corridor

The ecosystems analysts identified 15 wetlands, all associated with the shorelines of Portage Bay or Union Bay on Lake Washington. Exhibits 2-7a and 2-7b show the locations of these wetlands and the vegetation classes for each wetland.

The project vicinity is in the Puget Sound trough, which is a broad lowland located between the western Cascades and the Olympic Peninsula. The lowland has a history of extensive glaciation. Glacial processes created the landforms in this region and provide base material for the region's soils. The landforms of the region typically comprise a series of north-south trending ridges and valleys showing the direction of glacial advance. During advances and retreats, the glaciers deposited a thick layer of unsorted material, including clays, sands, gravels, silts, and boulders. This material is commonly called till, which can be several thousand feet thick in some areas (Alt and Hyndman 1984). More recently, rivers, streams, and lakes occupied the low-lying areas, depositing loose materials.





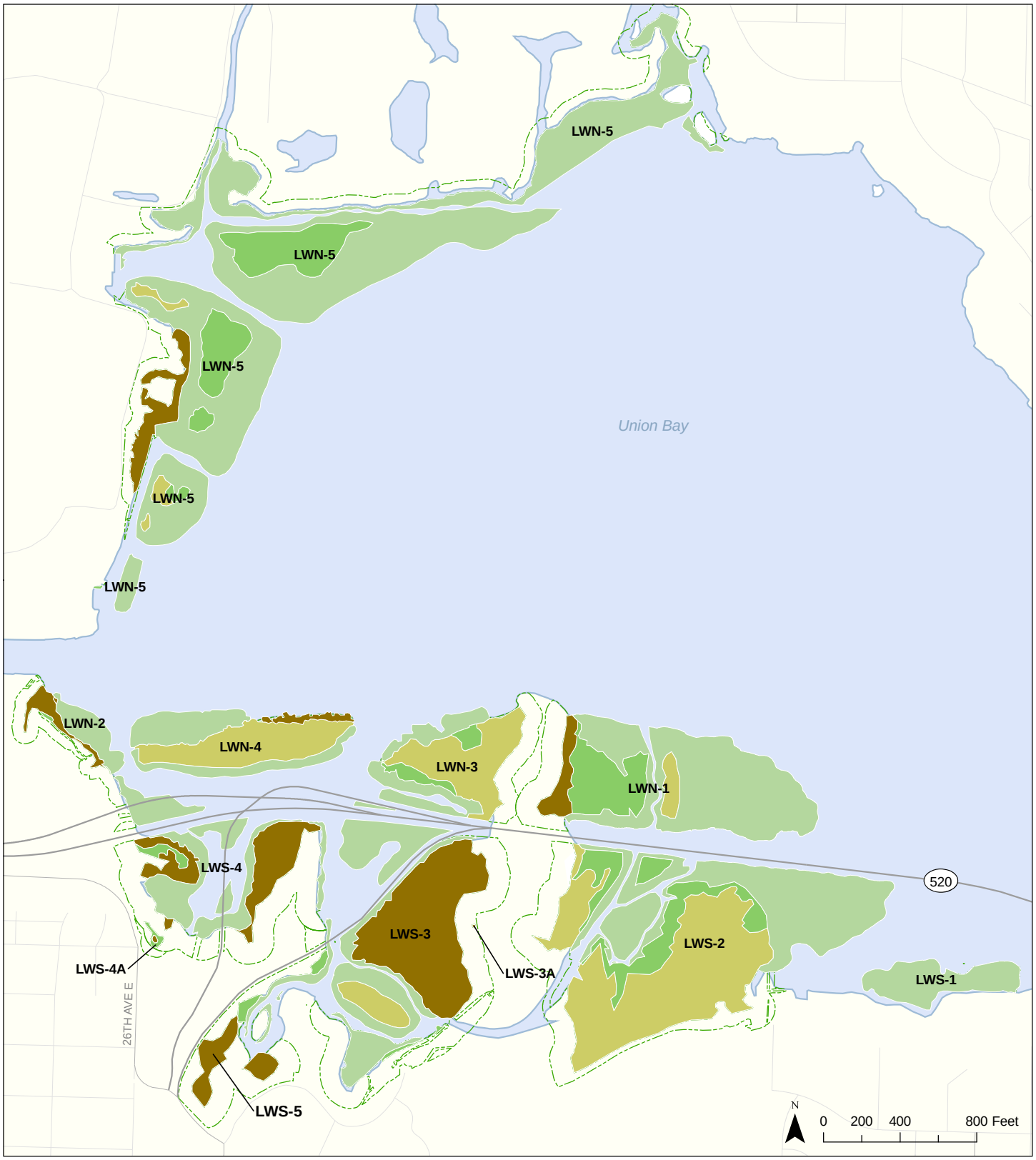
Wetland Vegetation Class

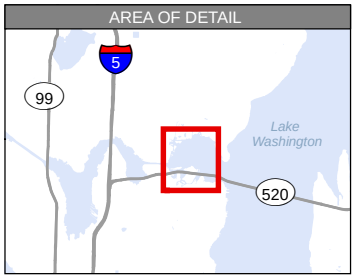
- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 2-7a. **Existing Wetlands in the Portage Bay Area**

I-5 to Medina: Bridge Replacement and HOV Project





Wetland Vegetation Class

- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 2-7b. **Existing Wetlands in the Montlake Area**

I-5 to Medina: Bridge Replacement and HOV Project

Stream-deposited materials are called alluvium, and lakebed deposits are called lacustrine deposits. As these parent materials eroded and broke down, they formed the soils of this region. Some of the soils are poorly drained or impede infiltration of water, which lead to the formation of wetlands. These soils are considered to be hydric (wetland) soils. Other freer-draining soil types (called nonhydric soils) support upland habitats. Within these two general soil groups, there are a number of individual soil series or types.

Four geologic units are mapped within the study area. They include Holocene alluvium, Esperance sand, Vashon till, and Modified land. The majority of the study area consists of Vashon till, which is hydric/nonhydric (City of Seattle 2003).

Puget Sound is located within the western hemlock forest zone described in *Natural Vegetation of Oregon and Washington* (Franklin and Dyrness 1988). Western hemlock and western red cedar are the dominant upland forest species in this zone, although Douglas fir is also very common. Most wetlands in the study area support a mixture of native and introduced species. Red alder, black cottonwood, western red cedar, and Oregon ash generally dominate the forested wetlands.

Forested wetland on Lake Washington.

Dominant species in shrub wetlands include various willows, Himalayan blackberry, red-osier dogwood, rose spirea, and salmonberry. Along Lake Washington and in wetlands with standing water, American white waterlily (a non-designated Class C noxious weed in King County [2009]), cattails, rushes, horsetails, and various native and non-native grasses dominate.

Lake Washington serves as the primary source of water for all the wetlands in the study area. Water levels in Lake Washington and Lake Union are controlled by USACE at the Ballard Locks. USACE lowers the water level by approximately 2 feet each winter. This vertical fluctuation is the dominant hydrologic change in these wetlands, which otherwise have very stable water levels.

Three wetlands are located along Portage Bay. Wetland PBS-1 is a large system (approximately 12.7 acres) that wraps around the entire southern shoreline of Portage Bay. It includes forested, emergent, and aquatic bed communities. The forested portion of the wetland includes willows and black cottonwood, and the emergent portion is dominated

by reed canarygrass. Aquatic bed communities are composed of American white waterlily. Wetland PBS-1A is a very small depressional wetland with scrub-shrub and emergent vegetation dominated by Himalayan blackberry, creeping buttercup, bentgrass, and Japanese knotweed.

The northernmost wetland (PBN-1) is 0.9 acre and is an emergent wetland on the eastern shore of Portage Bay, immediately north of SR 520. The vegetation in this wetland is primarily composed of broadleaf cattail.

Union Bay on Lake Washington is home to a large wetland complex that includes a portion of the University of Washington campus and the Washington Park Arboretum. The ecosystems analysts divided this wetland complex into 12 separate areas (LWN-5, LWN-2, LWN-4, LWS-4, LWS-4A, LWS-5, LWS-3, LWN-3, LWS-3A, LWS-2, LWN-1, and LWS-1).

Exhibit 2-8 describes these wetlands, along with their classifications and ratings.

The Union Bay wetlands are divided according to the Cowardin classification system, which includes forest, scrub-shrub, emergent, and aquatic bed (floating aquatic plants). The aquatic bed community extends from the edge of the emergent vegetation to water depths of 6.6 feet.

A wetland on Lake Washington within the study area with forest, shrub, and emergent vegetation.

Vegetation in the forested communities (Wetlands LWN-1, LWN-2, LWN-4, LWS-3, LWS-3A, LWS-4, LWS-4A, and LWS-5) includes red alder, black cottonwood, paper birch, Pacific willow, and Oregon ash. The shrub communities (LWN-1, LWN-2, LWN-3, LWN-4, LWN-5, LWS-2, and LWS-3) support Pacific and other species of willows, red-osier dogwood, salmonberry, and rose spirea. Invasive species, such as Himalayan blackberry and bittersweet nightshade, are common in these communities. Invasive Eurasian milfoil is also present in the area, but it is not dominant in the wetlands because it is mostly a submerged plant. Broadleaf cattail, reed canarygrass, slough sedge, and non-native creeping buttercup dominate the emergent communities (LWN-1, LWN-2, LWN-3, LWN-5, LWS-2, LWS-3, LWS-4, LWS-4A, and LWS-5).

Exhibit 2-8. Summary of Wetlands in the Study Area

Wetland Name by Watershed	HGM Class and Sources of Hydrology	Cowardin Classification[a]	Approximate Size (acres)	Rating[b] Ecology/ Local	Dominant Vegetation	Soil Characteristics
Portage Bay						
PBN-1	Lake-Fringe/Lake Washington	Emergent, Aquatic bed	0.9	IV/IV	Broadleaf cattail	No sample plots were dug due to lack of permission for soil disturbance.
PBS-1A	Depressional, Slope/High groundwater table	Scrub-shrub, Emergent	< 0.1	III/III	Creeping buttercup, Himalayan blackberry, bentgrass, and Japanese knotweed	Mucky loam (10YR 2/2) over sandy clay loam (10YR 4/1)
PBS-1	Lake-Fringe, Slope/Lake Washington	Forested, Emergent, Aquatic bed	12.7	III/III	Reed canarygrass, English ivy, black cottonwood, Pacific willow, and American white waterlily	Mucky peat (2.5Y 2.5/1)
Lake Washington (Union Bay)						
LWN-1	Lake-Fringe/Lake Washington and runoff	Forested, Scrub-shrub, Emergent, Aquatic Bed	14.5	II/II	Rose spirea, red-osier dogwood, American white waterlily and red alder	Loam with organics (10YR 2/1) over loam (10YR 4/2) over silt loam (10YR 5/2)
LWN-2	Lake-Fringe/Lake Washington	Forested, Scrub-shrub, Emergent, Aquatic bed	3.0	III/III	Red-osier dogwood, reed canarygrass, and Pacific willow	Silt (10YR 3/1) over silt clay loam (10YR 5/1) with redoximorphic features over peat (10YR 2/1)
LWN-3	Lake-Fringe/Lake Washington	Scrub-shrub, Emergent, Aquatic bed	7.1	III/III	American white waterlily, broadleaf cattail, red-osier dogwood, red alder, and Oregon ash	Silt (10YR 2/1) over mucky peat (10YR 4/2)
LWN-4	Lake-Fringe/Lake Washington	Forested, Scrub-shrub, Aquatic bed	7.7	III/III	Willows and American white waterlily	No sample plots were dug due to lack of permission for soil disturbance.
LWN-5	Lake-Fringe/Lake Washington	Scrub-shrub, Emergent, Aquatic bed	37.2	III/III	Red-osier dogwood, Pacific willow, broadleaf cattail, and black cottonwood	No sample plots were dug due to lack of permission for soil disturbance.
LWS-1	Lake-Fringe/Lake Washington	Aquatic bed	3.0	IV/IV	American white waterlily	No sample plots were dug because the wetland is aquatic bed only.
LWS-2	Lake-Fringe/Lake Washington	Scrub-shrub, Emergent, Aquatic bed	22.4	II/II	American white waterlily, Himalayan blackberry, salmonberry, red-osier dogwood, and red alder	Peat (10YR 2/1) over muck (10YR 2/2) over loam (10YR 2/2) over sand (10YR 4/1)

Exhibit 2-8. Summary of Wetlands in the Study Area

Wetland Name by Watershed	HGM Class and Sources of Hydrology	Cowardin Classification[a]	Approximate Size (acres)	Rating[b] Ecology/ Local	Dominant Vegetation	Soil Characteristics
LWS-3	Lake-Fringe/Lake Washington	Forested, Scrub-shrub, Emergent, Aquatic bed	15.2	II/II	Birch, salmonberry, slough sedge, red-osier dogwood, and Oregon ash	Mucky peat (10YR 3/2) over peat (10YR 2/2)
LWS-3A	Depressional/ Seasonal high groundwater table	Forested	< 0.1	IV/IV	Slough sedge, red-osier dogwood, and Oregon ash	Silty clay loam (2.5YR 4/2) over clay (10YR 4/1)
LWS-4	Lake-Fringe/Lake Washington	Forested, Emergent, Aquatic bed	7.0	II/II	Pacific willow, creeping buttercup, sweet gum, reed canarygrass, and birch	Silt loam (10YR 2/1) over loam (10YR 3/2) with redoximorphic features
LWS-4A	Slope/Surface runoff and precipitation	Forested, Emergent	0.1	IV/IV	Willow, bluegrass, and creeping buttercup	Mucky loam (10YR 2/2) over silt clay loam (5Y 4/1) with redoximorphic features
LWS-5	Lake-Fringe/Lake Washington	Forested, Emergent, Aquatic bed	2.3	II/II	Pacific willow, creeping buttercup, and black cottonwood	Silt loam (10YR 3/1) over silt loam (7.5YR 3/1)

[a] Cowardin et al. (1979).

[b] Hruby (2004) and City of Seattle Municipal Code, Title 25.09.420.

The non-native American white waterlily dominates the aquatic bed communities (LWN-1, LWN-2, LWN-3, LWN-4, LWN-5, LWS-1, LWS-2, LWS-3, LWS-4, and LWS-5).

Pontoon Construction and Transport

Wetlands at the new facility in Grays Harbor being developed and permitted as part of the Pontoon Construction Project are described in the Pontoon Construction Project Ecosystems Discipline Report (WSDOT 2009e). The Concrete Technology Corporation (CTC) casting basin facility is completely developed; it contains no vegetative cover and no potential to support wetlands. In addition, there are no wetlands associated with pontoon transport.

What functions do wetlands in the study area provide?

Exhibit 2-9 below summarizes the level of water quality improvement, hydrologic, habitat, and social functions provided by the wetlands in the study area, according to the results of the Ecology rating system (Hruby 2004).

Exhibit 2-9. Summary of Wetland Functions in the Study Area

Wetlands by HGM Class	Wetland Functions[b]			
	Water Quality	Hydrology	Habitat	Social Values[c]
Depressional				
LWS-3A	Low	Low	Low	None
Slope				
LWS-4A	Low	Low	Moderate	None
Lake-Fringe				
PBN-1, LWN-1, LWN-2, LWN-3, LWN-4, LWN-5, LWS-1, LWS-2, LWS-3, LWS-4, and LWS-5	Moderate	Low	Moderate	Moderate
Multiple HGM [a]				
PBS-1, PBS-1A	Moderate	Low	Moderate	None

[a] Wetland PBS-1 has lake-fringe and slope classes; Wetland PBS-1A has slope and depressional classes.

[b] Functions are rated using the Ecology rating system (Hruby 2004); this information is available upon request.

[c] Social values are limited to educational, scientific, and recreational values.

Because the wetlands are located lower in the watershed adjacent to or floating on Lake Washington, their potential to alter flood flows or store flood waters is limited. In addition, USACE controls water levels in Lake Washington at the Ballard Locks.

The summer lake level is typically 22 feet (USACE datum). In winter, the lake level is about 2 feet lower so that winter and spring fluctuations can be controlled.

The dense vegetation in these wetlands retains sediments and nutrients, which enter as runoff from adjacent upland areas and paved roads. The lake-fringe wetlands and wetlands with multiple HGM classes are typically larger than 3 acres. Because of their size, multiple Cowardin classes, and dense vegetation along the shoreline, they have the greatest potential to improve water quality. This vegetation also protects the shoreline of Lake Washington from erosion, which is a particularly important feature because of the heavy recreational boat traffic in the area. The dense shoreline vegetation also contributes fine organic material and woody debris to Lake Washington. The larger wetlands provide more organic material than the smaller ones. However, lake-fringe wetlands cannot rate high for water quality because pollution taken up in plant material would be released back into the water column when the plants die (Hruby 2004).

Great blue heron at Foster Island in Lake Washington.

Most wetlands in the study area provide habitat for a variety of wildlife, from invertebrates to mammals. Stable water levels, dense emergent and shrub vegetation, snags and floating logs, and relatively undisturbed forested and shrub buffers contribute to the habitat suitability of these wetlands. Interspersion of standing water, as well as vegetation and connectivity to other aquatic and terrestrial habitats, are also important indicators of habitat function support.

Recreation at the Washington Park Arboretum along Lake Washington includes walking, jogging, boating, biking, and wildlife viewing.

Various birds, reptiles, and amphibians use the wetlands within the study area. They include Cooper's hawks, bald eagles, great blue herons, red-winged blackbirds, red-eared slider turtles, Pacific treefrogs, and several types of waterfowl such as mallards and American coots.

Wetland-associated mammals in these wetlands include river otters and beavers, as well as terrestrial opossums, raccoons, mice, moles, and voles. The wetlands only rate as moderate for habitat because of non-native vegetation and their proximity to urban areas. The Wildlife and Habitat section in this report provides further details about the presence of each of the numerous and varied animal species and their use of the study area.

Because of their proximity to Seattle, the Washington Park Arboretum, and the University of Washington, these wetlands (particularly wetlands LWN-2, LWN-3, LWN-4, and LWN-5) provide social values through opportunities for both educational and recreational use.

Potential Effects of the Project

What methods were used to evaluate the potential effects on wetlands?

GIS analysts calculated the physical effects of the proposed project by overlaying the construction and operation areas onto the surveyed wetland boundaries and designated buffers to determine the extent and location of clearing and filling under the 6-Lane Alternative design options and suboptions. The analysts also calculated the area of wetland and buffer that would be shaded by elevated roadway (bridges and approach structures). Increased shading could reduce incoming sunlight and decrease the distribution, density, and/or growth rate of wetland vegetation.

For the purpose of quantifying shade effects, the analysts calculated only the areas that would be directly under the bridge structures as shaded. The analysts did not attempt to differentiate between partial shading and total shading caused by bridge height or width in this analysis. These and other factors will be more fully analyzed during the permitting process.

The ecosystems analysts used GIS data and other information to evaluate project effects on wetland functions and values. The calculations of wetland and buffer clearing, filling, and shading are based on preliminary engineering and are approximate. The following sections describe the construction and operational effects of the project by location and option.

Construction activities and work areas that may affect wetlands include construction work bridges, finger piers that extend from the work bridges to the support piles, falsework, a detour bridge, staging areas, and construction access roads. Specific staging and sequencing of construction activities would be determined as part of the construction contract packages.

How would construction of the project affect wetlands?

No Build Alternative

There would be no construction effects on wetlands or wetland buffers related to the No Build Alternative.

Construction effects would occur from work bridges, falsework, detour bridges, staging areas, and construction access roads during the construction period.

6-Lane Alternative

Seattle

The geographic areas of I-5, Portage Bay, Montlake, and the west approach make up the Seattle location and are discussed in this section. To safely construct any of the proposed design options and their suboptions, WSDOT would build construction work bridges in Portage Bay and Union Bay to allow traffic and construction activity to occur simultaneously in the project corridor. Construction work bridges would be 30 feet wide, approximately 10 to 15 feet above the high water elevation, and located on both the north and south sides of the bridge. Finger piers would also be constructed perpendicular to the existing bridge to enable access to the existing and proposed bridge columns from the construction work bridges. Through Portage Bay construction, work bridges would be built on the north and south sides of the bridge and remain in place for a combined duration of a little more than 5 years. The construction work bridge would be built first on the north side of the bridge and then on the south. Through Union Bay, the north and south construction work bridges would be in place for a combined duration of approximately 4.5 years for Options A and L. For Option K, the construction work bridges would be in place for a year longer than Options A and L. In addition, For Option K, WSDOT would build a detour bridge in Union Bay from Montlake Boulevard to Foster Island, which would remain in place approximately 4 years. The construction detour bridge would be approximately 52 feet wide and 10 to 15 feet above the high water elevation.

Construction work bridges and the detour bridge would result in shading of wetlands. These effects would cease once the structures are removed.

Because of the time construction work bridges would be in place, clearing, filling, and shading from construction activities would be considered long-term, but not permanent, effects. Shading may affect the growth rates of vegetation, but would not likely cause plant mortality. These effects would cease once the structures are removed.

In 2008, the *Wetland Vegetation Response to Shade Special Study Technical Memorandum* was initiated to assess the effects of shade on vegetation under and adjacent to the SR 520 bridge structure through the Washington Park Arboretum and the I-90 bridge in Mercer Slough (Parametrix 2009). The study concluded the following:

- Bridge heights 8 feet or less almost eliminate vegetation cover under the entire width of the bridge.
- Bridge heights of approximately 24 feet or higher have limited effects on total vegetation cover (except under the middle of the bridge).
- Wide bridges reduce light availability, especially towards the middle of the bridge deck width.
- Gaps between bridges can allow sufficient incoming light for plant growth.

The results of the shade special study suggest that the construction work bridges and the detour bridge would shade wetland vegetation in Portage Bay and the Arboretum areas. Because the shading could occur for more than 5 years in some areas, it is expected that wetland functions would be affected during the construction period. These construction effects are quantified below for each option.

Steel piles would be installed to support the construction work bridges, which would result in wetland fill. Some heavy equipment would be needed to install the steel piles. While much of the work would be done from the work bridge, some work (particularly tree felling) may have to occur on the ground. Where heavy equipment would be needed, steel plates and/or mats could be used to reduce soil compaction of wetlands.

Trees and shrubs in certain areas would be cleared for construction staging areas, access roads, and to facilitate bridge and ramp construction. Clearing limits would be marked before construction to minimize vegetation removal. Areas would remain cleared for the duration that is needed to facilitate construction. Soil disturbance would be minimized by implementing various soil protection BMPs. The soil would still be available for replanting after construction, but the vegetative parts would have been removed. In addition, construction would clear some trees and shrubs along portions of the shoreline under the bridge structure. This clearing could expose these areas to increased erosion. Most of the affected shoreline is not highly exposed to wave action from wind or from boats using the Montlake Cut, so the effects would be low. An erosion and sedimentation control plan would be implemented to minimize effects on water quality from clearing and construction activities.

Other potential short-term construction effects that may occur include spills of hazardous materials (such as oil, gasoline, and hydraulic fluid), chemical contaminants, or other materials. Control of hazardous materials is a standard provision in construction contracts and permits and would be addressed with BMPs. The contractor would be required to submit a spill prevention and control plan before starting work. Following completion of the Bridge Replacement and HOV project, all construction work bridges would be removed, including the support columns. In addition, all cleared and filled areas affected by construction would be restored and replanted with appropriate native vegetation. However, the effects of the construction activity on the wetlands may be evident for many years. Aquatic bed wetlands would revert to preconstruction conditions relatively quickly. However, trees, shrubs, and emergent plants in the palustrine wetlands would take time to re-establish, which could affect habitat functions and reduce the aesthetic value of the wetlands.

The equipment used to construct the 6-Lane Alternative would produce additional noise that could affect wildlife in the nearby wetlands. See the Fish and Aquatic Resources and Wildlife and Habitat sections in this report for a more detailed discussion about the effects of noise on fish and wildlife.

Option A

Construction activities would result in approximately 0.6 acre of wetlands cleared or filled and 2.8 acres of buffer cleared or filled.

Of the 0.6 acre of wetlands, 0.3 acre would be Category II, 0.3 acre Category III, and less than 0.1 acre would be Category IV wetlands. The affected wetlands would be Wetlands PBN-1, PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-4, LWS-4A, and LWS-5. Approximately 0.3 acre would be forested wetlands, 0.3 acre scrub-shrub wetlands, less than 0.1 acre emergent wetlands, and less than 0.1 acre aquatic bed wetlands (see Exhibits 2-10, 2-11a, and 2-11b). Filling of portions of Wetlands PBN-1, PBS-1, PBS-1A, LWN-1, LWN-3 would occur in areas where the construction bridge transitioned from land to over water. This would also result in filling of portions of buffer for Wetlands PBN-1, PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-2, LWS-3, LWS-4, and LWS-5. Wetland LWN-2 and its buffer would also be affected by clearing activities related to construction of a stormwater facility and a staging area. Wetland LWS-4A and its buffer, as well as the buffer of Wetland LWS-4, would be cleared for activities related to the construction of the bicycle/pedestrian path. Wetland LWS-4 and LWS-5 buffers would be cleared for construction activities related to removal of the R.H. Thomson Expressway ramps and a construction staging area.

Exhibit 2-10. Summary of Construction Effects on Wetlands and Buffers by Option[a] (in acres)

	Option A				Option K				Option L			
	Wetland		Buffer		Wetland		Buffer		Wetland		Buffer	
Wetland Category[b]	Clear/ Fill	Shade	Clear/ Fill	Shade	Clear/ Fill	Shade	Clear/ Fill	Shade	Clear/ Fill	Shade	Fill	Shade
II	0.3	4.1	2.2	< 0.1	0.4	5.8	2.4	0.4	0.2	3.9	2.3	0.1
III	0.3	2.1	0.6	0.1	0.7	2.2	0.8	0.2	0.3	2.4	0.5	0.2
IV	< 0.1	0.2	< 0.1	< 0.1	< 0.1	0.1	-	-	< 0.1	0.1	< 0.1	-
Total[c]	0.6	6.4	2.8	0.2	1.1	8.1	3.2	0.6	0.5	6.4	2.8	0.2

Note: Affected areas were calculated using global positioning system (GPS) data gathered in the field, aerial photography, National Wetland Inventory maps, and local wetland inventories. Affected area estimates are based on preliminary design information and subject to change. Totals may not add up due to rounding.

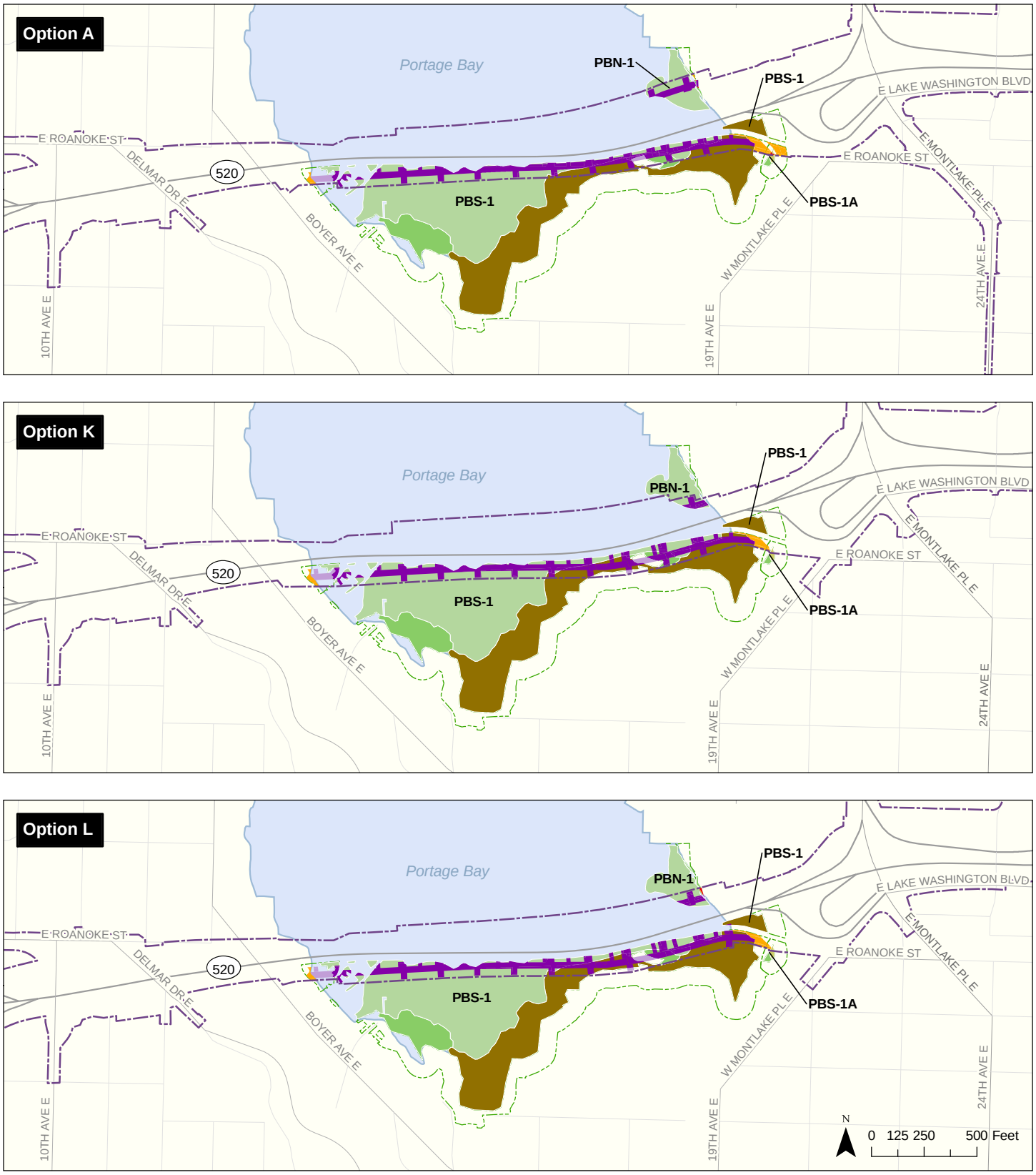
[a] Excludes suboptions.

[b] From Hruby (2004).

[c] Less than 0.01 acre of wetland would be filled from construction work bridge piles.

The construction work bridges would shade 6.4 acres of wetlands and 0.2 acre of buffer. There would be 4.1 acres, 2.1 acres, and 0.2 acre of Category II, Category III, and Category IV wetland shaded.

The wetlands that would be affected by shading from the construction work bridges are wetlands PBN-1, PBS-1, LWN-1, LWN-2, LWN-3, LWN-4, LWS-2, LWS-3, LWS-4, and LWS-5.



Construction Effect

- Affected Wetland (Clear/Fill)
- Affected Buffer (Clear/Fill)
- Affected Wetland (Shade)
- Affected Buffer (Shade)
- Limits of Construction

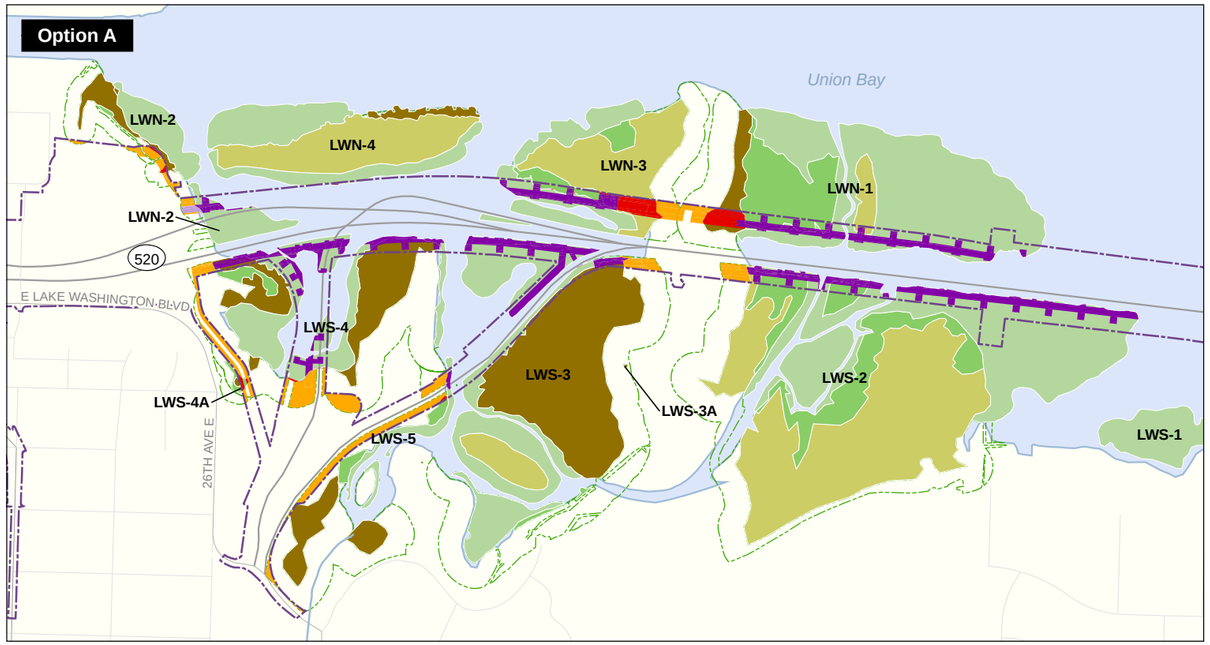
Wetland Vegetation Class

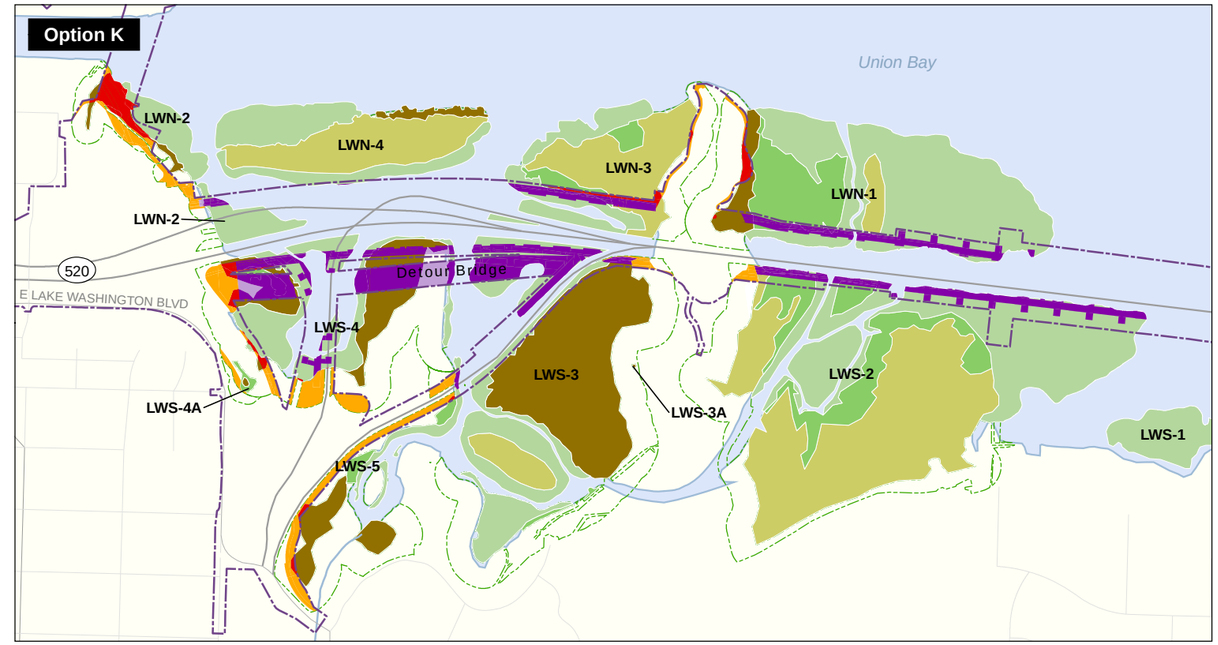
- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

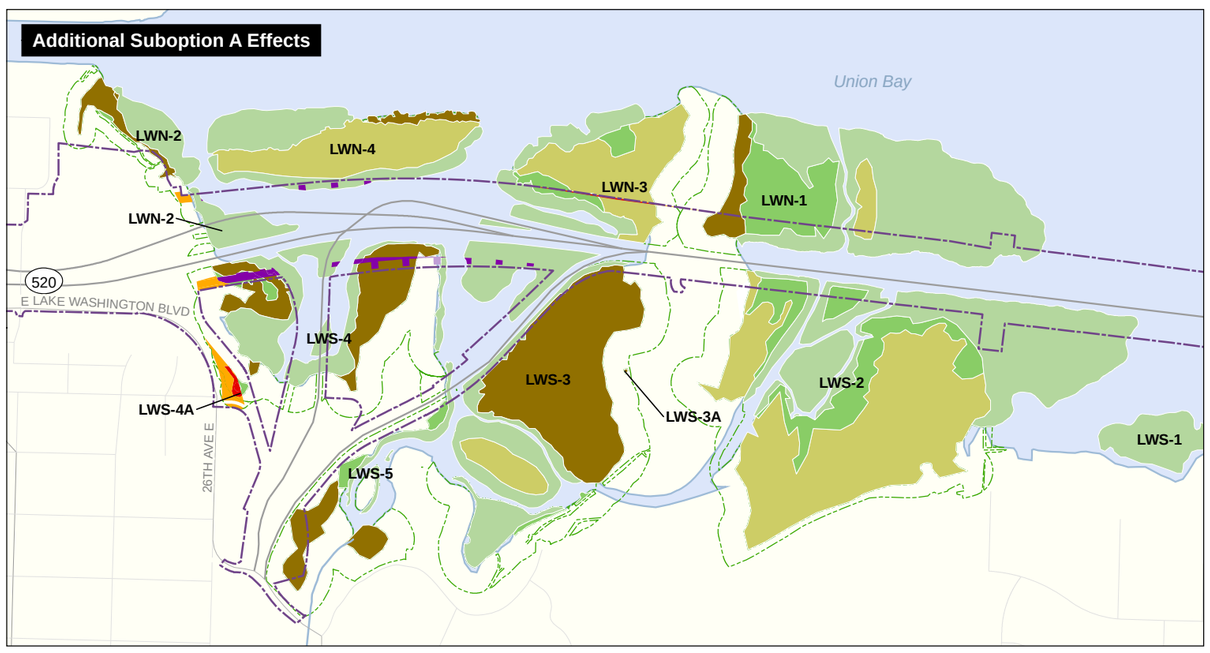
Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008 and 2009) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

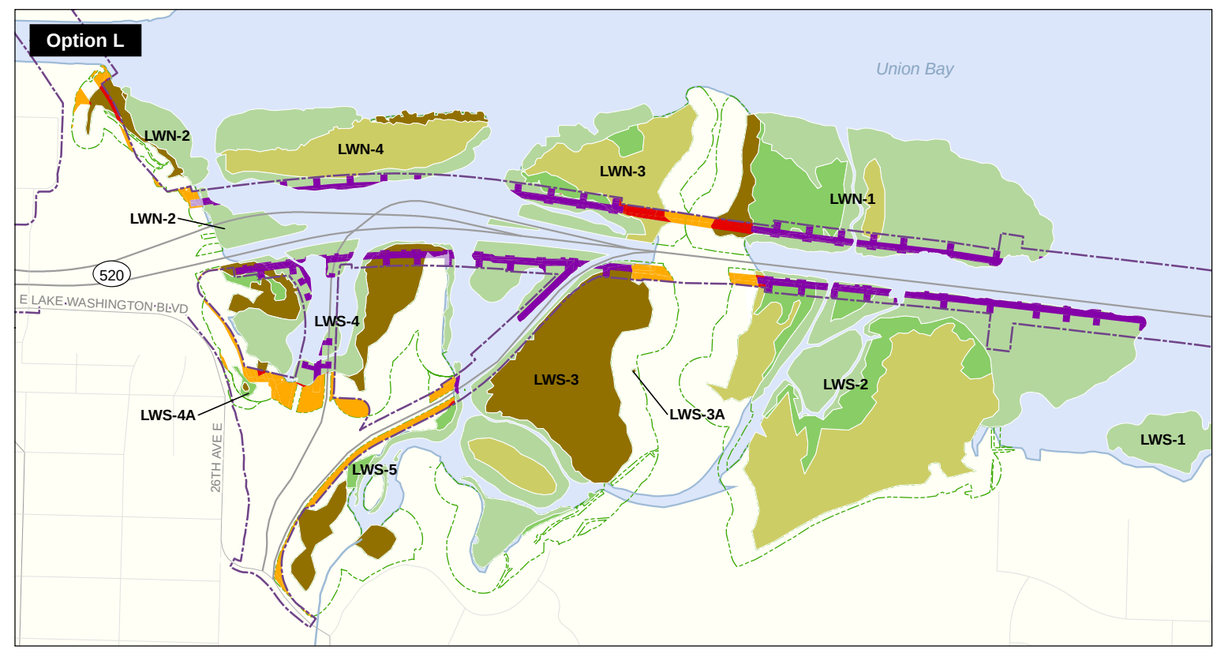
Exhibit 2-11a. **Construction Effects on Wetlands and Buffers in the Portage Bay Area**

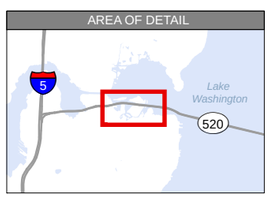
I-5 to Medina: Bridge Replacement and HOV Project











Construction Effect

- Affected Wetland (Clear/Fill)
- Affected Buffer (Clear/Fill)
- Affected Wetland (Shade)
- Affected Buffer (Shade)
- Limits of Construction

Wetland Vegetation Class

- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

N

0 250 500 1,000 Feet

Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008 and 2009) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 2-11b. **Construction Effects on Wetlands and Buffers in the Montlake Area**

I-5 to Medina: Bridge Replacement and HOV Project

There would be 0.6 acre of forested, 0.2 acre scrub-shrub, 0.5 acre emergent, and 5.1 acres of aquatic bed wetlands that would be shaded under Option A (see Exhibits 2-10, 2-11a, and 2-11b).

If the suboptions for Option A are implemented, an additional 0.1 acre of wetland and 0.4 acre of buffer would be cleared. The affected wetlands would be Wetlands LWN-1, LWN-3, and LWS-4A (see Exhibits 2-11a, 2-11b, and 2-12). An additional 0.4 acre of wetland and less than 0.1 acre of buffer would be shaded if the suboptions are added to Option A. Shading would affect wetlands LWN-2, LWN-4, LWS-3, and LWS-4 (see Exhibits 2-11a, 2-11b, and 2-12). These effects would result from activities related to adding eastbound and westbound off-ramps to Lake Washington Boulevard.

Option K

In addition to the types of construction effects that apply to all of the options, Option K includes a 60-foot-wide detour bridge in Union Bay, which would result in shading of forested and aquatic bed wetlands and vegetated buffers in the Washington Park Arboretum from the bridge deck and fill from the support structures.

For Option K, construction areas and activities would clear or fill 1.1 acres of wetlands. Of these 1.1 acres, approximately 0.4 acre is Category II, 0.7 acre is Category III, and less than 0.1 acre is Category IV wetlands. There are 0.8 acre of forested wetlands, 0.1 acre of scrub-shrub wetlands, 0.2 acre of emergent wetlands, and 0.1 acre of aquatic bed wetlands that would be temporarily cleared or filled. The wetlands that would be affected are LWN-1, LWN-2, LWN-3, LWN-5, LWS-4, and LWS-5. In addition, 3.2 acres of buffer would be cleared or filled for construction activities (see Exhibits 2-10, 2-11a, and 2-11b). Portions of Wetlands LWN-1, LWN-3, and their buffers, as well as portions of buffers from Wetlands LWS-2 and LWS-3 would be cleared for activities related to the construction of the Foster Island land bridge. Portions of Wetland LWN-2 and its buffer and Wetland LWN-5 would be cleared and filled with materials from activities related to construction of the tunnel under the Montlake Cut and the construction of a stormwater facility. Portions of Wetland LWS-4 and its buffer would be filled where the construction bridge and detour bridge transition from on land to over water. Portions of Wetland LWS-4 and its buffer would also be cleared during activities related to the construction of the traffic turnaround at Lake Washington Boulevard East.

Exhibit 2-12. Wetland and Buffer Construction Effects by Geographic Area (in acres)

Option/Suboption	I-5 Area	Portage Bay Area	Montlake Area	West Approach Area	Floating Bridge and Eastside Transition Area	Total Effect[b]
Option A (Suboption)[a]	**-**					
Wetland Filled/Cleared	-	<0.1	-	0.6 *(0.1)*	-	0.6 *(0.1)*
Wetland Shaded	-	1.7	-	4.7 *(0.4)*	-	6.4 *(0.4)*
Buffer Filled/Cleared	-	0.2 *(<0.1)*	<0.1	2.6 *(0.4)*	-	2.8 *(0.4)*
Buffer Shaded	-	0.1	-	0.1 *(< 0.1)*	-	0.2 (< 0.1)
Option K (Suboption)[a]						
Wetland Filled/Cleared	-	-	0.5	0.5	-	1.1
Wetland Shaded	-	1.8	<0.1	6.4	-	8.1
Buffer Filled/Cleared	-	0.1	0.7	2.3	-	3.2
Buffer Shaded	-	0.1	<0.1	0.4	-	0.6
Option L (Suboption)[a]						
Wetland Filled/Cleared	-	<0.1 *(<0.1)*	0.1	0.4	-	0.5 *(<0.1)*
Wetland Shaded	-	1.8	<0.1	4.6	-	6.4
Buffer Filled/Cleared	-	0.1	0.5*)*	2.2	-	2.8
Buffer Shaded	-	0.1	<0.1	0.1	-	0.2

[a] Suboption effects are included in parentheses and should be added to the option effect. If the suboption does not change the effect, no number in parentheses is included.

[b] The area of additional effects from the addition of the suboptions for each of the base options (A, K, or L).

Totals may not add up due to rounding.

"-" means no effect.

Portions of Wetland LWS-4 and LWS-5 and their wetlands would be cleared for construction activities related to the removal of the R.H. Thomson Expressway ramps and a construction staging area.

Option K would shade 8.1 acres of wetlands and 0.6 acre of buffers. Portions of Wetlands PBN-1, PBS-1, LWN-1, LWN-2, LWN-3, LWN-4, LWS-2, LWS-3, LWS-4, and LWS-5 would be shaded by the construction work bridges and detour bridge. Approximately 5.8 acres would be Category II wetlands, 2.2 acres would be Category III, and 0.1 acre would be Category IV wetlands. Most of the shading of Wetlands LWS-3 and LWS-4 would be from the construction detour bridge. Most of the shaded wetlands would be aquatic bed (5.5 acres); the remainder would be 1.8 acres forested, 0.2 acre scrub-shrub, and 0.6 acre of emergent wetlands (see Exhibits 2-10, 2-11a, and 2-11b).

The construction of the suboptions for Option K would not affect wetlands or wetland buffers (see Exhibit 2-12).

Option L

Construction of Option L would clear and fill 0.5 acre of wetland and 2.8 acres of buffer. Wetlands PBN-1, LWN-1, LWN-2, LWN-3, LWS-2, LWS-4, and LWS-5 would be partially cleared and filled. There would be 0.2 acre of clearing and filling of Category II wetlands, 0.3 acre of Category III wetlands, and less than 0.1 acre of Category IV wetlands. Half of the construction would affect forested wetlands (0.3 acre). In addition, 0.2 acre of scrub-scrub and less than 0.1 acre each of emergent and aquatic bed wetlands would be affected by construction (see Exhibits 2-10, 2-11a, and 2-11b). Filling of portions of Wetlands PBN-1, LWN-1, LWN-3, and LWS-2 would occur in areas where the construction bridge transitioned from on land to over water. This would also result in filling portions of buffer for Wetlands PBN-1, PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-2, LWS-3, and LWS-4. Portions of Wetland LWN-2 and its buffer would be cleared for activities related to the construction of the second bascule bridge over the Montlake Cut. Portions of Wetlands LWS-4 and LWS-5 and their buffers would be cleared for construction activities related to the removal of the R.H. Thomson Expressway ramps and a construction staging area.

The construction work bridges for Option L would shade 6.4 acres of wetlands and 0.2 acre of buffer (see Exhibits 2-10, 2-11a, and 2-11b). Most of this shading would affect Category II wetlands (3.9 acres); 2.4 acres of Category III wetlands would be shaded, and

0.1 acre of Category IV wetlands would be shaded. Wetlands PBN-1, PBS-1, LWN-1, LWN-2, LWN-3, LWN-4, LWS-2, LWS-3, LWS-4, and LWS-5 would be affected by shading. Most of the shaded wetlands would be aquatic bed wetlands (4.8 acres), with 0.9 acre of forested, 0.1 acre of scrub-shrub, and 0.5 acre of emergent wetlands shaded (see Exhibits 2-11a and 2-11b).

The suboptions for Option L would clear less than 0.1 acre of wetland; only Wetland PBS-1 would be affected (see Exhibit 2-12). This effect would be from construction activities related to the increased capacity northbound on Montlake Boulevard Northeast and the relocation of a stormwater facility.

Lake Washington

The Lake Washington area includes the floating bridge, east approach, and the bridge maintenance facility. No wetlands occur in the vicinity of the floating bridge and bridge maintenance facility.

Eastside Transition Area

No wetlands occur in the vicinity of the relocated Evergreen Point Road transit stop. Restriping to tie into the Eastside alignment would be within the paved roadway and would not affect wetlands. Therefore, construction would not affect wetlands in the Eastside transition area.

Pontoon Construction and Transport

Effects on wetlands from pontoon construction are discussed in the Pontoon Construction Project Ecosystems Discipline Report (WSDOT 2009e). In addition, the CTC facility does not have the potential to support wetlands; therefore, no wetlands would be affected.

There are no effects associated with pontoon transport because there are no wetlands along the transport route.

Phased Implementation Scenario

To address the potential for a Phased Implementation scenario, this report evaluates the vulnerable structures as a subset of the 6-Lane Alternative. The evaluation focuses on how the effects of phased implementation would differ from those of full build and how constructing the project in phases might have different effects than constructing it all at one time (see Exhibit 1-8). Exhibit 2-12 shows wetland and buffer construction effects by geographic area. There are no wetlands in the I-5 area, and only small portions of wetlands extend

into the Montlake area. For this reason, most construction effects on wetlands and buffers would occur in the Portage Bay and west approach areas. With phasing, effects on wetlands would be similar, but could prolong the duration of effects. Some wetland areas potentially may be affected more than once if work has to occur in the same area but in different phases.

How would operation of the project affect wetlands?

No Build Alternative

Under the No Build Alternative, no new roadways or bridge structures would be constructed; therefore, new road and bridge structures would not permanently fill or shade wetlands or buffers. Bridge structures, including the unused R.H. Thomson Expressway ramps in the west approach area, would not be removed.

Under the No Build Alternative, the quantity and quality of water entering wetlands in the study area would not change. Currently, runoff from the existing structures discharges directly to Portage Bay and Union Bay, and runoff is not treated before being discharged. This untreated runoff carries pollutants from automobiles (such as petroleum products and metal from tires and brake linings). Untreated runoff from the roadway would continue to be discharged. This would result in a continuing negative effect on water quality in the wetland resources located adjacent to and downstream of SR 520, Lake Washington, and its tributary streams—areas where fish and other wildlife occur.

Operational effects are effects that would occur while the new bridge, roadways, ancillary facilities, and any mitigation features are in use.

If the existing bridge were to remain in operation until 2030, traffic volumes would increase by approximately 17 percent over 2008 levels. Please refer to the Transportation Discipline Report (WSDOT 2009f) for more information about predicted traffic volumes and travel patterns. This increase would likely raise noise levels, but would not be expected to substantially affect wetland habitat functions.

6-Lane Alternative

Seattle

The geographic areas of I-5, Portage Bay, Montlake, and west approach make up the Seattle location and are discussed in this section. The 6-Lane Alternative for the Bridge Replacement and HOV Project would construct new bridges, expand the existing road and bicycle/pedestrian

corridor, and build stormwater facilities in and adjacent to wetlands and wetland buffers. This alternative would have permanent effects on wetlands including permanent filling, removal of trees and shrubs, shading of some wetlands that are currently exposed, and conversion of pervious surfaces to impervious surfaces.

The amount of wetland and buffer filled varies among the three options and is described next. Filling a wetland or part of a wetland, as well as altering its vegetation, reduces its capacity to store stormwater, filter pollutants, protect stream banks and lakeshores, and provide wildlife habitat. These alterations can also reduce the uniqueness of wetlands (by lowering vegetation diversity) or decrease their educational or scientific value by limiting access, reducing wetland size, or changing the wetland character.

The amount of wetland and buffer shaded by bridges varies among the three options and is described below. For all options and suboptions, the proposed bridges would vary in width, but on average they would be approximately twice as wide as the existing bridges. Through Portage Bay, Option A would be slightly wider than Options K and L because it would have seven lanes rather than six. The west approach through Union Bay would be somewhat similar in width to Options K and L but would be substantially narrower for Option A. For the remainder of the corridor, the bridges for each option would be similar in width. The expanded bridge widths would increase the area of wetlands shaded and could reduce the distribution, density, and growth of wetland vegetation. The intensity of the shade would vary based on the height of the bridge. The effect of the relationship between structure height and width on shading is complex. In general, however, a design that increases the height over wetlands would partially offset effects from the increased bridge width. Refer to the discussion under *How would construction of the project affect wetlands?* presented earlier. In addition, the number of bridge support piers varies between options.

Option A

Option A would directly fill approximately 0.1 acre of wetland in the Portage Bay area and in the west approach area in Union Bay. This would include 0.1 acre each of forested wetland and less than 0.1 acre of scrub-shrub, emergent, and aquatic bed wetlands. The affected wetlands would be PBN-1, PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-4, and LWS-4A (see Exhibits 2-13 and 2-14a and 2-14b).
Most of these effects are to Category III wetlands. In addition, Option A would fill 0.7 acre of buffer.

Fill in Wetland PBN-1, PBS-1, LWN-1, LWN-2, and LWN-3 would be from bridge support structures such as columns. Stormwater facilities would also result in filling portions of Wetland PBS-1, LWN-2, and their buffers. Wetland PBS-1A and its buffer would be filled by the bicycle/pedestrian path.

Exhibit 2-13. Summary of Operational Effects on Wetland and Buffer by Option[a] (in acres)

Wetland Category[b]	Option A				Option K				Option L			
	Wetland		Buffer		Wetland		Buffer		Wetland		Buffer	
	Fill	Shade	Fill	Shade	Fill	Shade	Fill	Shade	Fill	Shade	Fill	Shade
II	< 0.1	0.7	0.2	0.5	0.5	1.5	3.3	0.1	< 0.1	1.9	0.7	0.6
III	0.1	2.1	0.4	0.4	1.2	1.4	2.1	0.1	0.2	2.4	0.8	0.7
IV	< 0.1	0.3	< 0.1	< 0.1	0.1	< 0.1	-	-	0.1	< 0.1	-	-
Total	0.1	3.2	0.7	0.9	1.8	2.8	5.4	0.1	0.3	4.3	1.5	1.3

Note: Affected areas were calculated using GPS data gathered in the field, aerial photography, National Wetland Inventory maps, and local wetland inventories. Affected area estimates based on preliminary design information and subject to change. Totals may not add up due to rounding.

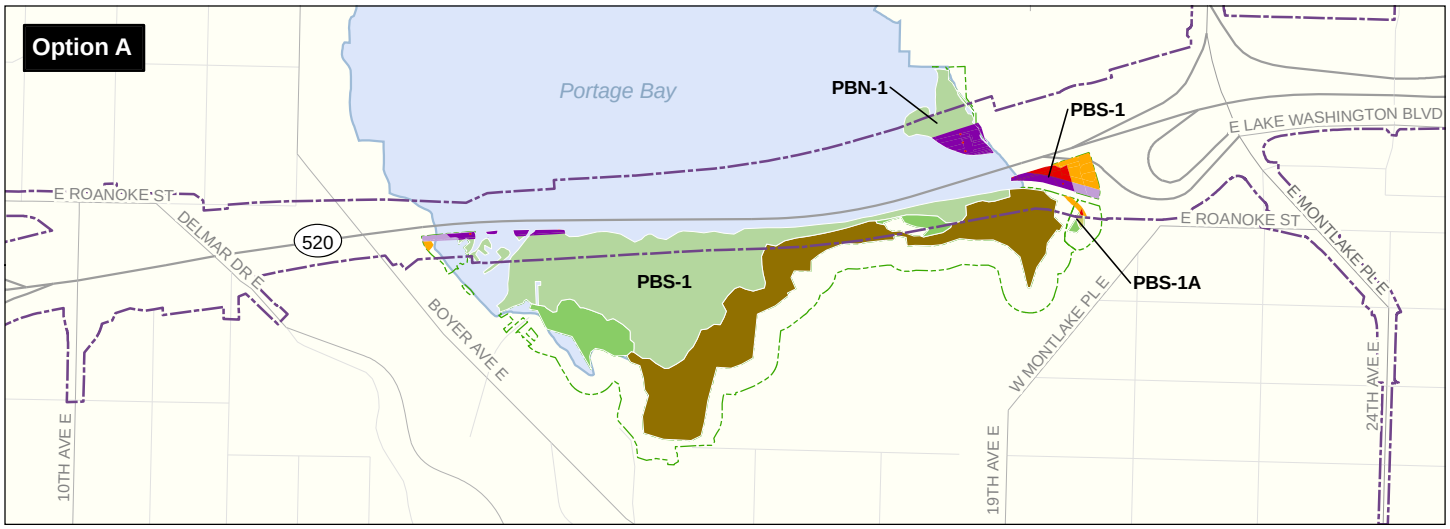
[a] Excludes suboptions.

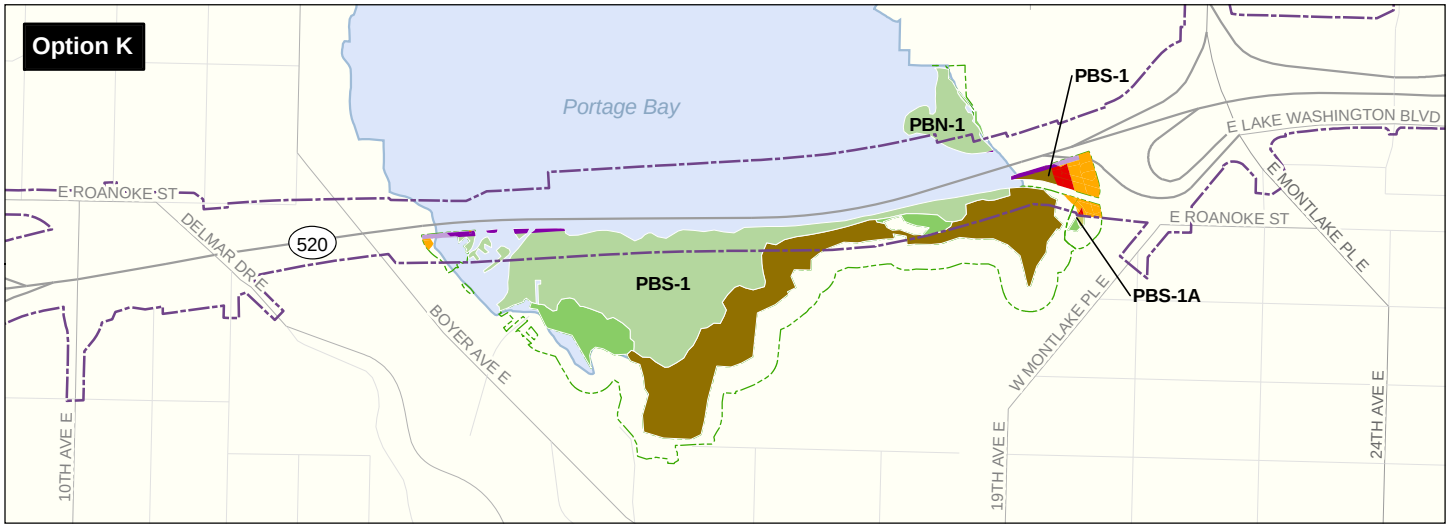
[b] From Hruby (2004).

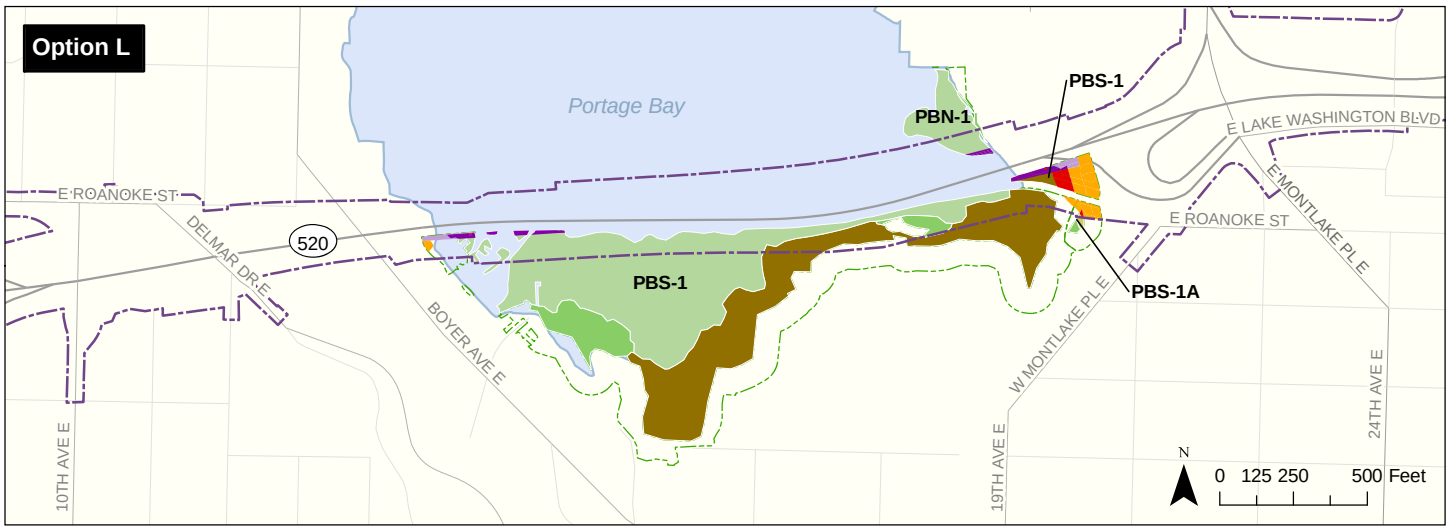
The new bridges elevated over existing wetlands and buffers would cause shading effects. The increased width of the proposed bridges would reduce the light levels under the structure compared to existing conditions. Areas under the center of the bridge would likely not provide optimal conditions for plant growth (because of light and, in some cases, moisture limitations), but areas near the edges of the bridge would probably be able to support well-developed plant communities, including shrubs and small trees.

The replacement Portage Bay Bridge would have seven lanes, be almost twice as wide as the existing bridge, and be slightly wider than Options K and L. Option A would provide the narrowest bridge over Union Bay among the three options. For Option A, the replacement bridge in the west approach area would range between 9 and 15 feet higher above the water than the existing bridge from Montlake to just east of Foster Island.

Through Portage Bay, the bridge height would match the existing profile for the western half of the bridge, but the bridge beams would be thicker to allow for longer spans and would result in a lower height clearance than the existing bridge. The eastern half of the bridge would be higher than the existing bridge and about 13 feet above the water (see Exhibits 2-14a and 2-14b and 2-15).







Operational Effect

- Affected Wetland (Fill)
- Affected Buffer (Fill)
- Affected Wetland (Shade)
- Affected Buffer (Shade)
- Limits of Construction

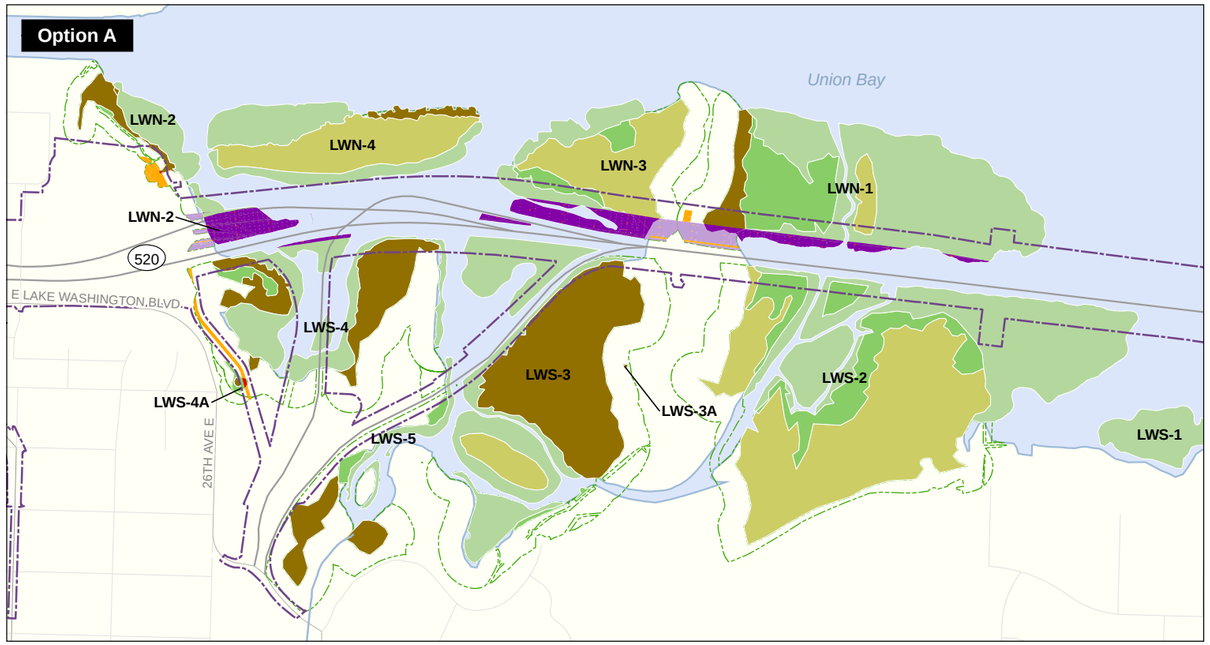
Wetland Vegetation Class

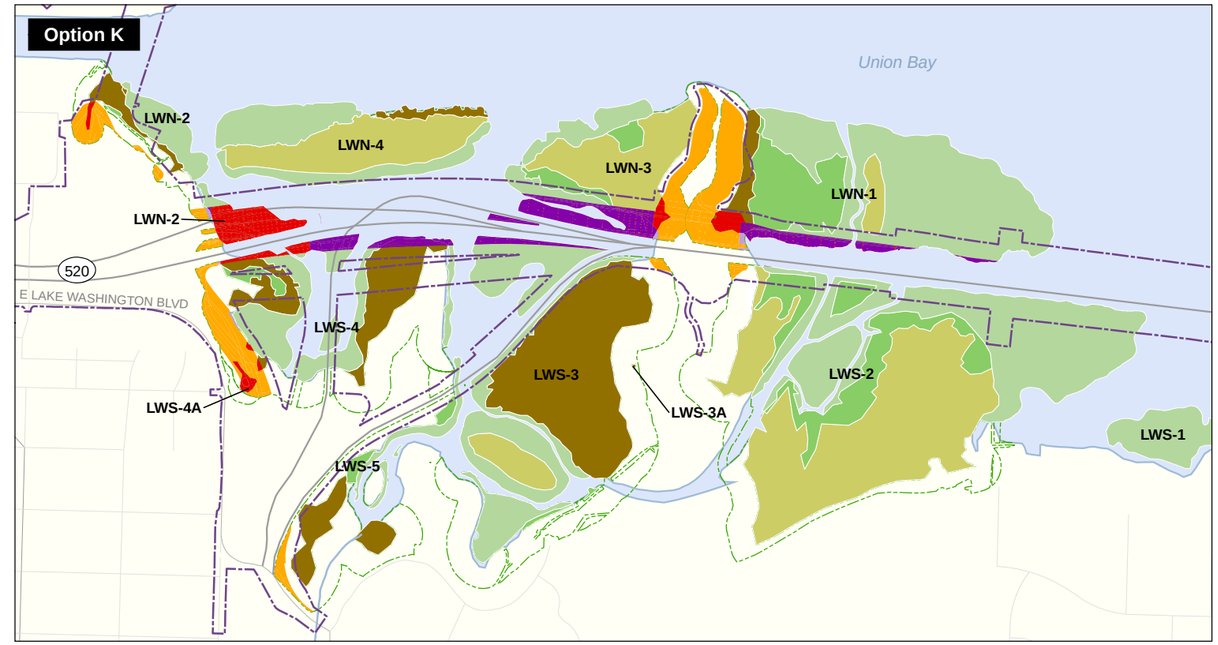
- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

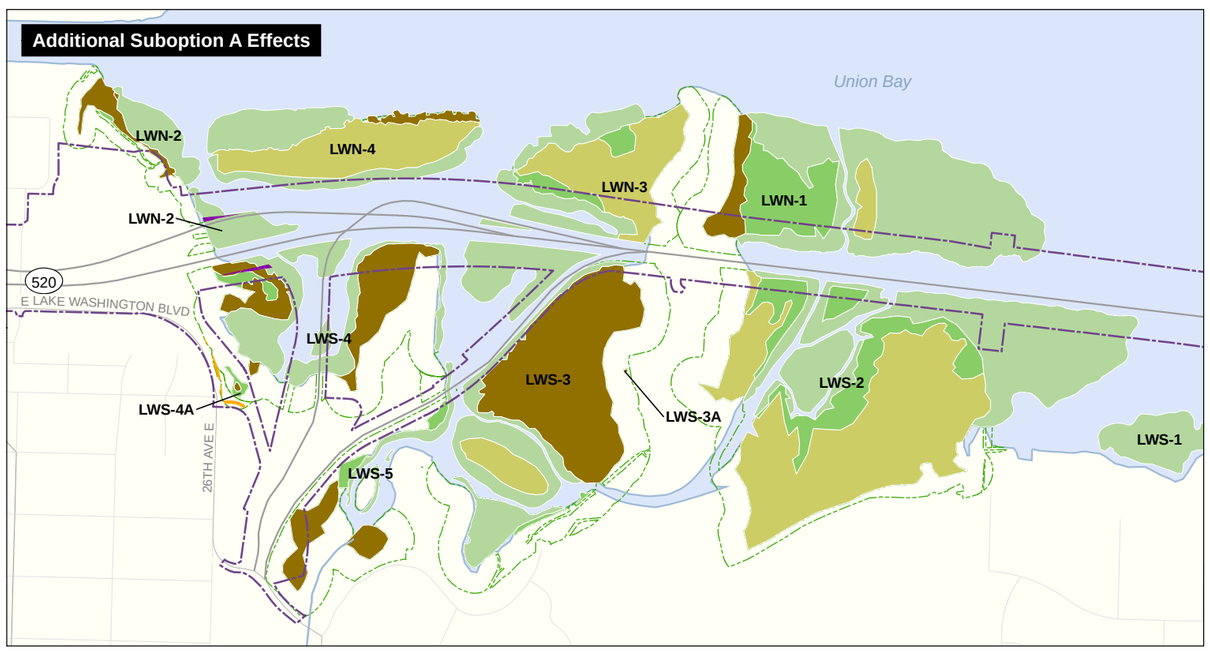
Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008 and 2009) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

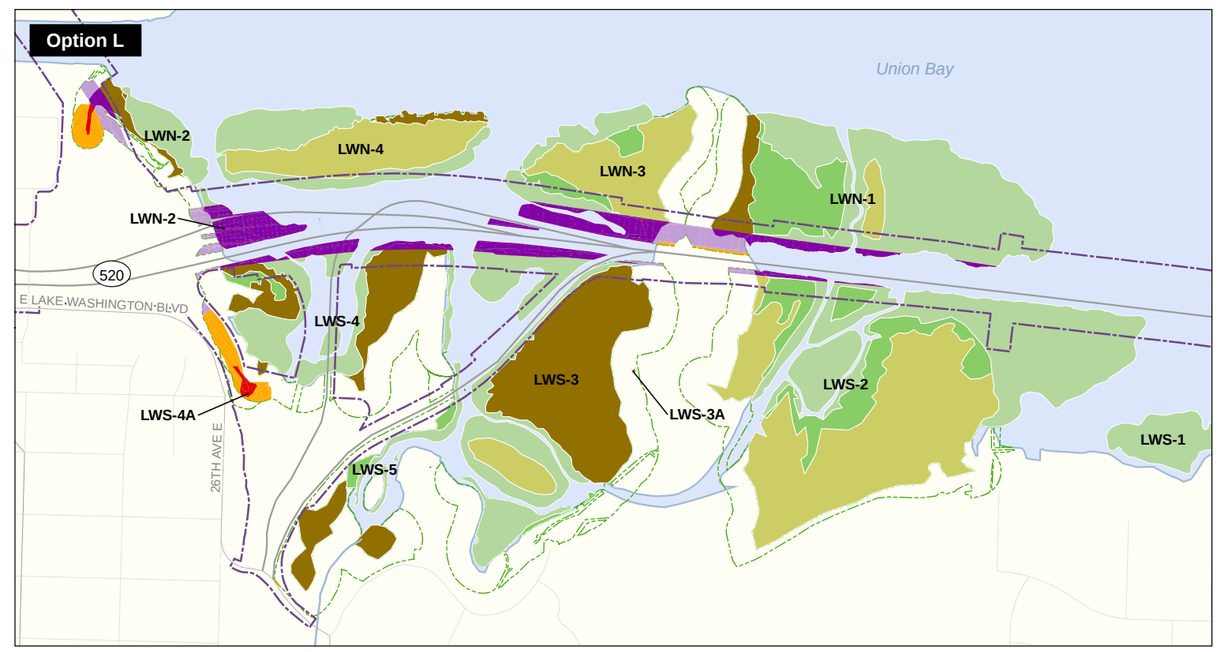
Exhibit 2-14a. **Operational Effects on Wetlands and Buffers in the Portage Bay Area**

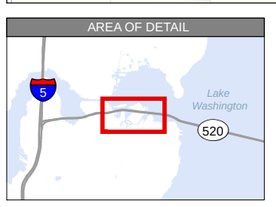
I-5 to Medina: Bridge Replacement and HOV Project











Operational Effect

- Affected Wetland (Fill)
- Affected Buffer (Fill)
- Affected Wetland (Shade)
- Affected Buffer (Shade)
- Limits of Construction

Wetland Vegetation Class

- L2AB (Aquatic Bed)
- PFO (Palustrine Forested)
- PSS (Palustrine Scrub-shrub)
- PEM (Palustrine Emergent)
- Wetland Buffer

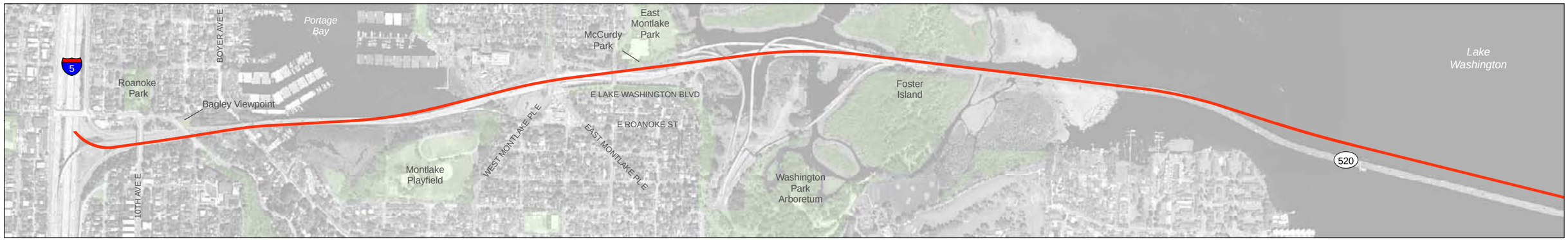
N

0 250 500 1,000 Feet

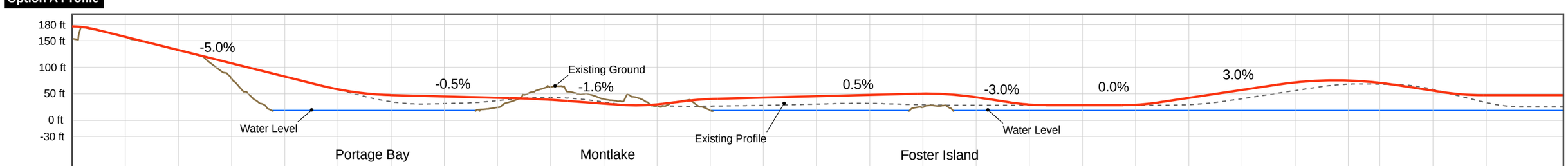
Source: King County (2005) GIS Data (Streets), King County (2007) GIS Data (Water Bodies), Parametrix (2008 and 2009) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 2-14b. **Operational Effects on Wetlands and Buffers in the Montlake Area**

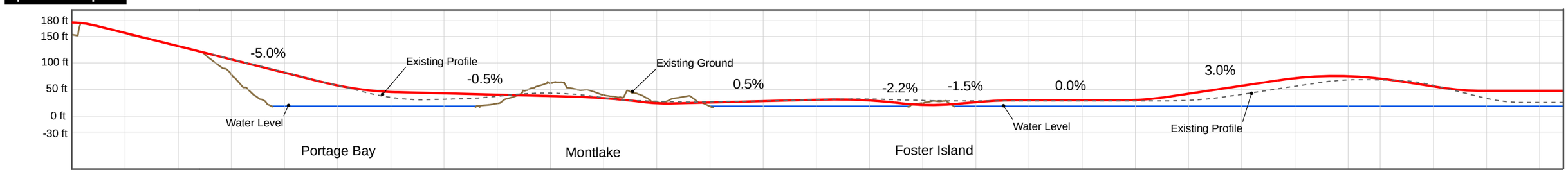
I-5 to Medina: Bridge Replacement and HOV Project



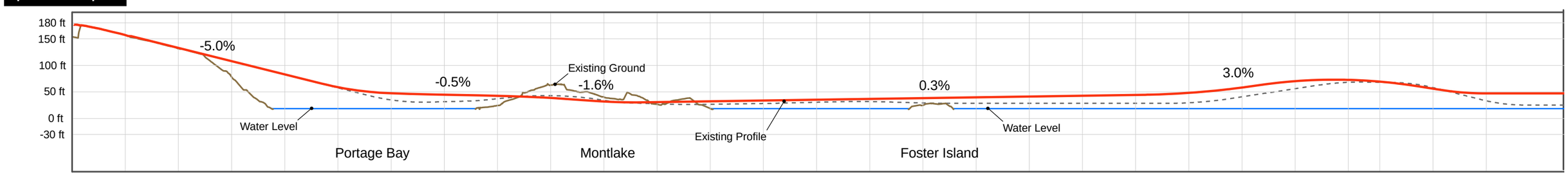
Option A Profile

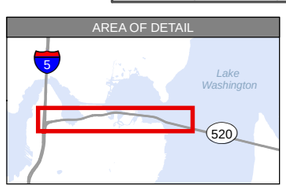


Option K Profile
Option A Suboption



Option L Profile
Option A Suboption





Proposed Mainline Profile
Existing Profile
Park

N
0 500 1,000 2,000 Feet

Source: King County (2006) Aerial Photo, CH2M HILL (2008) GIS Data (Park). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 2-15. **6-Lane Option Profiles from I-5 to Lake Washington**

I-5 to Medina: Bridge Replacement and HOV Project

Through Union Bay and east of Foster Island, the proposed bridge under Option A would be much higher (14 to 19 feet higher) than either the existing bridges and those proposed under Options K and L (see Exhibit 2-16).

Exhibit 2-16. Approximate Height from the High Water Level to the Underside of Various Portions of the Bridge Structures, by Option

Location	Existing (No Build)	Option A	Option K	Option L
Portage Bay				
West shoreline	50	48	48	48
Mid-point	10	16	16	16
East shoreline	8	13	13	13
Union Bay				
West Washington Park Arboretum shoreline	2.5	17	<0[b]	8
West Foster Island shoreline	6	25	<0[b]	13
West Approach				
East Foster Island shoreline	4	23	<1	15
Mid-point [c]	4	8	5	19

[a] Option K will tunnel under the Montlake Cut.

[b] The proposed roadway would occur below the high water elevation in the nearshore area of the Washington Park Arboretum by several feet.

[c] About 1,400 feet east of Foster Island, midway between the island and west transition span. East of this point is over deep water. See Section 3, Fish and Aquatic Resources.

The increased height of the bridge would allow sufficient light for plant growth under the edges of the bridge. However, even at 25 feet above the water surface, shading would inhibit vegetation cover under the middle of the bridge width. Option A would shade approximately 3.2 acres of wetlands. Aquatic bed wetlands would be most affected (2.8 acres). Of the remaining acres, approximately 0.2 acre of forested wetlands, 0.2 acre of scrub-shrub wetlands, and less than 0.1 acre of emergent wetlands would be affected by shade. The shaded wetlands would be PBN-1, PBS-1, LWN-1, LWN-2, LWN-3, and LWS-4. Approximately 0.7, 2.1, and 0.3 acres of Category II, III, and IV wetlands, respectively, would be shaded under Option A. This option would permanently shade 0.9 acre of buffer (see Exhibits 2-13 and 2-14a and 2-14b).

The suboptions for Option A would fill less than 0.1 acre of wetland (portions of LWN-2 and LWS-4) and 0.1 acre of buffer. Approximately 0.1 acre of Wetlands LWN-2 and LWS-4 would also be shaded, but no buffer would be shaded with the suboptions for Option A (see Exhibits 2-14a, 2-14b, and 2-17).

Exhibit 2-17. Wetland and Buffer Operational Effects by Geographic Area (in Acres)

Option/Suboption	I-5 Area	Portage Bay Area	Montlake Area	West Approach Area	Floating Bridge and Eastside Transition Area	Total Effect (Full Build)[b]
Option A *(Suboption)*[a]						
Wetland Filled	-	0.1	<0.1	<0.1 *(<0.1)*	-	0.1 *(<0.1)*
Wetland Shaded	-	0.4	0.1	2.6 *(0.1)*	-	3.2 *(0.1)*
Buffer Fill	-	0.3	<0.1	0.4 *(0.1)*	-	0.7 *(0.1)*
Buffer Shaded	-	0.1	0.1	0.8*)*	-	0.9
Option K *(Suboption)*[a]						
Wetland Fill	-	0.1 *(<0.1)*	0.1	1.6 *(<0.1)*	-	1.8 *(<0.1)*
Wetland Shaded	-	0.1	< 0.1	2.7	-	2.8
Buffer Fill	-	0.4 *(<0.1)*	1.5	3.6	-	5.4 *(<0.1)*
Buffer Shaded	-	0.1	< 0.1	0.1	-	0.1
Option L *(Suboption)*[a]						
Wetland Fill	-	0.1	0.1 *(<0.1)*	0.1	-	0.3 *(<0.1)*
Wetland Shaded	-	0.2	1.0 *(<0.1)*	3.1 *(<0.1)*	-	4.3 *(<0.1)*
Buffer Fill	-	0.4	0.6 *(<0.1)*	0.5	-	1.5 *(<0.1)*
Buffer Shaded	-	0.1	0.4	0.9*)*	-	1.3

[a] Suboption effects are included in parentheses and should be added to the option effect. If the suboption does not change the effect, no number in parentheses is included.

[b] The area of additional effects from the addition of the suboptions for each of the base options (A, K, or L).

Totals may not add up due to rounding.

These effects would be from the additional eastbound and westbound off-ramps to Lake Washington Boulevard. One suboption for Option A would change the profile to the same profile proposed for Option L. In the west approach area over Union Bay and west of Foster Island, the suboption bridge profile would be slightly higher but very similar to existing conditions. East of Foster Island, the bridge would be higher than existing conditions (see Exhibit 2-16).

How would operation of the project affect the water quality and hydrologic functions of the wetlands?

Option A and its suboptions would fill 0.1 acre and shade 3.2 acres of wetlands. This would decrease the ability of those wetlands to provide water quality and hydrologic functions. However, the amount of wetland area filled or shaded is small relative to size; therefore, decreased capacity would not be measurable (see Exhibit 2-18). In addition, all stormwater would be treated and returned to Lake Washington.

Exhibit 2-18. Summary of Operational Effects on Wetland Functions for all Options

	Wetland Functions[a]			
Wetlands by Area	**Water Quality**	**Hydrologic**	**Habitat**	**Social Values**
Portage Bay Area				
PBN-1, PBS-1A, PBS-1	Loss of wetland area reduces the potential to remove pollutants; stormwater treatment would generally reduce some pollutant loading downstream.	Filling parts of these wetlands may reduce their capacity to provide flood storage. However, the fill area would be very small relative to the size of the flood storage area (Portage Bay).	Some of the shoreline habitat functions would be lost.	Shoreline wetlands are used for recreational bird viewing.
West Approach Area (Union Bay)				
LWN-1, LWN-2, LWN-3, LWN-4, LWN-5, LWS-1, LWS-2, LWS-3, LWS-3A, LWS-4, LWS-4A, and LWS-5	Loss of wetland area reduces the potential to remove pollutants; stormwater treatment would generally reduce some pollutant loading downstream.	Filling parts of these wetlands may reduce their capacity to provide flood storage. However, the fill area would be very small relative to the size of the flood storage area (Union Bay).	Shoreline habitat functions would be lost, especially in Wetland LWN-2 and LWN-3.	Educational or scientific value may increase with the project due to improved access. Effects on heritage values[b] would be avoided.

[a] Functions rated using Ecology's wetland rating system (Hruby 2004); this information is available upon request.

[b] The wetlands on and around Foster Island are valued by local and interested tribes.

Option A and its suboptions may include seven new stormwater facilities. Sediment loads to receiving Lake Washington and its wetlands would be reduced. Option A would reduce total loading of total suspended solids, total and dissolved copper, and total and dissolved zinc to Portage Bay, Lake Union, and Union Bay. Stormwater discharges would be required to comply with federal and state water quality standards. Option A and its suboptions would be designed according to the 2008 *Highway Runoff Manual* (WSDOT 2008b). The hydrologic functions of remaining wetlands in the study area would not be affected. The Water Resource Discipline Report (WSDOT 2009a), provides more details of project effects on water quality.

How would operation of the project affect the habitat functions of the wetlands?

Option A and its suboptions would reduce the availability and quality of wetland and wetland buffer habitat for invertebrates, amphibians, birds, fish, and mammals. Removal or reduction of woody vegetation associated with filling and shading could reduce the amount of small and large woody debris entering the habitats associated with Lake Washington, which would reduce food and cover for wildlife (see Exhibit 2-18).

The new bridges would be wider, but generally higher, and would shade wetlands in Portage Bay and Union Bay near Foster Island (some areas are already shaded by the existing bridges). This shading would reduce the amount and quality of habitat for amphibians and waterfowl in these areas. Species such as songbirds and most small mammals would be less affected by the loss of wetland habitat because they do not depend on specific types of wetland habitats and are accustomed to human intrusion.

Under existing conditions, the at-grade SR 520 roadway and adjacent fencing are barriers to wildlife movement. Over Foster Island, Option A would remove this barrier. Noise from Option A and its suboptions would be lower than under existing or No Build conditions (because of the addition of sound walls throughout the project corridor), so there could be a slight improvement in the quality of wildlife habitat in the study area. See the Wildlife and Habitat section of this report for more detailed information about noise, obstruction, or barrier effects on wildlife.

Option K

Option K would permanently fill approximately 1.8 acres of wetlands. This would include 0.4 acre of forested wetlands, 0.1 acre of scrub-shrub wetlands, 0.1 acre of emergent wetlands, and 1.2 acres of aquatic bed wetlands. The affected wetlands would be PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-3, LWS-4, and LWS-4A (see Exhibits 2-13 and 2-14a and 2-14b). Option K would fill 5.4 acres of buffer. Most of the wetland fill is in Wetland LWN-2 (0.9 acre), which is a Category III wetland and is a result of the low bridge profile and depressed SPUI on the west side of Union Bay. In Options A and L, the bridge is high enough to be out of the water and therefore the effects on Wetland LWN-2 would be shade rather than fill. In addition, a stormwater facility would result in filling portions of wetland LWN-2 and its buffer. Wetlands PBS-1 and PBS-1 and their buffers would have portions filled as the result of a stormwater facility. The landscaped lid over Foster Island, as well as support columns, would result in fill in Wetlands LWN-1, LWN-3, and their buffers, as well as the buffers of Wetlands LWS-2 and LWS-3. The traffic turnaround at Lake Washington Boulevard East would cause filling of Wetland LWS-4 and its buffer, as well as all of Wetland LWS-4A.

As with Option A, the new bridges elevated over existing wetlands and buffers would be affected by shading. For Option K, the Portage Bay Bridge would be wider than the existing bridge, but narrower than Option A. Option K does not include a westbound auxiliary lane, making Option K 12 feet narrower than Option A. Through Union Bay, the bridge would vary in width, but would be wider than existing conditions and Option A.

The proposed bridge heights through Portage Bay would be similar to Options A and L and generally higher than the existing bridges. Through Union Bay, the bridge structures would be lower than the other two options and existing conditions. It would be below the high water elevation because of the depressed SPUI in the Montlake area. It would also be below the high water elevation west of Foster Island. East of Foster Island, the profile would be slightly lower than existing conditions, but much lower than the other options (see Exhibit 2-16).

Option K would shade 2.8 acres of wetlands; of these 2.8 acres, 1.5 acres would be Category II; 1.4 acres, Category III; and less than 0.1 acre would be Category IV wetlands. Wetlands PBN-1, PBS-1, LWS-2, LWS-3, LWS-4, LWN-1, LWN-2, and LWN-3 would be

permanently shaded. Most of the shading would affect aquatic bed wetlands (2.3 acres), with 0.3 acre of forested wetlands, 0.2 acre of scrub-shrub wetlands, and less than 0.1 acre of emergent wetlands affected by shade. Option K is very close to the water surface in the Union Bay and west approach area. This would produce intense shading that would likely prohibit vegetation growth. In addition, Option K would shade 0.1 acre of buffer (see Exhibits 2-13 and 2-14a and 2-14b).

The Option K suboptions would add less than 0.1 acre of fill to both wetlands and buffers affecting Wetlands PBS-1A, LWN-2, and LWS-4 (see Exhibit 2-17). These effects would be the result of adding a right-turn-only, eastbound off-ramp to Montlake Boulevard East.

How would operation of the project affect the water quality and hydrologic functions of the wetlands?

Option K and its suboptions would fill 1.8 acres and shade 2.8 acres of wetlands, which would slightly decrease the ability of those wetlands to provide water quality and hydrologic functions. However, the amount of wetland area filled or shaded is small relative to size; therefore, decreased capacity would not be measurable (see Exhibit 2-18). In addition, all stormwater would be treated and returned to Lake Washington.

Option K and its suboptions may include eight new stormwater facilities, and water quality BMPs would be used to treat and remove pollutants. Sediment loads to receiving water bodies, including wetlands, would be reduced. Option K would reduce loading of total suspended solids, total and dissolved copper, and total zinc, while increasing loading of dissolved zinc to Portage Bay, Lake Union, and Union Bay. Stormwater discharges would comply with federal and state water quality regulations.

Option K and its suboptions would be designed according to the 2008 *Highway Runoff Manual* (WSDOT 2008b). The water quality and hydrologic functions of remaining wetlands in the study area would not be affected. More detailed project effects on water quality are presented in the Water Resource Discipline Report (WSDOT 2009a).

How would operation of the project affect the habitat functions of the wetlands?

Effects on wetlands from project operation under Option K and its suboptions would be slightly higher than the operational effects from Option A.

Option L

Option L would fill approximately 0.3 acre of wetland in the Portage Bay area and in the west approach area in Union Bay. This would include 0.2 acre of forested wetland, less than 0.1 acre of scrub-shrub wetland, 0.1 acre of emergent wetland, and less than 0.1 acre of aquatic bed wetland. The affected wetlands would be PBS-1, PBS-1A, LWN-1, LWN-2, LWN-3, LWS-2, LWS-3, LWS-4, and LWS-4A (see Exhibits 2-14a and 2-14b). Most of the affected wetlands are Category III wetlands (0.2 acre). Option L would also fill 1.5 acres of buffer (see Exhibits 2-13 and 2-14a and 2-14b). Wetland PBS-1, PBS-1A, LWN-2, and their buffers would have portions filled for stormwater facilities. Bridge support columns would result in fill in Wetlands LWN-1, LWN-2, LWN-3, and LWS-4. Wetland LWS-4A would be eliminated by the ramp connection to Lake Washington Boulevard and a stormwater facility.

As with Options A and K, the new bridges elevated over existing wetlands and buffers would result in shading of wetlands. For Option L, the Portage Bay Bridge would be replaced with a wider structure similar to Option K, but would be 12 feet narrower than Option A. Through Union Bay the bridges would be wider than Option A, but similar in width to Option K.

The bridge profile through Portage Bay would be similar to Options A and K. In the west approach area over Union Bay and west of Foster Island, the proposed bridge profile would be slightly higher than existing conditions, but lower than is proposed for Option A. East of Foster Island, the proposed bridge would be much higher than existing conditions and what is proposed for Option K. Compared to Option A, it would be higher closer to Foster Island, but it would increase in height. Option A would decrease in height (see Exhibit 2-16).

Option L would permanently shade 4.3 acres of wetlands and 1.3 acres of buffer. For the wetlands, 1.9 acres of Category II wetlands, 2.4 acres of Category III wetlands, and less than 0.1 acre of Category IV wetlands would be shaded. Of the 4.3 acres, 0.4 acre would be forested, 0.2 acre scrub-shrub, less than 0.1 acre emergent, and 3.6 acres aquatic bed. The affected wetlands would be PBN-1, PBS-1, LWN-1, LWN-2, LWN-3, LWS-2, LWS-3, and LWS-4 (see Exhibits 2-13 and 2-14a and 2-14b). The bridge structures in Option L are higher than with Option K but lower than with Option A. The degree and intensity of shading and the

resulting effect on vegetation from Option L would be intermediate between the other two options.

The Option L suboptions would add less than 0.1 acre of fill in both wetlands and buffers and would shade less than 0.1 acre of wetland. Wetland PBS-1A would be affected by fill due to the relocation of a stormwater facility. Wetland LWN-2 would be affected by shading related to increased capacity northbound on Montlake Boulevard Northeast to Northeast 45th Street.

How would operation of the project affect the water quality and hydrologic functions of the wetlands?

Similar to Option A, Option L and its suboptions would fill 0.3 acre and shade 4.3 acres of wetlands, which would decrease the ability of those wetlands to provide water quality and hydrologic functions. However, the amount of wetland area filled or shaded is small relative to size; therefore, decreased capacity would not be measurable (see Exhibit 2-18). In addition, all stormwater would be treated and returned to Lake Washington.

Option L and its suboptions may include six new stormwater facilities and water quality BMPs to treat and remove pollutants. As a result of these new facilities, sediment loads to receiving water bodies, including wetlands, would be reduced. Like Option K, Option L would reduce loading of total suspended solids, total and dissolved copper, and total zinc, while increasing loading of dissolved zinc to Portage Bay, Lake Union, and Union Bay. Stormwater discharges would comply with federal and state water quality regulations. Option L and its suboptions would be designed according to the 2008 *Highway Runoff Manual* (WSDOT 2008b). The hydrologic functions of remaining wetlands in the study area would not be affected. More details of project effects on water quality are presented in the Water Resource Discipline Report (WSDOT 2009a).

How would operation of the project affect the habitat functions of the wetlands?

Effects on wetland habitat functions from project operation described for Option L and its suboptions would be similar to those under Option A.

Lake Washington

The Lake Washington location includes the floating bridge and east approach. No wetlands occur in the vicinity of the floating bridge and

bridge maintenance facility. Effects to deep-water habitats are discussed in the Fish Resources section of this report.

Eastside Transition Area

There are no wetlands in the vicinity of the bridge maintenance facility dock or the relocated Evergreen Point Road transit stop. Restriping to tie into the Eastside alignment would be within the paved roadway and would not affect any wetlands.

Pontoon Construction and Transport

Effects on wetlands from pontoon construction are discussed in the Pontoon Construction Project Ecosystems Discipline Report (WSDOT 2009e). In addition, the CTC facility does not have the potential to support wetlands; therefore, no wetlands would be affected.

There are no effects associated with pontoon transport, because there are no wetlands along the transport route.

Phased Implementation Scenario

As is the case for the construction effects on wetlands, most operational effects on wetlands would occur in the Portage Bay, west approach, and floating bridge (see Exhibits 2-14a and 2-14b). Exhibit 2-17 shows wetland and buffer effects by geographic area. There are no wetlands in the I-5 area, and only small portions of the wetlands extend into the Montlake area.

If the project were delivered in phases, effects on wetland would be similar to those described for the full build out of the 6-Lane Alternative. However, phasing could prolong the duration of effects. There is a potential that some wetland areas may be affected more than once if work has to occur in the same area, but in different phases.

Mitigation

Federal regulators, Washington state agencies (including WSDOT), and some local governments require that mitigation efforts be completed in the following prescribed sequence:

1. Avoid the effect altogether by not taking a certain action or parts of an action.

2. Minimize the effect by limiting the degree or magnitude of the action and its implementation by using appropriate technology or by taking affirmative steps to avoid or reduce impacts.
3. Rectify the effect by repairing, rehabilitating, or restoring the affected environment.
4. Reduce or eliminate the effect over time by preservation and maintenance operations during the life of the action.
5. Compensate for the effect by replacing, enhancing, or providing substitute resources or environments.
6. Monitor the effect and take appropriate corrective measures.

Despite the avoidance and minimization measures summarized below, the 6-Lane Alternative would have unavoidable effects on wetlands and buffers.

What has been done to avoid or minimize negative effects?

WSDOT has designed the project to minimize the permanent and construction effects of the proposed alternatives. Specific aspects of the design that have been incorporated to avoid and minimize effects on wetlands include the following:

- The bridge alignment was extended to the north of the existing alignment in Portage Bay and Union Bay to minimize effects on wetlands.
- Retaining walls would be used instead of standard fill slopes to reduce the footprint of the at-grade roadway sections and the amount and extent of wetland fill.
- Sound walls would be installed along most of the SR 520 corridor to minimize noise disturbance. This would benefit wildlife using the wetland habitats adjacent to the roadway.
- Stormwater treatment facilities would be constructed to treat roadway runoff before it is discharged to downstream aquatic habitat. This would improve water quality in the study area.
- The spacing of the columns for the bridge structures would be increased compared to existing conditions to reduce the number of columns in wetlands and open waters, including their buffers.

- During bridge construction, contractors would use BMPs to avoid unintentional fill of wetlands and buffers from column excavation. For example, construction bibs that function as nets could be used to catch falling debris during construction of the new bridge decking and demolition of the existing decking.
- BMPs could include implementing erosion and sediment control measures, a stormwater management plan, and a pollution prevention plan. Other BMPs could include operating construction equipment from mats or steel plates to minimize soil compaction when working in or near sensitive areas and restricting refueling of vehicles within 100 feet of wetlands to reduce potential spills of petroleum and hydraulic fluids in sensitive areas.
- Contractors would restore cleared areas and replant the areas with appropriate native herbaceous and woody species.

What mitigation is proposed to compensate for project effects?

Approach to Mitigation

WSDOT has engaged several regulatory agencies in collaborative technical working groups to assist in the development of appropriate mitigation for project effects. WSDOT has also assembled a team of scientists to prepare formal mitigation plans required for project permitting. These mitigation plans incorporate field investigations, scientific research, and the collective knowledge from the technical working group and mitigation team. An Initial Wetland Mitigation Report will be prepared in the fall of 2009 for agency review. This section summarizes key elements of that plan.

WSDOT identified wetland mitigation candidate sites using a hierarchical selection process based on the watersheds in the study area. The process was intended to provide a list of sites that would not only provide mitigation appropriate to the level of project effects, but would also provide benefits extending beyond the site boundaries. Examples of these benefits include addressing limiting factors at the watershed level and providing critical linkages in habitat corridors.

Key steps in the mitigation site selection process are as follows:

- The study area for initial site selection extended to I-5 on the west, Lake Washington on the east, and the water resource inventory area (WRIA)—8 boundaries on the north and south.

- In order to identify potential mitigation sites, WSDOT reviewed existing documents (planning documents, aerial photography, and other public GIS layers available for WRIA 8). WSDOT also incorporated wetland mitigation sites submitted by the City of Seattle Parks Department and the University of Washington.
- To select the most appropriate potential wetland mitigation sites, WSDOT identified broad parameters that would define the best sites for the master list of potential mitigation sites. These parameters are divided into two sets: opportunity parameters and risk parameters. The "opportunity set" consists of four parameters: mitigation type, special characteristics, location, and cost. The "risk set" includes four parameters: availability, hydrology, hazardous waste, and cultural resources.
- The initial screening focused first on risk factors to eliminate high-risk sites, then on opportunities.
- Generally, the sorting identified the top sites with the greatest mitigation potential.
- Final site selection would be based on the amount of mitigation available at the potential sites and the suitability of the mitigation.

Construction Mitigation

Areas affected by construction of the I-5 to Medina Project would require mitigation; however, specific ratios have not yet been determined. As the design advances and effects from construction are better understood, WSDOT will define appropriate mitigation measures in consultation with federal and state agencies and the City of Seattle. WSDOT anticipates that mitigation measures would include restoration of the temporarily affected areas, and any additional mitigation would consider the time needed to restore the impaired functions.

Operational Mitigation

The I-5 to Medina Project would fill from 0.1 acre to 1.8 acres of wetlands, depending on the option selected. These effects would reduce or eliminate water quality, hydrologic, and habitat functions in the affected wetlands and watersheds.

Most of the affected wetlands in the study area are Category II and III, with smaller effects to Category IV wetlands. These effects would be mitigated at one or more sites with the greatest potential for successful

mitigation, including sites that have significant invasive species or relatively low habitat scores.

Compensatory mitigation would be a component of all the options of the 6-Lane Alternative. Mitigation would be used to replace the area of wetland and buffer that was filled or shaded and to offset the loss of wetland and buffer functions operation of the project. No buffer replacement would be provided if there was a complete loss of wetland area and function. Wetland buffers would be required on wetlands that would be used in the mitigation. The goal of the compensatory mitigation would be to achieve no net loss of wetland area or function.

The final compensatory mitigation for the I-5 to Medina Project would be a comprehensive package designed to meet the requirements of the Federal Rule on Compensatory Mitigation and to be consistent with federal and state "no net loss" policies. The project would also be designed to meet the mitigation sequencing, compensation, reporting and monitoring requirements typically used in WSDOT projects.

Wetlands lost due to operational effects of the I-5 to Medina Project would require compensatory mitigation. Exhibit 2-19 summarizes the area of wetland fill by option and the corresponding required mitigation for the filled wetlands.

Exhibit 2-19 Potential Mitigation Needs for the Project

		Option A		Option K		Option L	
Wetland Category	**Mitigation Ratio[a]**	**Wetland Fill**	**Mitigation required**	**Wetland Fill**	**Mitigation required**	**Wetland Fill**	**Mitigation required**
II	3:1	<0.1	-	0.5	1.5	<0.1	-
III	2:1	0.1	0.2	1.2	2.4	0.2	0.4
IV	1.5:1	<0.1	-	0.1	0.15	0.1	0.15
Total		**0.1**	**0.2**	**1.8**	**4.05**	**0.3**	**0.55**

[a] Ratios are based on Ecology et al. (2006) and City of Seattle SMC 25.09.160 E. Mitigation ratios assume creation or re-establishment of wetlands.

Note: Suitable mitigation ratios for shading effects have not yet been determined.

Mitigation ratios shown above are based on the wetlands ordinance for the City of Seattle (SMC Wetlands Ordinance [SMC 25.09.160 E, October 2008], retrieved July 10, 2009), and Ecology and USACE's joint guidance as found in *Wetland Mitigation in Washington State: Part 1*: *Agency Policies and Guidance* (Ecology et al. 2006). The standard mitigation ratios for creation or re-establishment of Category II, III, and IV wetlands are the

same in these two systems. The reader should note that the ratios shown in Exhibit 2-19 reflect only one type of wetland effect (filling) and one potential mitigation activity (wetland creation). As a result, the data presented in this section do not necessarily reflect the final mitigation activities and ratios that would be used in the compensatory mitigation for the I-5 to Medina Project.

The project would also shade 2.8 acres to 4.3 acres of wetlands, depending on the selected option. There are no specific mitigation ratios for shading effects on wetlands. As a result, WSDOT would develop mitigation measures for wetland shading in consultation with the regulatory agencies and the City of Seattle. WSDOT anticipates that the amount and type of mitigation measures would be determined based on the goal of replacing lost or impaired wetland functions associated with the shaded areas. For planning purposes, WSDOT anticipates that the necessary compensatory mitigation for shading effects would be addressed first by onsite wetland enhancement and then by offsite mitigation elements (for example, wetland restoration, rehabilitation, or enhancement) available within the set of candidate mitigation sites identified.

In addition to the wetland effects, the project would fill 0.7 acre to 5.4 acres of buffers (depending on the option). An additional 0.1 acre to 1.3 acres of buffer would be shaded, depending on the option selected. WSDOT will add appropriate buffers to wetlands in the mitigation areas. The City of Seattle does not specify mitigation for wetland buffers.

The three Lake Washington Boulevard ramps would be removed, which would offset some of the fill and shading by exposing previously shaded areas. These ramps are mainly over upland or open-water areas, as opposed to vegetated wetlands, but their removal would expose 0.8 acre of previously shaded wetlands and aquatic habitat. In addition, 18 support columns (<0.1 acre of fill) would be removed.

What negative effects would remain after mitigation?

The mitigation proposed is intended to fully mitigate for project effects to wetlands.

3. Fish and Aquatic Resources

Affected Environment

The Lake Washington watershed supports a diverse group of fish species, including several species of native salmon and trout. Many of these species are an integral part of the economy and culture of the Pacific Northwest. Large-scale alteration and destruction of fish habitat within the Lake Washington watershed have occurred over the last 100 years, adversely affecting local fish populations. The fish resources of Lake Washington, Union Bay, and the Lake Washington Ship Canal may be further affected in different ways by the alternatives being proposed for the I-5 to Medina Project. The Ship Canal refers collectively to Montlake Cut, Portage Bay, Lake Union, Fremont Cut, Ballard Locks, and Salmon Bay. The Ship Canal is included as part of the study area because this is the route through which pontoon sections would be towed to the project construction area. It is also a potential route for importing other construction-related material and equipment to the construction area. Also, because the pontoons could also be towed from Grays Harbor and from the CTC facility in Tacoma, these towing routes are included in the study area. The Fish and Aquatic Resources section assesses these resources to provide the foundation for evaluating the potential effects of each project alternative on the resources.

All anadromous salmonids (fish that migrate to the ocean) produced in the Lake Washington watershed travel under or adjacent to the Portage Bay and Evergreen Point bridges. Therefore, the project alternatives have the potential to either positively or negatively affect salmonid production from the Lake Washington watershed, including the Endangered Species Act (ESA)-listed populations of Chinook salmon, steelhead, and bull trout, by altering a portion of their rearing and migration habitat.

Is the project within a recognized tribal fishing area?

The project occurs within the federally adjudicated usual and accustomed fishing areas of the federally recognized

Muckleshoot Indian Tribe. The Muckleshoot usual and accustomed fishing area includes the Ship Canal and Lake Washington, where the Muckleshoot harvest adult salmon from the Lake Washington study area pursuant to adjudicated recognized treaty rights, as interpreted by the Boldt Decision of 1974. Over the years, judicial decisions have affirmed that treaty Indian Tribes have a right to harvest fish free of state interference, subject to conservation principles; to co-manage the fishery resource with the state; and to harvest up to 50 percent of the harvestable fish.[1]

The Muckleshoot Tribe has a staff of fisheries biologists and takes an active role in managing salmonids within the area. Tribal fishing can occur at multiple and variable locations within the Ship Canal and Lake Washington. WSDOT is coordinating with the Muckleshoot Tribe because the proposed project could potentially affect fisheries resources and the access of the Muckleshoot to their affirmed treaty fishing areas.

Usual and accustomed fishing areas for a number of other Tribes occur in the overall project vicinity, including in the marine waters between the pontoon construction site in Grays Harbor and in central Puget Sound, which includes Elliott Bay and Salmon Bay, where salmonids produced in the Lake Washington basin and other watersheds are harvested. See the Indian Fishing Rights section in the Cultural Resources Discipline Report (WSDOT 2009g) for more information.

How was the information on fish resources and aquatic habitat collected?

Project biologists collected documented information on fish species, distribution, and habitat use within the study area. The analysts read available literature, such as peer-reviewed articles in scientific journals, technical reports, and data from various tribal, state, county, and city entities. These reports include recent tagging studies conducted in the immediate project vicinity that evaluated the distribution and behavior of fish in the vicinity (Celedonia et al. 2008a, 2008b). Project biologists also visually inspected existing habitat conditions within Lake Washington, Portage Bay, and Union Bay, as well as the area streams that exist within the project right-of-way, as described further below.

[1] For details on these judicial decisions, refer to *United States v. Washington*, 384 F. Supp. 312 (W.D. Wash. 1974), aff'd 520 F.2d 676 (9th Cir. 1975); *Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n*, 433 U.S. 658 (1979).

The biologists surveyed and characterized the nearshore and in-water habitats in the project right-of-way, including the potential fish-bearing tributary streams in the Eastside transition area (Fairweather and Cozy Cove creeks) where the streams cross the project alignment. The characterization included an evaluation of the distribution and extent of aquatic vegetation, as well as the general substrate and depth characteristics in the nearshore environment of Lake Washington.

In the tributary streams, the biologists conducted aquatic habitat surveys using procedures consistent with King County Level I (basic) stream survey methods and guidelines (King County 1991). The habitat survey measured or described in-stream habitat features, riparian vegetation, streambank stability, substrate composition, and fish passage obstructions for approximately 500 feet upstream and downstream of the SR 520 corridor. This effort included assessments of the fish passage conditions through the existing culverts under SR 520.

Fish usage was determined, in part, from existing data and discussions with local resource agency representatives. Additional methods included visual sightings of fish in the creeks and spot-checking with a backpack electroshocker in May 2002. Resource agency representatives and the ecosystems analysts also inspected the aquatic and riparian habitat along the SR 520 corridor on several occasions during previous stages of the project.

Recent and ongoing research projects in Lake Washington and the Ship Canal also provided additional information on the potential influence of the existing Evergreen Point Bridge, approach structures, and other shoreline modifications on the behavior of salmonids and potential predator species.

What are the general aquatic habitat characteristics of the Ship Canal, Lake Union, Portage Bay, Union Bay, Lake Washington, and area streams?

Portage Bay, Union Bay, Lake Washington, and the entire SR 520 corridor are within the Lake Washington watershed (WRIA 8). The Water Resource Discipline Report (WSDOT 2009f) provides information on water quality within the project vicinity. The Lake Washington watershed comprises 13 major drainage subbasins and numerous smaller drainages, totaling approximately 656 miles of streams; three major lakes (Washington, Sammamish, and

What is a water resource inventory area (WRIA)?

Washington state is divided into 62 WRIAs for water and aquatic-resource management issues. A WRIA can include more than one watershed. However, the terms "WRIA" and "watershed" are frequently used interchangeably.

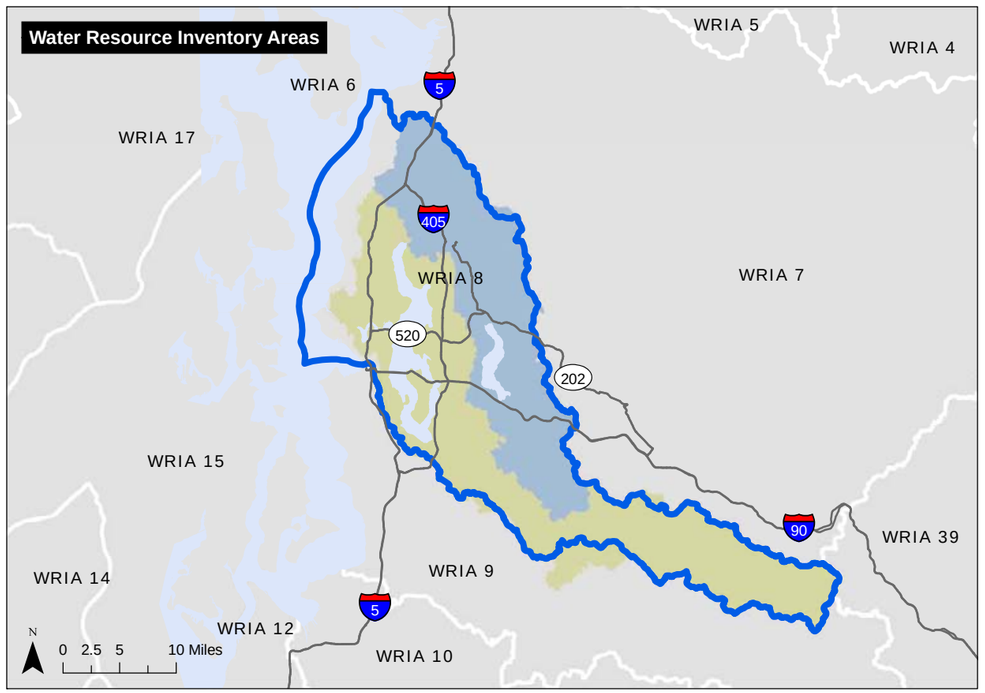
Union); and numerous smaller lakes (Exhibit 3-1). Within the Lake Washington watershed, the Ship Canal and the west side of the Lake Washington shoreline are in Seattle. The eastern Lake Washington shoreline and potential fish-bearing tributary streams along the corridor occur in Medina and Hunts Point (Exhibit 3-2).

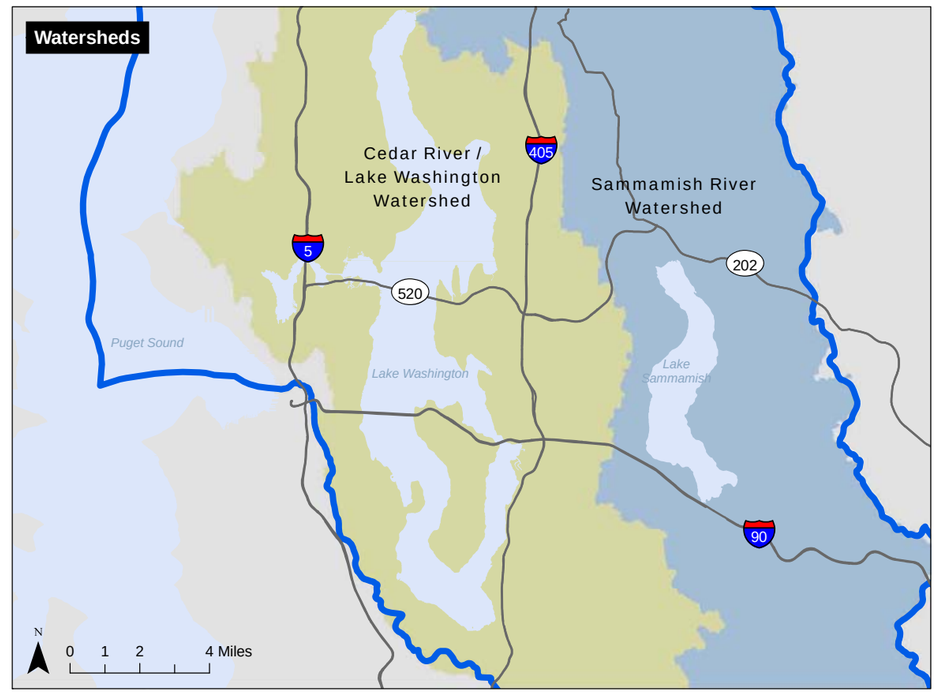
The Ship Canal, which extends from Lake Washington to Puget Sound, is part of a highly urbanized watershed with a high percentage of modified shoreline and impervious surface area, such as roadways, sidewalks, and rooftops. Historically, Lake Union was separated from Lake Washington and its waters discharged directly to Puget Sound through Salmon Bay, while Lake Washington discharged into the Black River at the southern end of the lake (Weitkamp and Ruggerone 2000). Construction of the Ship Canal in 1917 lowered the elevation of Lake Washington by approximately 9 feet, disconnected Lake Washington from its historical outlet to the Black River, and produced a new migration route for the juvenile anadromous salmonids produced in the Lake Washington watershed through the Ship Canal.

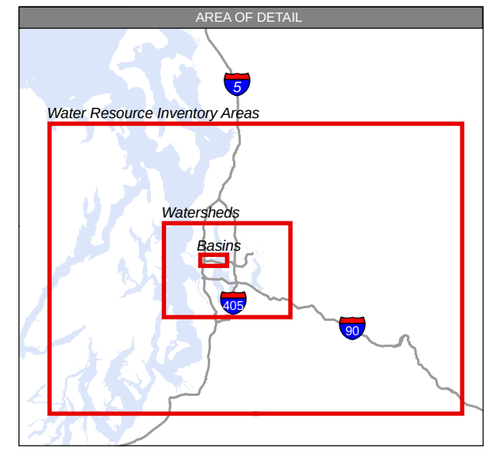
Little natural shoreline habitat remains in the Ship Canal/Lake Union area, resulting in much less open-water habitat to support fish species compared to Lake Washington. Docks, houseboats, and other structures cover most of the shoreline. Only small sections of the shoreline are open with natural substrates and slopes (Exhibit 3-3).

Shoreline modifications in Portage Bay include the Queen City Yacht Club, with boat moorage on the west side of the Portage Bay Bridge. On the east shoreline, modifications include the Seattle Yacht Club, with boat moorage, and the National Atmospheric and Oceanic Administration (NOAA) Northwest Fisheries Science Center. South of the existing Portage Bay Bridge are vegetated shallows with a fringe marsh along the shoreline.

While much of the Montlake Cut consists of concrete or riprap-armored shoreline, substantial portions of the Union Bay shoreline habitat are naturally vegetated. Armored shoreline areas in Union Bay primarily occur in residential development areas, including most of the northern shoreline and the southern shoreline east of Foster Island.







Water Resource Inventory Area 8 Boundary

Water Resource Inventory Area

Watershed

Cedar River / Lake Washington Watershed

Sammamish River Watershed

Basin

Combined Sewer

East Lake Washington

Fairweather Creek

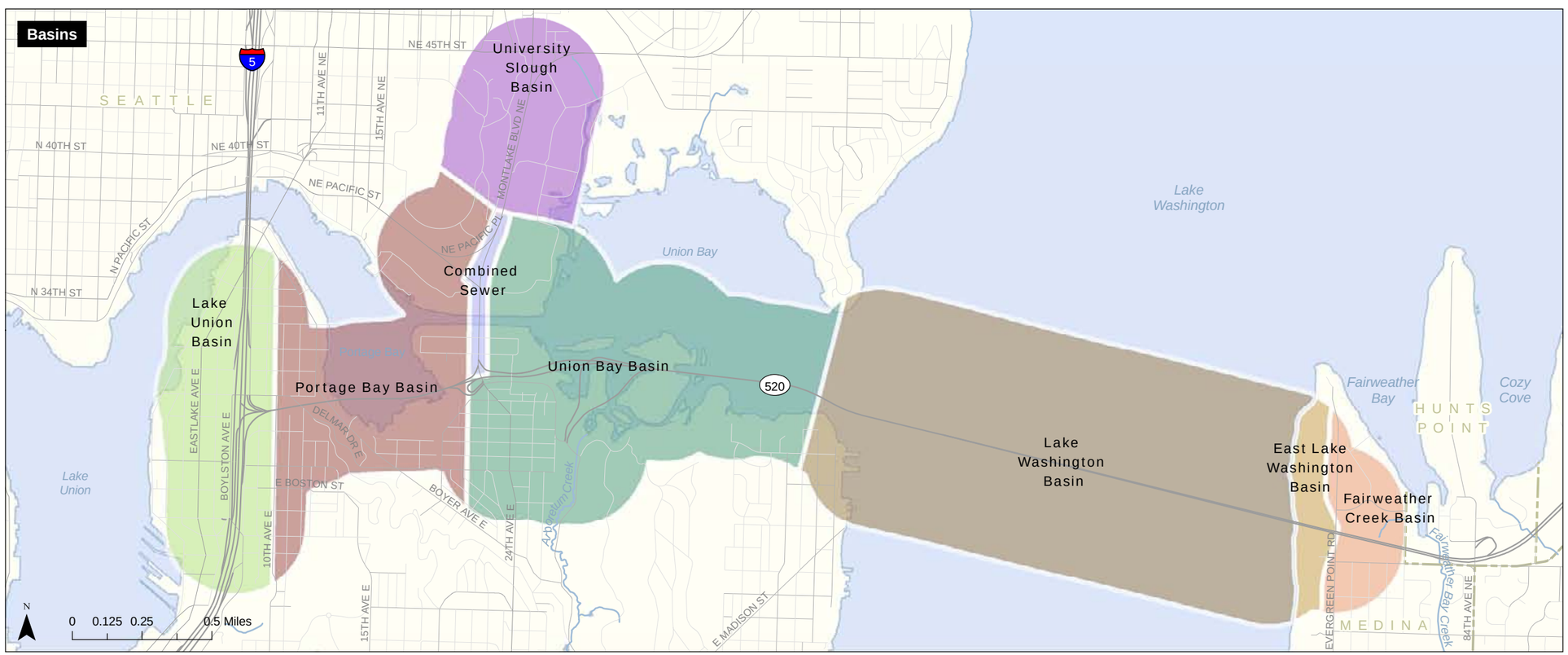
Lake Union

Lake Washington

Portage Bay

Union Bay

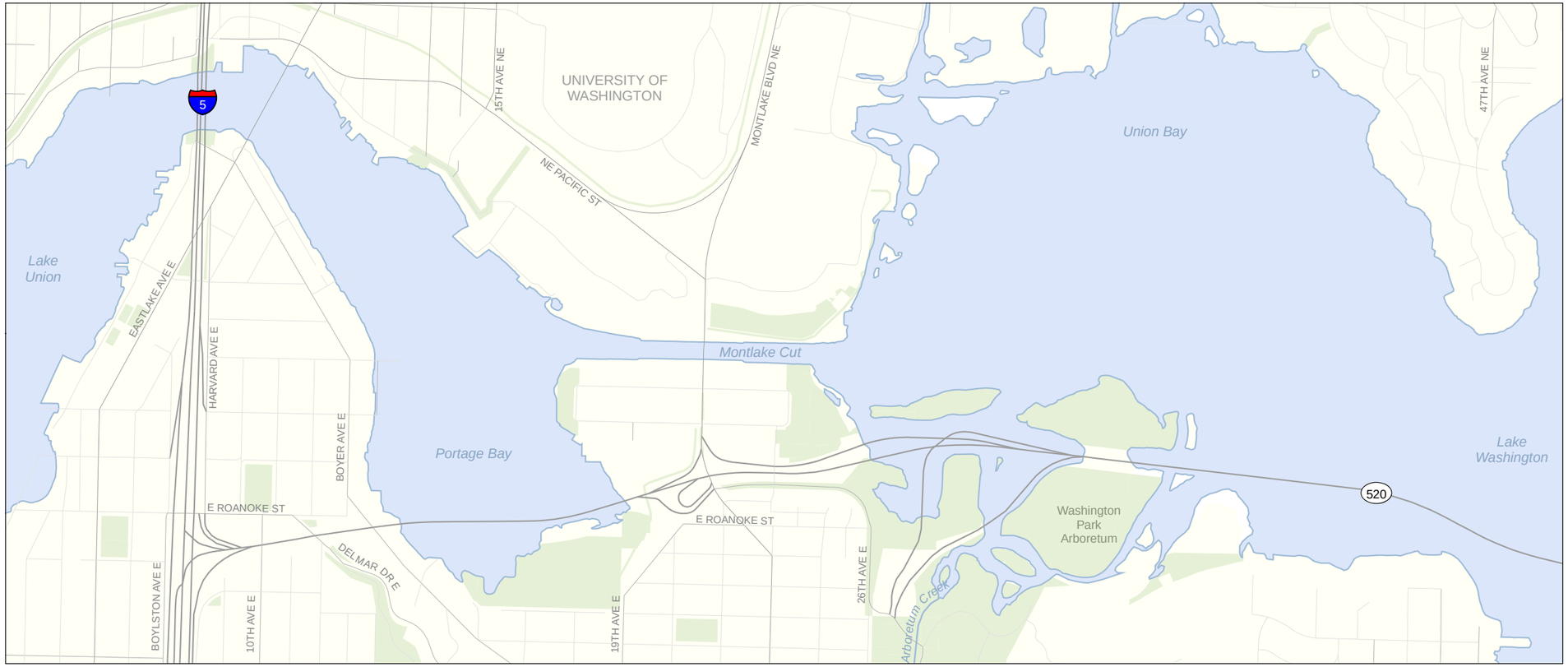
University Slough

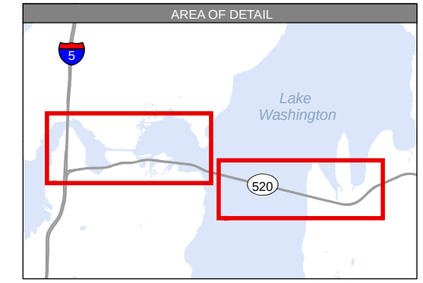


Source: King County (2007) GIS Data Water Bodies), King County (2005) GIS Data (Streets and Streams), Ecology (2000) GIS Data (WRIA), Ecology (2001) GIS Data (Shoreline), WSDOT (2004) GIS Data (State Routes). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 3-1. **Location of Affected Watersheds and Basins**

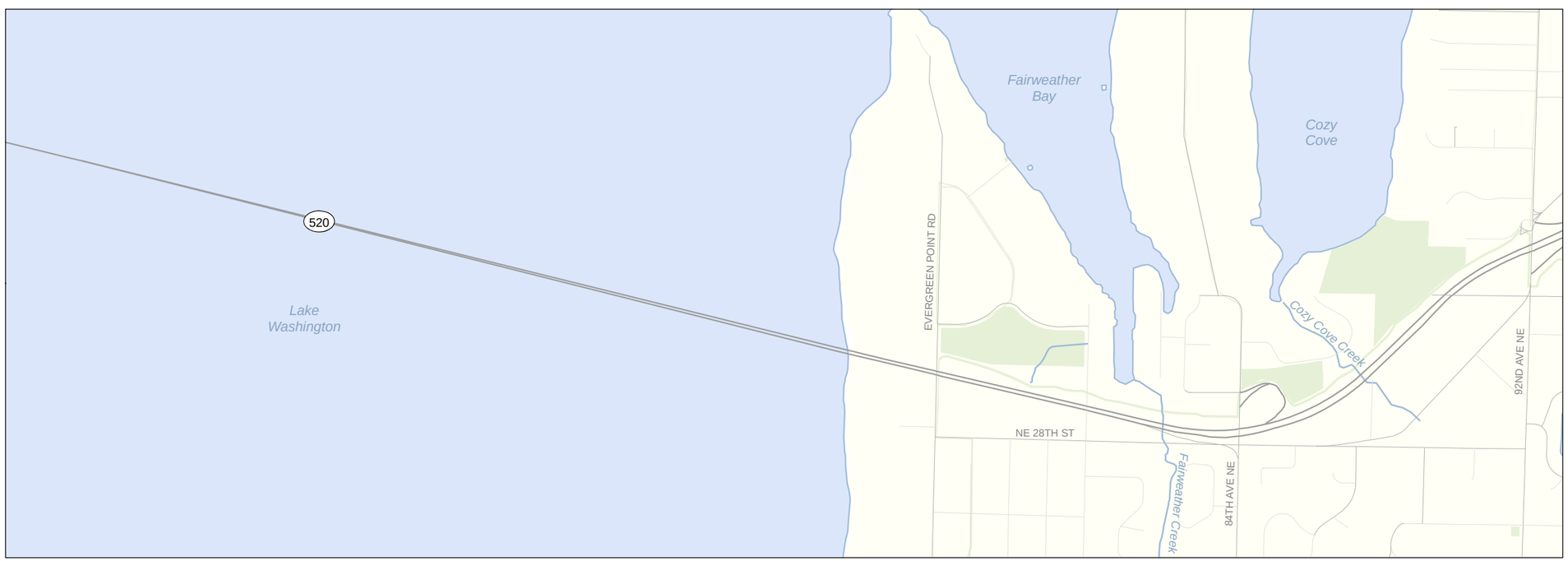
I-5 to Medina: Bridge Replacement and HOV Project





Stream

Park



N

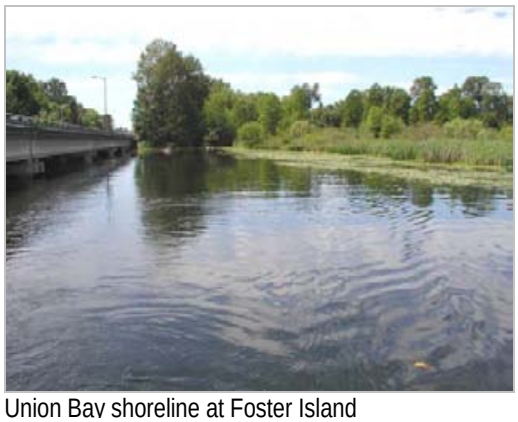
0 500 1,000 2,000 Feet

Source: King County (2005) GIS Data (Streams and Streets), King County (2007) GIS Data (Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 3-2. **Study Area Waterbodies**

I-5 to Medina: Bridge Replacement and HOV Project

White water lilies and Eurasian milfoil are the dominant aquatic vegetation in Portage Bay and Union Bay. This nonnative aquatic vegetation also covers much of the SR 520 corridor on the west side of Union Bay and the shallow area on both sides of the west approach to the Evergreen Point Bridge in Union Bay.



Union Bay shoreline at Foster Island

Lake Washington east shoreline crossing location

Portage Bay shoreline north of west end of Portage Bay Bridge

Portage Bay shoreline north of east end of Portage Bay Bridge

Exhibit 3-3. Various Shoreline Habitat Areas within the Project Area

In Union Bay, the area encompassing Marsh Island and Foster Island has generally undeveloped shorelines that emerged when the elevation of the lake was lowered after the completion of the Ship Canal (see Exhibit 3-3).

Congress has mandated (Public Law 74-409, August 30, 1935) that USACE maintain the lake elevation between 20 and 22 feet (USACE datum) as measured at the Ballard Locks. USACE regulates the lake elevation based on runoff forecasts, lake level measurements, and projected water demands for operating the Ballard Locks

(including the juvenile and adult fish passage facilities and operational considerations at the Ballard Locks).

Marsh and Foster islands generally have gradually sloping shorelines, with silt substrate and dense aquatic vegetation. The aquatic vegetation is also commonly the nonnative species of white water lily or Eurasian milfoil. Much of the shallowest water also has dense growths of cattail. Various forms of native and nonnative riparian vegetation grow along much of the shoreline not occupied by SR 520, walking trails, or access points. Wetland vegetation occurs along much of the shoreline and nearshore areas of these islands and Union Bay. However, apartments and over-water condominiums along the Lake Washington shoreline south of the Evergreen Point Bridge substantially minimize the riparian vegetation.

The Lake Washington shoreline is bordered primarily by landscaped yards of private and multifamily residences and public parks. Around Lake Washington, 65 percent of the shoreline is held by private homeowners, while only 15 percent is held by commercial entities (University of Washington 2007). The remaining 20 percent of the shoreline is publicly held by cities, with most of these public entities having already completed or planning habitat enhancement projects on their properties. Much of the Lake Washington shoreline, including the shallow-water areas of Portage Bay, Union Bay, Fairweather Bay, and Cozy Cove, contains large expanses of aquatic vegetation. Although aquatic vegetation also occurs along the east shoreline of Lake Washington, within the SR 520 corridor these beds typically are less extensive than many of the other shallow-water lake habitat areas in the corridor.

Lake Washington's shoreline is an important fish resource that generally supports juvenile salmonid rearing and migration, including sockeye salmon spawning at some locations. When young Chinook salmon enter Lake Washington, they prefer to rear along the shorelines in water less than 3 feet deep with sandy gravel substrate (Tabor et al. 2004). Young Chinook find abundant prey and apparently refuge from large predatory fish in this shallow-water habitat. Naturally sloped gravel beaches occur at many public parks and some private residences, but much of the Lake Washington shoreline has bulkheads or riprap armoring. Bulkheads and shoreline armoring that produce hard vertical faces at the shorelines have substantially reduced the shallow-water habitat preferred by young Chinook salmon. Water depths adjacent to most of these armored shorelines are generally several feet at the

shoreline (2 to 6 feet deep or more). A variety of predatory fish such as bass, perch, bullhead, and northern pikeminnow (some of which prey on young salmonids) reportedly favors bulkhead habitat. Later, as the young Chinook mature, they move offshore into deeper water and are less affected by shoreline modifications (Tabor et al. 2004).

At other locations, broad muddy substrate areas support water lilies, Eurasian milfoil, and other aquatic vegetation that provide habitat more suitable for predator species than juvenile salmonids. Such areas include the vegetated shallows with silty substrate areas of Portage, Union, and Fairweather Bays. The extensive aquatic vegetation in these areas makes much of the shallow-water habitat in the project vicinity generally unsuitable for juvenile salmonids.

The Lake Washington water column is stratified (a defined warmer surface layer above a colder water layer) from June through October, but undergoes complete mixing between December and March when the surface layer cools (City of Seattle 2008). Surface water temperature in the lake ranged between approximately 43 degrees Fahrenheit (°F) (6 degrees Celsius [°C]) to over 75°F (24°C) between 2000 and 2007 (City of Seattle 2008). The warm summer surface water temperatures are also generally unsuitable for salmonids.

How does the Evergreen Point Bridge affect aquatic habitat in Lake Washington?

The Evergreen Point and I-90 floating bridges tend to interrupt waves and water currents produced by the wind on Lake Washington. The southerly and northerly winds tend to move surface water currents north or south on the lake, commonly at an angle to the shorelines. Prevailing winds are commonly out of the southwest toward the east end of the Evergreen Point Bridge.

The effect of these bridges on water movements and biological resources in Lake Washington is not clearly defined. The bridges interrupt wind-driven currents by effectively dividing the lake into three circulation cells for surface water. This may have some effect on how much phytoplankton and zooplankton grow in the lake. However, juvenile sockeye salmon exhibit very high growth rates in Lake Washington (Ballantyne et al. 2003), indicating adequate zooplankton prey is available in the lake.

Available information on water quality, plankton, and fish distribution implies other factors may have a substantially greater effect on these

characteristics than the presence of the bridges (Arhonditsis et al. 2002, 2004; Edmondson 1997; Edmondson and Litt 1982; Chigbu 2000; Chigbu et al. 1998; Chigbu and Sibley 1998a, 1998b). The characteristics of Lake Washington have changed substantially since the Evergreen Point Bridge was constructed. These changes are mainly due to reduced amounts of phosphorus being discharged into the lake. Prior to 1963, Lake Washington received primary and secondary treated sewage that added a substantial nutrient load to the lake and caused eutrophication (Edmondson 1991). Since then, the reduction of phosphorous in the lake from approximately 70 parts per billion (ppb) to 15 ppb has resulted in major changes in the life forms in the lake. The cyanobacteria, *Oscillatoria rubescens*, which was a dominant phytoplankton in the lake when phosphorous concentrations were high, subsequently became a small part of the phytoplankton community after the sewage discharges ceased. Possum shrimp (*Neomysis mercedis*) production also decreased at approximately at the same time. These changes allowed a substantial increase in the water flea Daphnia sp., which provides food for young sockeye salmon and longfin smelt. The population of longfin smelt has increased substantially since the 1960s.

Eutrophication occurs when high nutrient levels are present in lake water, leading to abundant algae production that can result in lower dissolved oxygen levels.

During the last 50 years, other limnological changes (changes in the life and aquatic ecology of lakes) have occurred in Lake Washington. The annual mean alkalinity has increased from approximately 29 to over 40 milligrams per liter (mg/L) of calcium carbonate. The change in alkalinity may be due to urbanization, which has altered the discharge to Lake Washington tributaries. Surface water temperatures in the lake have steadily increased by 1°C to 2°C (Arhonditsis et al. 2004). High densities of aquatic vegetation growing in many shallow areas of the lake can produce low dissolved oxygen levels, which can have adverse effects on fish (Frodge et al. 1995).

What fish species occur in the project vicinity?

Many native and nonnative fish species inhabit the Lake Washington watershed. Most of these species are likely to occur at least occasionally in the project vicinity. Exhibit 3-4 below provides information on the general habitat used by the most common of these species, which are of greatest concern within the watershed.

Lake Washington has a number of tributaries that provide fish habitat for migratory species that also use the lake habitat during various life stages (Williams et al. 1975). Although only a few of the larger

tributaries support sustaining populations of Chinook salmon and steelhead (both ESA-listed species), many smaller tributaries sustain other anadromous and resident salmonids. This includes the small tributary streams within the I-5 to Medina Project right-of-way. Small numbers of bull trout (another ESA-listed species) are also occasionally found in Lake Washington.

Exhibit 3-4. Prevalent Lake Washington Watershed Fish Species and their Ecological Roles

Species Scientific Name	Federal and State Status [a]	Origin	Ecological Role
River lamprey *Lampetra ayresi*	FCo, SC	Native	Salmonid predator occurring in Lake Washington system; apparent abundance levels suggest relatively high predation rates (Celedonia et al. 2009).
Pacific lamprey *Lampetra tridentata*	FCo	Native	Potential salmonid predator occurring in Lake Washington system.
Western brook lamprey *Lampetra richardsoni*	None	Native	Potential salmonid predator occurring in Lake Washington system.
Bull trout *Salvelinus confluentus*	FT, SC	Native	Overlapping habitat with other salmonids, but very low numbers or nonexistent in most of watershed. Major fish predator.
Cutthroat trout *Oncorhynchus clarki*	None	Native	Young compete with other salmonids for prey. Adult cutthroat consume fish, including juvenile Chinook and sockeye salmon. Population likely smaller than some other potential predators.
Steelhead/rainbow trout (anadromous/resident) *Oncorhynchus mykiss*	FT [b], SC	Native	Overlapping habitat with other salmonids; consume similar prey. Some predation on young salmonids probable.
Chinook salmon *Oncorhynchus tshawytscha*	FT, SC	Native	Wild and hatchery origin.
Coho salmon *Oncorhynchus kisutch*	FCo	Native	Probably most abundant in north Lake Washington, area; primarily hatchery origin.
Sockeye salmon/kokanee (anadromous/resident) *Oncorhynchus nerka*	None for Lake Washington	Native [c]	Pelagic[d] in open-water areas.
Largemouth bass *Micropterus salmoides*	None	Nonnative	Major fish predator that occupies shoreline habitat. Young compete with young salmonids for some prey.
Smallmouth bass *Micropterus dolomieui*	None	Nonnative	Major fish predator that occupies salmonid habitat, resulting in some prey competition. Population size uncertain.
Brown bullhead *Ictalurus nebulosus*	None	Nonnative	Competitor with young salmonids for similar prey.
Longfin smelt *Spirinchus thaleichthys*	None	Native	Pelagic in open-water areas. Little likelihood of salmonid prey competition.
Northern pikeminnow *Ptychocheilus oregonensis*	None	Native	Major fish predator that occupies salmonid fish habitat. Former common name was northern squawfish.

Exhibit 3-4. Prevalent Lake Washington Watershed Fish Species and their Ecological Roles

Species Scientific Name	Federal and State Status [a]	Origin	Ecological Role
Peamouth chub *Mylochelius caurinus*	None	Native	Large numbers. Some occupy shallow benthic habitat; consume some of same prey as young salmonids.
Threespine stickleback *Gasterosteus aculeatus*	None	Native	Numerous, substrate-oriented, often near aquatic vegetation, provide prey for larger fish.
Pelagic sculpin *Cottus aleuticus*	None	Native	Pelagic in open-water areas. Some overlap in prey with young salmonids. Sculpin represent 72 percent of Lake Washington biomass.
Prickly sculpin *Cottus asper*	None	Native	Benthic habitat from shorelines to deep water. Preys and competes with young salmonids. Sculpin represent 72 percent of Lake Washington biomass.
Yellow perch *Perca flavescens*	None	Nonnative	Prey overlap with young salmonids. Abundant but substantially fewer than peamouth chub.

[a] FCo=Federal Species of Concern, FT=Federally Threatened, SC=State Candidate Species, ESU=evolutionarily significant unit.

[b] Anadromous form is listed as threatened although some introgression between this and resident stocks likely occurs.

[c] Introduced stock; it is uncertain whether there was originally a native stock inhabiting this watershed.

[d] Pelagic species typically occur in open water habitat, off of the lake bottom.

Salmonids in the Lake Washington watershed are a mix of native and nonnative species, and sometimes a single species can include both native and nonnative stocks. For example, recent evidence for sockeye indicates that the Cedar River and Issaquah Creek spawners are likely descendents of introduced fish (Baker Lake stock), while those spawning in Bear Creek may be native fish (Hendry et al. 1996). All sockeye salmon tend to have similar life history patterns in the Lake Washington watershed, but the adult sockeye returning to spawn in the Cedar River tend to be larger and older than the Bear Creek spawners (Hendry and Quinn 1997). Juvenile sockeye salmon commonly rear in the open-water habitat of the lake for a year before migrating to saltwater, including the area along the floating portion of the Evergreen Point Bridge.

Chinook salmon naturally reproduce in many of the larger streams in the watershed and are supplemented by hatchery production of fish originally from the Green River (Weitkamp and Ruggerone 2000). Steelhead and rainbow trout are a mix of introduced hatchery and native stocks. Cutthroat trout are assumed to be a native coastal cutthroat stock. Several other introduced species also occur in Lake Washington, such as black crappie, carp, smallmouth and largemouth bass, goldfish, and yellow perch.

Lake Washington and the Ship Canal provide the migratory corridor and juvenile-rearing area for anadromous salmonids produced in the Lake Washington watershed. The connection of the Ship Canal with Lake Washington, via the Montlake Cut, allows fish to generally move freely between the two areas. Anadromous salmonids migrate through Lake Union and the Ship Canal on their way to Puget Sound as juveniles and again on their return spawning migration as adults. Juvenile salmonids migrating and rearing in the project vicinity primarily include subyearling (less than 1 year old) Chinook and chum salmon; yearling (greater than 1 year old) sockeye, Chinook, and coho salmon; and steelhead. Adults of each anadromous salmonid species migrate through the Ship Canal to Lake Washington tributaries as they return from Puget Sound. Young and adult bull trout and cutthroat trout most likely also migrate in both directions through the Ship Canal.

Based on Washington State Department of Fish and Wildlife (WDFW) map records (K. Buchanan, Fish Biologist, WDFW, Olympia, Washington. July 26, 2004. Personal communication), the Lake Washington shoreline, including the existing and proposed east end of the Evergreen Point Bridge, has been identified in the past as a place where sockeye salmon spawn. However, no recent surveys have been conducted to determine if spawning sockeye salmon currently use this location (see Exhibit 3-5). This sockeye spawning beach is one of more than 85 shoreline spawning beaches and is less than 1 percent of the beach spawning habitat previously identified in Lake Washington on maps provided by WDFW (K. Buchanan, Fish Biologist, WDFW, Olympia, Washington. July 26, 2004. Personal communication).

Exhibit 3-5. Identified Sockeye Salmon Spawning Beach

Estimated annual escapement of Lake Washington beach spawning sockeye varied from 54 to 1,032 fish from 1976 through 1991 (WDFW 2004). These sockeye spawn wherever suitable gravel beaches and groundwater upwelling occur around the lake, particularly along the north shore of Mercer Island and the east shore of Lake Washington. These spawning areas occur over a wide range of water depths. The estimated total beach spawning population ranged between 200 and 1,500 fish between 1986 and 2003 (WDFW 2004).

The deeper open water areas of Lake Washington provide habitat for salmonid species. For example, juvenile sockeye spend over 1 year in the lake, and inhabit deep water areas, particularly during summer stratification (due to avoidance of high temperatures on the lake's surface). In addition, larger Chinook fry and fingerlings tend to move into deeper waters in late spring/early summer to feed and rear.

However, the juvenile Chinook tend to remain relatively near Lake Washington's shores within the surface layer of the lake as they migrate to the Ship Canal (Celedonia et al. 2008a, 2008b). Steelhead migrate as relatively large smolts, moving quickly through Lake Washington and the Ship Canal during the late spring. Because steelhead commonly undergo active rather than rearing migrations, it is likely the Cedar River steelhead pass the SR 520 site within a month of their movement out of the lower Cedar River, likely between late April and early June. Little is currently known about the habitat use of coho salmon in Lake Washington, although coho salmon are mainly found near the shorelines and likely undergo a relatively rapid migration similar to steelhead.

Lake Washington tributaries provide spawning and rearing habitat for anadromous Chinook, coho, and sockeye salmon, as well as steelhead trout. Cutthroat trout are also present in many of the tributaries and the lake. Rainbow trout (resident form of steelhead) were commonly planted in Lake Washington in the past and are still present in the lake.

Several observers have reported sightings of individual bull trout in the watershed, but there is no evidence of a substantial population or of reproduction occurring within Lake Washington or its tributaries. There is a substantial reproducing population of bull trout in the Chester Morse Reservoir within the upper Cedar River watershed and the major tributaries of the Cedar River. Some bull trout observed in the Ship Canal and Lake Washington may have originally come from this upper Cedar River population and moved downstream, becoming isolated from their original population. Bull trout produced in other watersheds may occasionally migrate into the Ship Canal and Lake Washington or prey on juvenile salmon downstream from the Ballard Locks.

USFWS has identified the Lake Washington watershed as critical foraging, migration, and overwintering habitat for bull trout, including the lower Cedar River, the Sammamish River, Lake Sammamish, Lake Union, the Ship Canal, and all accessible tributaries and lakes.

Fish species in the Ship Canal are the same as those in Lake Washington with the following exception: because no deep-water habitat is present, the species that require this habitat type are not likely to occur in the Ship Canal. In addition, the shoreline and shallow-water areas of Portage Bay and Union Bay provide habitat primarily for those species that prefer shallow-water habitats with abundant aquatic vegetation.

Many introduced species such as carp, smallmouth bass, and yellow perch use the shallow areas within this highly altered habitat.

Based on sampling conducted in Grays Harbor, more than 50 fish species inhabit the harbor, including resident and anadromous species. Six species of salmonids spawn in the rivers and streams flowing into Grays Harbor on a seasonal basis, including Chinook, chum, and coho salmon; steelhead; coastal cutthroat trout; and native char. Salmonids within WRIAs 22 and 23 are a mix of native and introduced stocks.

Critical food (that is, forage) fish for salmonids occupy areas within Grays Harbor. Simenstad and Eggers (1981) found that seven species of forage fish occur in Grays Harbor: Pacific herring (*Clupea harengus pallasi*), Pacific sand lance (*Ammodytes hexapterus*), northern anchovy (*Engraulis mordax*), surf smelt (*Hypomesus pretiosus*), longfin smelt (*Spirinchus thaleichthys*), whitebait smelt (*Allosmerus elongatus*), and American shad (*Alosa sapidissima*). Simenstad and Eggers (1981) found forage fish in Grays Harbor to be highly transitory and typically related to influxes of fish into the estuary from offshore sources. The residence time of forage fish appeared to depend on physical processes (for example, the interaction of ocean currents with the harbor).

Spawning beds for two forage fish species, Pacific herring and Pacific sand lance, have been identified within Grays Harbor, although no spawning of these species is known to occur near the potential construction sites for the supplemental stability pontoons (WSCC 2001, WDFW 2008). The closest Pacific herring spawning area occurs at locations within the south bay of outer Grays Harbor and at the southeast end of Ocean Shores, over 10 miles away from the pontoon construction sites (WDFW 2008). Larval northern anchovy are found in deeper waters of Grays Harbor and serve as food for Chinook and chum salmon (Simenstad and Eggers 1981).

Do any federally listed fish species or federal fish species of concern occur in the project vicinity?

Lake Washington supports one or more life stages of Chinook salmon, steelhead, and bull trout, which are currently listed as threatened under the ESA (NOAA Fisheries 2009, USFWS 2009). Lake Washington Chinook salmon are a part of the Puget Sound evolutionarily significant unit (ESU) (NOAA Fisheries 1998, 1999). Lake Washington has two native Chinook salmon populations (North Lake Washington and Cedar River populations) and a nonnative

An **evolutionarily significant unit**, or **ESU**, of a fish species is the term used by NOAA Fisheries for the population protected by a listing under the ESA.

Issaquah Hatchery stock (NMFS 2008). The general trend in the abundance for the North Lake Washington stock has remained generally consistent, with escapements (number of adults that return to the spawning grounds) between 200 and 500 adults, and is considered healthy (WDFW 2004). The Cedar River Chinook salmon have shown a long-term negative trend in escapements and chronically low escapement values, which is considered depressed (WDFW 2004).

What is the Endangered Species Act?

The ESA is an act of Congress passed in 1973 that governs how animal and plant species whose populations are dangerously in decline or close to extinction will be protected and recovered.

NOAA Fisheries also designated critical habitat for the Puget Sound ESU of Chinook salmon (NOAA Fisheries 2005). This critical habitat includes Lake Washington, as well as the Ship Canal and Lake Union between the Ballard Locks and Lake Washington. The designation identified Lake Washington as high-conservation-value habitat due to its connectivity with the high-value Cedar River watershed and its support of rearing and migration habitat for fish from all four watersheds in the subbasin.

Lake Washington steelhead are part of the Puget Sound distinct population segment (DPS), also listed by National Marine Fisheries Service (NMFS) as threatened (NMFS 2007). The listing indicated that Lake Washington steelhead include spawning populations in the Cedar River, Issaquah Creek, and Bear Creek, with the Cedar River contributing the majority of the escapement. While the Lake Washington population also appears to include a substantial number of rainbow trout, the resident form of steelhead, there is insufficient information to evaluate whether, under what circumstances, and to what extent the resident form may contribute to the viability of steelhead over the long term (NOAA Fisheries 2007). The Lake Washington steelhead population shows a declining trend, with about 308 natural spawners between 1980 and 2004, and about 37 between 2000 and 2004 (NMFS 2008). Critical habitat has not yet been designated for Puget Sound steelhead.

USFWS listed the Coastal-Puget Sound DPS of bull trout as federal threatened, which includes the population in the Lake Washington watershed (USFWS 1999). Distribution of bull trout in the Lake Washington watershed is uncertain, but individuals occasionally have been observed in recent years at the Ballard Locks and at several other locations in the watershed. Observations of about 20 subadult or adult bull trout have occurred in Lake Washington, Lake Union, the Ship Canal, and the Ballard Locks since 1975 (Emile Teachout, Staff Biologist, USFWS, Olympia, Washington. February 6, 2009. Personal communication).

USFWS also designated bull trout critical habitat in Lake Washington, in the Ship Canal, and Lake Union (USFWS 2005). These areas provide foraging, migratory, and overwintering habitat for bull trout outside of currently delineated core areas in the Puget Sound Recovery Unit. No bull trout critical habitat is designated in any Lake Washington tributaries. The Puget Sound/Strait of Georgia population of coho salmon is listed as a species of concern by NOAA Fisheries (2004).

In addition to the listed salmonids in the Lake Washington watershed, several ESA-listed fish occur in the Grays Harbor area, the potential construction site of the supplemental stability pontoons for the 6-Lane Alternative options and suboptions. These species include bull trout (native char) and green sturgeon (*Acipenser medirostris*). Jeanes et al. (2003) indicate a total of 15 documented native char in the Grays Harbor area from 1966 to 2000. While bull trout use the Grays Harbor estuary, no char spawning has been documented within the basin (WSCC 2001). The low gradients in the Chehalis drainage are not considered to be ideal habitat for bull trout.

Two distinct population segments of green sturgeon occur along the West Coast. The Southern DPS is federally listed as a threatened species, while the Northern DPS is a federal species of concern. Green sturgeon have a complex anadromous life history and spend more time in the ocean than any other sturgeon. While no green sturgeon spawn in the Grays Harbor system, sturgeon from southern rivers (such as the Klamath, Sacramento and Rogue rivers) concentrate in coastal estuaries during the late summer and early fall (Moyle et al. 1992). Grays Harbor is the northernmost estuary with concentrations of green sturgeon peaking in August, when tribal and commercial fisheries land around 500 fish per year. In Grays Harbor commercial and sport fisheries, green sturgeon harvest is by catch (fish and other animals caught in fishing gear meant for other species) (Adams et al. 2002).

Neither feeding nor spawning occurs in association with these concentrations (Beamesderfer and Webb 2002), and there are no records of juveniles from Grays Harbor (Adams et al. 2002). Only general information is known about green sturgeon feeding. The stomach contents of captured green sturgeon include shrimp, mollusks, amphipods, and some small fish (Houston 1988, Moyle et al. 1992).

Do any state-listed or other state priority fish species occur in the project vicinity?

Priority fish species include all state endangered, threatened, sensitive, and candidate species, as well as species of recreational, commercial, or tribal importance that are considered vulnerable. All fish species with state candidate status that occur in the project vicinity also hold a federal designation and have been discussed earlier in this section. No state sensitive, threatened, or endangered fish species occur within the project vicinity. Other fish species that are designated as priority species (WDFW 2009) may occur within the project vicinity. These are chum, sockeye, and kokanee salmon, steelhead and rainbow trout, and coastal cutthroat trout.

What are the general habitat characteristics of study area streams?

Immediately east of Lake Washington, the I-5 to Medina Project corridor crosses Fairweather and Cozy Cove creeks. Within the project corridor, Fairweather Creek and an unnamed tributary to Fairweather Bay flow through the cities of Hunts Point and Medina, and Cozy Cove Creek flows through the cities of Hunts Point and Clyde Hill. With the exception of Arboretum Creek, which terminates in the Union Bay area, no other streams were identified within the project vicinity during reconnaissance surveys in September 2007.

Human activity in the Lake Washington watershed affects fish habitat in a variety of ways. Land clearing removes shade and large streamside trees that once fell periodically into a stream. Construction adjacent to streams can cause erosion, which in turn fills the water with sediment that can clog spawning gravel. Many of these effects can be controlled by appropriate project design and the application of appropriate BMPs. Culverts can block fish passage and alter water flow. Removing creek meanders (straightening stream channels) and filling wetlands eliminate feeding areas and the slow-water habitats important for sheltering young coho and other salmonids from the high winter stream flows.

In the study area, salmonid species (salmon and trout) are sensitive to in-stream habitat conditions. Salmonids depend on healthy in-stream habitats for food, water volume, cover, water quality, and fish passage. The condition of these variables in the project corridor streams is,

however, generally marginally supportive of salmonids. Exhibit 3-6 summarizes the features of streams that cross the project corridor.

Exhibit 3-6. Features of Streams that Cross the Project Corridor

Stream	Total Stream Length (miles)	Jurisdiction	Local Jurisdiction Stream Type	Local Jurisdiction Stream Buffer (feet)[a]
Arboretum Creek	0.8	Seattle	N	100
Unnamed Tributary to Fairweather Bay	0.2	Hunts Point	None [b]	0
		Medina	Type F	100 (standard) 50 (minimum with mitigation)
Fairweather Creek	1.4	Hunts Point	None [b]	0 (50)
		Medina	Type F	100 (standard) 50 (minimum with mitigation)
Cozy Cove Creek	0.4	Hunts Point	None [b]	0
		Clyde Hill	None [b]	0

[a] Buffer widths were determined from City Codes, as follows: Seattle, 25.09.030, Medina, Chapter 18.12.090; Hunts Point, Chapter 16.15; and Clyde Hill, Chapter 18.04.300.

[b] No streams within Hunts Point or Clyde Hill are covered under a Sensitive Areas Ordinance.

[c] Because City Code does not stipulate a buffer for these streams, a buffer of 50 feet was assigned to evaluate the project's effects on the riparian buffers.

The presence of fish species in these streams is based on historical information and a limited amount of more recent fish sampling within study area streams. No rigorous sampling efforts were conducted; therefore, the list of species is based solely on available fish presence data and limited observations of the in-stream habitat.

Arboretum Creek

Arboretum Creek (also known as Washington Park Creek) is a small stream that originates in the vicinity of the Seattle Japanese Garden in the Washington Park Arboretum, south of the study area. The creek flows about 0.8 mile north to Willow Bay, a minor arm of Union Bay. Upstream of the mouth, the stream flows under Lake Washington Boulevard East and through a narrow, uniform channel, immediately parallel to Lake Washington Boulevard East. Reed canarygrass and other herbaceous species dominate the riparian vegetation of the creek. Two inline culverts, about 400 feet long, connected at a manhole,

Arboretum Creek

convey the stream under Lake Washington Boulevard East and an Arboretum parking lot. The culvert outlet is perched about 2.5 feet above the downstream water level, precluding upstream fish passage. Although Seattle Public Utilities has identified the removal of this fish barrier as a high priority project, enhancement of upstream habitat would also be required to provide adequate fish habitat for salmonids. Downstream of the roadway, the channel widens as it flows several hundred feet northeast toward the open water of Willow Bay.

Unnamed Tributary to Fairweather Bay

The Unnamed Tributary to Fairweather Bay is a short (0.2-mile-long) stream that drains Fairweather Park, on the north side of SR 520, and also provides some drainage from the SR 520 roadway and some area south of the highway (Exhibit 3-7). The stream, which discharges into the east shoreline of Fairweather Bay via a discharge pipe under 80th Avenue NE, originates at the outlet of two corrugated metal culverts that discharge into a catch basin on the north side of SR 520. These culverts receive stormwater from paved areas within and south of the SR 520 right-of-way. The stream is perennial, which likely indicates groundwater input into the upstream pipe system, as no open channel conveyance was observed above the catch basin. The watershed is moderately developed upstream of SR 520, while the majority of open channel is located in an undeveloped area, with some residential development at the stream mouth.

Exhibit 3-7. Location of Fairweather Creek

The most upstream reach of the stream, from the catch basin outlet downstream to about 20 feet at the right-of-way fence, is entirely lined with quarry spalls. At the fence line, the stream channel enters a forested setting and begins forming an incised channel. The upper reaches of the channel do not have a well defined bed and bank, with flow (primarily stormwater driven) scouring over tree roots and other vegetation. Evidence of occasional high volume flows is present, with major stream incision occurring in the middle reaches of the stream. The channel incision reaches a depth of 4 to 10 feet, with bank top widths of about 10 to 20 feet. Several foot bridges cross over the stream at various locations. The bridges have been widened recently to accommodate stream incision and widening.

The stream enters a culvert and stormwater conveyance system just west of 80th Avenue NE. The area surrounding the culvert inlet has

been armored by gabion baskets on all sides, forming an artificial pool structure with an overflow sill on the south side. An overflow channel routes high flows to a secondary culvert located to the south. Both the primary culvert and overflow culvert appear to connect to a stormwater discharge system, which ultimately flows east to Lake Washington at one or more discharge points. Based on the size of the outlet culverts and the presence of inline vaults, fish passage from Lake Washington to the stream is unlikely.

Numerous large tree roots, ample woody debris, and timber grade control structures form a predominance of a step-pool morphology, with few riffles. Gravels and silt predominate, with a relatively high degree of embedded fine sediment.

The riparian area is predominantly intact, supporting primarily native species. Canopy dominants include red alder and bigleaf maple, with scattered western red-cedar and cottonwood. The understory is diverse and is comprised of Indian plum, salmonberry, snowberry, western hazelnut, ninebark, red-osier dogwood, and sword fern. Invasive species were limited, with only occasional presence of Himalayan blackberry.

Upstream (south) of SR 520, the watershed habitat quality is poor. Riparian vegetation consists of grass and a few shrubs, with almost no tree cover except for a few scattered red alders. Invasive species such as English ivy, nightshade, and Himalayan blackberry make up more than half of the existing riparian vegetation.

The stream is not listed for exceedances on the Ecology 303(d) list (Ecology 2009). The fish resources of the stream have not been inventoried, and no fish were observed during field reconnaissance efforts. Downstream barriers, high stream flows, likely limit the use of this stream by anadromous salmonids.

Fairweather Creek

Fairweather Creek (WRIA 08-0257), also referred to as Medina Creek, is a small stream (1.4 miles long) that drains approximately 600 acres from Medina north into Fairweather Bay and Lake Washington (Exhibit 3-7). The watershed is moderately developed, primarily with residential uses, and the SR 520 corridor occurs in the lower reaches of the stream.

Immediately upstream (south) of SR 520, the stream habitat quality is poor. Riparian vegetation consists of grass and a few shrubs, with

almost no tree cover except for a few scattered red alders. Invasive species such as English ivy, nightshade, and Himalayan blackberry make up more than half of the existing riparian vegetation. Further upstream, the stream is generally channelized.

After Fairweather Creek crosses the SR 520 corridor (approximately 0.5 mile east of the Lake Washington shoreline), it flows approximately 400 feet north before discharging into Fairweather Bay. This reach flows through single-family residential neighborhoods, with landscaped lawns immediately adjacent to the stream. Here, the stream is extremely channelized and characterized by riprapped banks 4 to 5 feet high. A few pools are present in the reach downstream from SR 520, but they are small and of poor quality. The dominant stream substrate is large gravel, with a relatively high degree of embedded fine sediments.

Located just downstream of SR 520, Cozy Cove Creek is an example of a stream affected by residential development. The stream is channelized and contained within riprapped banks. The riparian vegetation consists exclusively of grass and landscaping as the stream flows through residential yards.

Fairweather Creek is on the Ecology 303(d) list for exceeding state water quality standards for dissolved oxygen, temperature, and fecal coliform bacteria (Ecology 2009). Fairweather Creek is monitored as part of the King County Stream and River Monitoring Program, which reports a Water Quality Index of 10 for the stream for 2007. This unit-less index scale ranges from 10 to 100, with higher numbers representing higher water quality. Index values lower than 40 represent streams with a high concern for water quality conditions (King County 2009).

The fish resources of Fairweather Creek have not been extensively inventoried, although Kerwin (2001) and Williams et al. (1975) indicate that coho salmon use the stream for rearing. Three coho salmon and eleven cutthroat trout, all juveniles, were present downstream from SR 520 in a 2001 stream survey (Anderson and Ray et al. 2001). Stickleback and sculpin were also present.

In 2002, a salmon incubator was installed behind a residence on Medina Circle, upstream of SR 520, funded by the City of Medina. The City has continued to fund this project each year up through at least 2008, resulting in approximately 10,000 coho salmon released onsite each year. Anecdotal reports indicate that adult coho salmon have returned to the stream, although none have been reported upstream of SR 520 (WSDOT 2008c). However, there are no known recent reports of salmonids present upstream of SR 520, likely because of an abandoned

road and two in-line culverts under SR 520. These culverts have both been identified as fish passage barriers (WSDOT 2008c). During storms, these culverts have peak velocities of over 13 cubic feet per second (over six times greater than recommended velocities for salmonids), thus creating velocity barriers that can flush fish downstream.

High stream flows, overall pollutant levels, and high summer temperatures likely limit the use of this stream by anadromous salmonids. The stream size (average channel width less than 6 feet) likely eliminates Chinook salmon or steelhead spawn, although the size appears adequate to support coho salmon and cutthroat trout spawning. It is unlikely that any salmon extensively spawn or rear in the surveyed reach because of the low diversity of habitat types, poor riparian and stream cover conditions, and degraded substrate conditions. Juveniles migrating along Lake Washington shorelines may, however, use the mouth of the stream for short-term rearing, although the quality of habitat is substantially degraded from natural conditions.

Cozy Cove Creek

Cozy Cove Creek is a small (approximately 0.5-mile-long and typically less than 6-feet-wide) stream that drains from Medina north into Cozy Cove (see Exhibit 3-8). After crossing the SR 520 corridor, the stream flows approximately 1,000 feet north, through an emergent and scrub-shrub wetland at the mouth, before discharging to the cove. This stream reach flows through single-family residential neighborhoods with landscaped lawns immediately adjacent to the stream.

Exhibit 3-8. Location of Cozy Cove Creek

Between the mouth and SR 520, the stream is extensively channelized, with most of the bank length armored by riprap. Grass and a few shrubs dominate the narrow riparian vegetation zone. Upstream (south) of SR 520, the stream flows through a landscaped trail system located between several residences. This reach includes several footbridges and weir-formed pools constructed of artificial logs. The riparian zone is wider, with vegetation consisting of grass, shrubs, and some mixed trees.

Large gravel is the dominant stream substrate, and there is a moderate degree of substrate embeddedness. The amount of surface fines varies from 7 to 9 percent. Approximately 540 feet upstream of SR 520, the

culvert under NE 28th Street is a total barrier to fish passage because its outlet is perched 4.5 feet above the channel.

The fish resources of Cozy Cove Creek have not been inventoried, but juvenile cutthroat trout were observed in the stream at the time of the habitat surveys in May 2002. The small stream size and limited accessible length (less than 1,400 feet) make it an unlikely salmon spawning stream. However, juvenile salmon migrating along Lake Washington shorelines may use the lower reaches of the stream or the wetland at the mouth for short-term rearing, although the quality of habitat is substantially degraded from natural conditions.

How can shade and in-water and overwater structures affect fish resources?

Predation
- Attracting predators
- Concentrating prey

Behavior
- Avoiding shaded areas
- Delaying or altering migration

Habitat Alteration
- Decreasing productivity

Potential Effects of the Project

The potential effects of the project on fish and aquatic habitat resources are presented for the No Build Alternative and the proposed 6-Lane Alternative, by option and suboption.

What methods were used to evaluate the potential effects on fish resources?

Ecosystems biologists analyzed the potential effects of the I-5 to Medina Project on fish resources by reviewing existing information on the fish resources of Lake Washington, Portage and Union Bays, and tributary streams within the study area. Project biologists, along with resource agency representatives, made visual inspections of the habitat conditions in these areas, particularly the nearshore habitat areas. The biologists also reviewed project design data and proposed WSDOT construction practices to identify changes to fish habitat likely to occur during and following construction of each project alternative. GIS was used to analyze the effects of the proposed project by overlaying overwater and in-water structures of the 6-Lane Alternative onto the wetted perimeter of area water bodies to determine the extent and location of construction and operational effects.

The potential effects on fish resources are based primarily on the changes in aquatic habitat resulting from the construction and long-term presence of overwater and in-water structures as a result of the project. However, portions of the aquatic habitat are also classified as open-water wetlands, and the potential effects of the project on these areas are discussed in detail in the wetlands section. Therefore, there is

overlap between the open-water habitat presented in this section and open-water (aquatic) wetlands affected by the project.

How would construction of the project affect fish and aquatic habitat?

No Build Alternative

There would be no construction effects on fish and aquatic habitat under the No Build Alternative.

6-Lane Alternative

The proposed project would build new structures and/or maintain existing structures within the shoreline and open-water habitats that support various fish species throughout much of the Seattle study area and Lake Washington.

Construction effects are effects that would occur while the new bridge, roadways, ancillary facilities, and any mitigation features are being built.

The options and suboptions of the 6-Lane Alternative have the potential to affect fish and aquatic habitat in Portage Bay, the Montlake Cut, Union Bay, Lake Washington, and tributary streams of Lake Washington. The primary differences between the options occur in the Seattle study area, which extends from the I-5 interchange to the floating portion of the Evergreen Point Bridge.

Seattle

To safely construct any of the proposed design options or their suboptions, WSDOT would build construction work bridges along both sides of the existing bridge structures, except where construction activities could be conducted from barges or existing roadways. The construction work bridges would expand the overwater structures outside of the footprint of the proposed bridge—typically at least 30 feet on either side of the alignment. In addition, a detour bridge would be constructed in the Washington Park Arboretum to allow simultaneous vehicular traffic and construction activity in the project corridor under Option K.

These construction work bridges would result in shading of open water habitat and loss of lake bottom substrate for the duration of construction. Areas under the centre of the bridge would likely not provide optimal conditions for aquatic plant growth (because of light limitations), but areas near the edges of the bridge would probably support aquatic vegetation.

In-water shading could directly or indirect affect fish movement and distribution, including native salmonids, by reducing the growth of aquatic vegetation in shallower areas. In the West Approach area, the shadow of the bridge may delay, but not prohibit, outmigration of juvenile salmonids (Celedonia et al. 2008a). However, past studies in Lake Washington have indicated that the influence of in-water shading on fish behavior is complex and it varies by width and height of the structures, species, time of year, and other factors.

The intensity of the shade would vary based on the height of the overwater structure above the water surface (see Exhibits 2-15 and 2-16). The relationship between structure height and width on shading is complex. See the Wetlands section of this document for more information on the effects of shade on vegetation.

Additional aquatic habitat shading would also occur from construction barges temporarily anchored in the deeper water areas. Using barges as staging and construction platforms would likely reduce the overall effects of bridge construction in this area, because (1) they do not require in-water pile driving, (2) would result in only limited disturbance of the substrate, and (3) would remain in any one place for a shorter time than the work bridges.

Option A

The options vary in the amount of in-water and overwater construction that would be required to build the permanent structures. Option A would result in 10.9 acres of overwater shading from construction work bridges during construction and 2,893 square feet of in-water effects from support piles (see Exhibits 3-9, 3-10, and 3-11). Option A would have less construction shading that Option K but slightly more than Option L. The effects for all options from support piles would be less than 0.1 acre.

Exhibit 3-9. Approximate Acres of Shading from Construction Work Bridges and the Detour Bridge[a], by Option and Suboption (acres)

Location	Portage Bay	Montlake	West Approach[b]	East Approach	Total
Option A	3.0	0	7.6	0.3	10.9
Option A and Suboptions	3.0	0	7.2	0.3	10.5
Option K	3.0	0	8.5	0.3	11.8
Option K and Suboptions	3.0	0	8.5	0.3	11.8
Option L	3.0	0	7.0	0.3	10.3
Option L and Suboptions	3.0	0	7.0	0.3	10.3

[a] Option K only.

[b] Acreages do not include overlap with the proposed permanently shaded bridge structure or existing structures.

Portage Bay

Under Option A, the existing 4-lane Portage Bay Bridge would be replaced with a bridge that would include three eastbound and three westbound lanes, along with a westbound auxiliary lane.

The proposed bridge support structures would have drilled shaft foundations, which would minimize potential effects on fish and other aquatic species by eliminating the need for impact pile driving to construct foundations for the columns. Installation of column shaft cap configurations would require cofferdams, while individual columns could be installed inside a larger-diameter sleeve. Forty-seven in-water columns are needed to support the Portage Bay Bridge, with 19 supported by individual drilled shafts and 28 supported by multiple shafts and shaft cap structures. These columns would replace the 76 columns currently supporting the Portage Bay Bridge. To accommodate four lanes of traffic for the duration of the project, construction must be sequentially staged by initially widening the existing bridge to the south. Temporary in-water footings and additional columns and superstructure would be placed in line with the existing bridge. Traffic would be diverted to the south portion to allow the north portion of the existing structure to be demolished and the new bridge to be constructed. Following construction of the north portion of the bridge, traffic would be shifted to the north portion of the

bridge to allow demolition of the existing and temporary south bridge lanes and construction of the southern columns and superstructure. Arch work would be completed last.

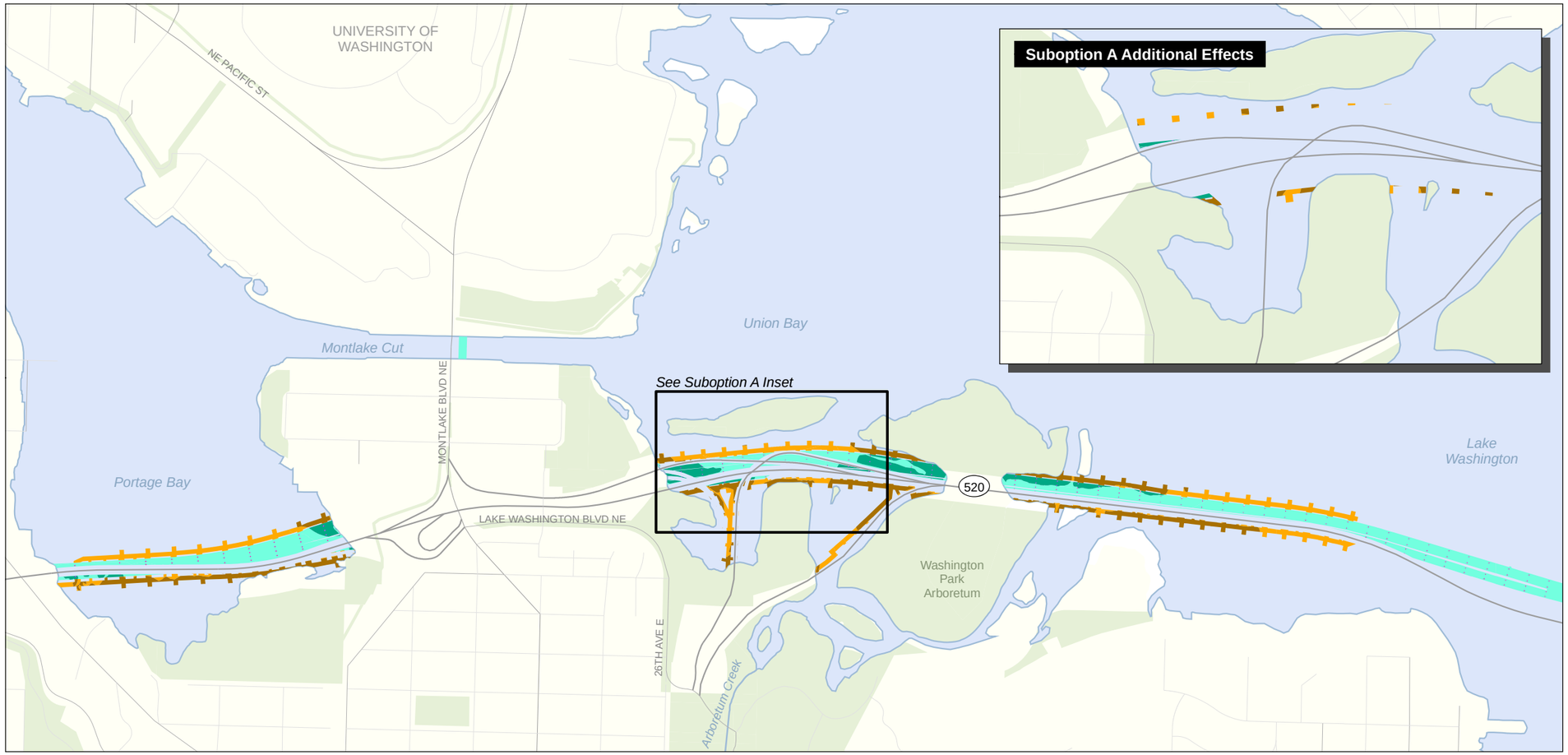
Construction work bridges would be constructed along both the south and north sides of the existing Portage Bay Bridge. The work bridges would be approximately 30 feet wide and approximately 10 to 15 feet above the high water elevation. Finger piers, perpendicular to the existing bridge, would also be constructed to allow access to the existing and proposed bridge columns from the work bridges.

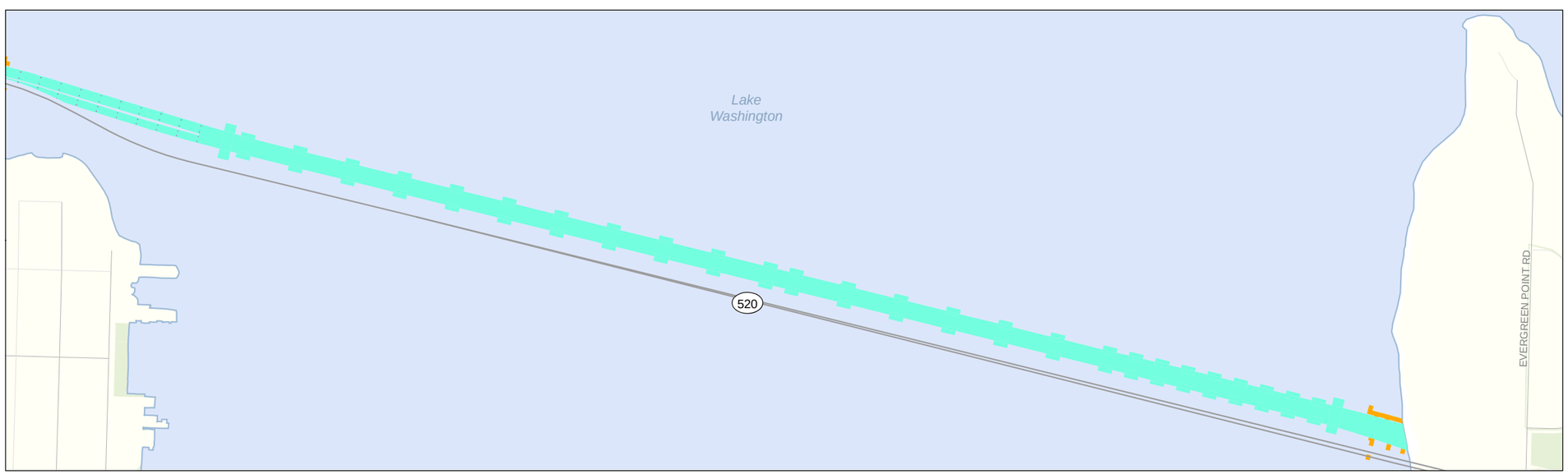
What is a pile bent?

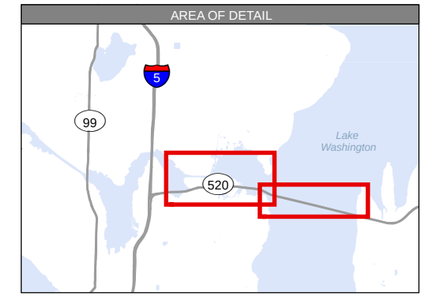
A bent is a row of piles that are fastened together. The row of piles together provides a framework for carrying lateral and vertical loads.

The work bridges constructed within Portage Bay would result in approximately 3.0 acres of overwater shading, which would reduce some of the natural functions of the affected aquatic habitat (Exhibits 3-9 and 3-10). The amount of shading from construction work bridges would be the same for all three options in Portage Bay. The construction work bridges would remain in place for more than 5 years in Portage Bay. Although these work bridges are relatively narrow (typically 30 feet), the combined shading effects of the existing bridge structure, the two work bridges, and the new highway bridge structures could result in shading an area up to approximately 350 feet wide. Much of the Portage Bay habitat in the construction area contains substantial nonnative aquatic vegetation beds, although native vegetation is also expected to grow in the area. The increased shading could reduce the distribution, density, and/or growth rate of aquatic vegetation in the shadow of these structures. These effects would cease once the construction work bridges are removed.

The construction of these work bridges would require installing approximately seven hundred and forty-one 24- to 30-inch hollow steel piles (Exhibit 3-11). The piles would be installed in bents (rows) spaced at approximately 30-foot intervals, with three to four piles per bent. These piles would occupy between 2,330 and 3,630 square feet of substrate area, depending on pile diameter. An additional 300 piles would be needed to support falsework for constructing the architectural treatment on the replacement bridge, occupying an additional 940 to 1,470 square feet of substrate area. All work bridge and finger pier structures would be removed after completion of the new Portage Bay Bridge.







Operational Open Water Effect

- Fill Effect
- Fill Effect - Aquatic Wetlands
- Shade Effect
- Shade Effect - Aquatic Wetlands

Construction Open Water Effect

- Shade Effect
- Shade Effect - Aquatic Wetlands
- Existing Roadway
- Stream
- Park

N

0 250 500 1,000 Feet

Source: King County (2005) GIS Data (Streams and Streets), King County (2007) GIS Data (Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 3-10. **Construction and Operational Effects of Option A and its Suboptions on Open Water**

I-5 to Medina: Bridge Replacement and HOV Project

Exhibit 3-11. Estimated Number of Support Piles and Associated Lake Bed Occupied for Construction Work Bridges[a] and the Detour Bridge[b], by Option and Suboption

Alternative	Portage Bay	West Approach	East Approach[a]	Total[a]
Option A	741 (2,330 sq/ft)	1,987 (6,240 sq/ft)	165 (520 sq/ft)	2,893 (9,090 sq/ft)
Option A and Suboptions	741 (2,330 sq/ft)	2,042 (6,410 sq/ft)	165 (520 sq/ft)	2,948 (9,260 sq/ft)
Option K	698 (2,190 sq/ft)	2,797 (8,790 sq/ft)	165 (520 sq/ft)	3,660 (11,500 sq/ft)
Option K and Suboptions	698 (2,190 sq/ft)	2,797 (8,790 sq/ft)	165 (520 sq/ft)	3,660 (11,500 sq/ft)
Option L	704 (2,210 sq/ft)	1,984 (6,230 sq/ft)	165 (520 sq/ft)	2,853 (8,960 sq/ft)
Option L and Suboptions	704 (2,210 sq/ft)	1,984 (6,230 sq/ft)	165 (520 sq/ft)	2,853 (8,960 sq/ft)

[a] Area calculations based on 24-inch piles.

[b] Option K only.

After completion of the replacement bridge structures in Portage Bay, the existing bridge would be removed. Most of this work would be conducted from the work bridges, although the existing bridge piers would be removed down to the mud line and would require additional in-water work. The pier removal process would occur inside of de-watered cofferdams to minimize potential effects on the aquatic environment. Appropriate BMPs would be implemented to minimize any spillage of concrete or other construction material into the bay.

Montlake Area

Construction activities in the Montlake area that could affect fish and aquatic habitat would be from building a second bascule bridge across the Montlake Cut. This second bridge would be approximately 60 feet wide, similar to the existing bridge. These activities would likely be limited to overwater work, and any in-water work (such as the placement of structures) would be from barges. Most of the construction activity to build the bridge supports would occur in upland areas, away from aquatic habitat areas, where the potential for effects would likely be substantially reduced. There would be no construction work bridges and as a result no shading from construction.

> What is a bascule bridge?
>
> A bascule bridge is a drawbridge with a counterweight that continuously balances the span (or "leaf") throughout its entire upward swing when opening to provide clearance for boat traffic.

After completing the upland pier supports, the bascule leaf structural steel members would either be assembled piece by piece onsite or the entire leaf would be assembled offsite, barged to the project, and erected with several derrick barges. A barge-mounted derrick would lift the bridge sections into position while they are attached to the support structures. These activities would likely require closing the Montlake Cut to all boat traffic periodically over a 3- to 4-week period, for a total of approximately 6 full (24-hour) days of complete closure. Although the Montlake Cut might be closed to over-height marine traffic throughout most of the 3- to 4-week construction period, the construction barges would likely only be located in the Montlake Cut during actual bridge assembly work. This would allow boats under approximately 46 feet high to pass under the new bridge structure when barge-assisted work was not occurring. Because of the depth and configuration of the Montlake Cut, the construction barges would likely have to be positioned and held in place by a tugboat. These activities would reduce the overall potential effects (from in-water noise or wave action) of boat traffic on fish migrations through the Montlake Cut, while the barge and tugboats are blocking the waterway.

Implementation of appropriate BMPs would prevent sediment from exposed soil areas or wet concrete from entering Montlake Cut, and overwater containment systems would prevent debris from falling into the water. No refueling of equipment would occur within 200 feet of the embankments. Other standard BMPs used for construction activities adjacent to water bodies would also be implemented to further reduce the potential for effects on aquatic habitats and species.

West Approach Area

The west approach to the Evergreen Point Bridge, occurring along the Union Bay shoreline, would be replaced and widened with a 6-lane bridge.

The proposed new bridge would be sequentially constructed because it would overlap with the location of the existing bridge in the west approach area. In-water construction would occur from construction work bridges where water depths would allow construction staging from barges. Potential effects associated with project construction activities in this geographic area would be similar to those described above for Portage Bay.

The work bridges would require pile driving an estimated 1,987 in-water support piles occupying between about 6,240 and

How do pile-driving sound waves travel in water?

Pile-driving sound waves radiate in all directions, but diminish in intensity (attenuate) as the wave spreads over a larger area. Waves are also attenuated or blocked by encountering obstructions such as shallow water or land masses. Therefore, potential effects to fish diminish with distance and their location relative to obstructions.

9,740 square feet of lake bed area, depending on pile-diameter size (see Exhibit 3-11). The associated pile-driving activities would result in elevated underwater sound levels that could affect aquatic species as the sound waves radiate in all directions from the pile-driving location. Pile driving in the waters south of Marsh Island would potentially only affect fish occurring in this relatively confined area because the underwater sound waves would be blocked by the surrounding land masses. In addition, the relatively dense aquatic vegetation occurring in this area likely limits the use of this habitat by fish, particularly salmonids.

Pile driving in waters east of Foster Island would produce a much larger area of potential effects because the sound waves would radiate into open-water areas with few obstructions. Radiating in all directions, the potential disturbance zone could extend to the east across Lake Washington and across Union Bay, except for areas where the sound waves would be blocked by a land mass.

A total of 7.6 acres of overwater habitat would be shaded by the construction work bridges in the west approach area (see Exhibits 3-9 and 3-10). These construction work bridges would be similar to those constructed in the other geographic areas and would shade the aquatic habitat for about 4.5 years.

Option A Suboptions

The primary differences between Option A and its suboptions occur in the west approach geographic area, and no substantial differences in potential effects on fish and aquatic resources are expected from construction related to the Option A suboptions.

Option K

As with the other options, Option K would include construction of work bridges, permanent in-water pier footings, overwater bridge structures, and removal of existing bridge structures. The construction work bridges would remain in place for approximately 5.5 years. However, Option K would also include a 60-foot-wide detour bridge between Foster Island and the east shoreline of the Washington Park Arboretum to bypass the SPUI construction. This detour bridge would be supported by hollow steel piles similar to those used in the construction of the work bridges, requiring approximately 230 piles. This overwater structure would be in place for approximately 4 years.

Single-point urban interchange (SPUI)

The term "single point" refers to the fact that all traffic passing through the interchange can be controlled from a single signal. This allows vehicles to clear the intersection much more quickly than in a diamond interchange, which requires two sets of traffic signals. In addition to moving traffic efficiently, a SPUI is useful in constrained urban areas because it can be designed to take up less space than other types of interchanges.

Option K would include substantially greater in-water and overwater work compared to the No Build Alternative and Option A or L. The primary differences in potential effects on fish and aquatic habitat in Option K include the number of pilings needed for in-water and nearshore work bridge and falsework, the number of permanent in-water piers constructed, and the amount of riparian and nearshore areas disturbed.

The construction of Option K would result in 11.8 acres of shading, which is more shading that the other options (see Exhibits 3-9 and 3-12). This option would include construction of twin tunnels under the Montlake Cut, instead of a second bascule bridge spanning the Montlake Cut. While the tunnels would result in less overwater and riparian construction at the Montlake Cut compared to Options A or K, the construction process would be substantially more complex and extensive. This would increase the potential for inadvertent effects on fish and aquatic resources in the Montlake and Union Bay areas should construction BMPs fail.

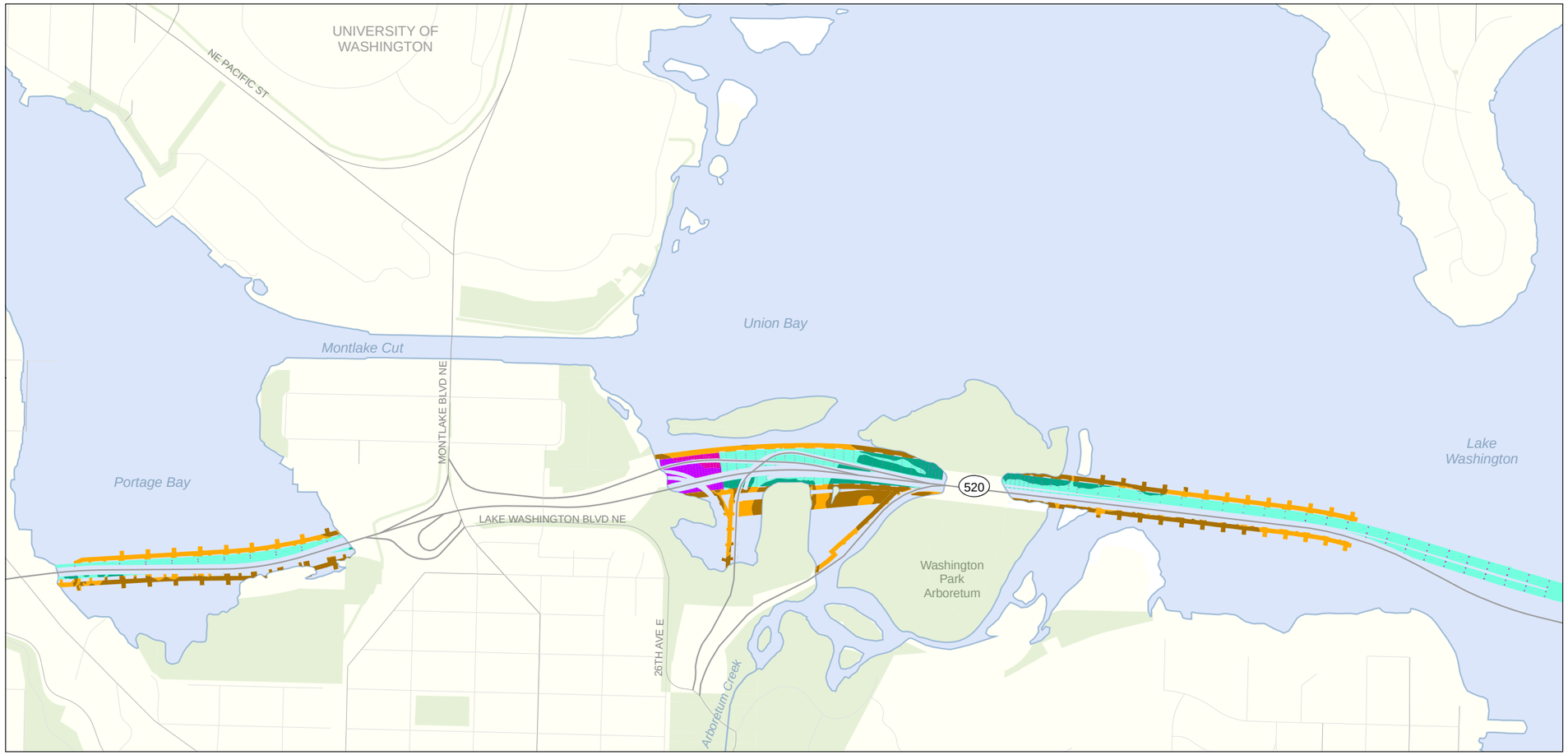
Portage Bay

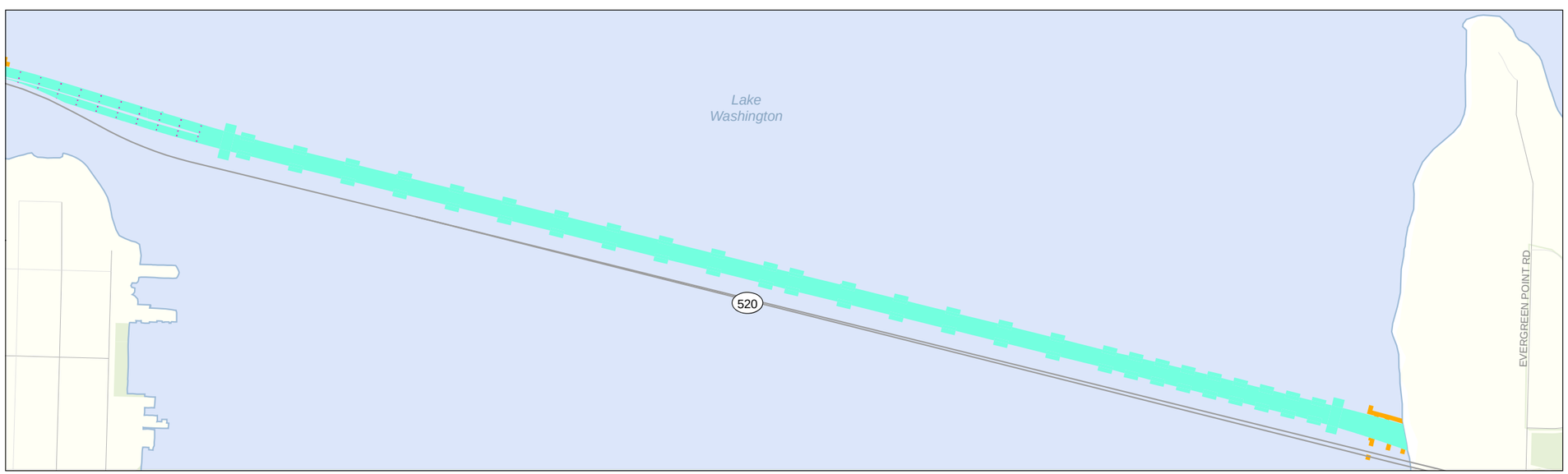
Construction activities in the Portage Bay area would be similar to those described for Option A, although the narrower bridge structure under Option K may require somewhat less construction. The amount of shading from construction work bridges in Portage Bay would be the same for all three options in Portage Bay, approximately 3.0 acres (Exhibits 3-9 and 3-12).

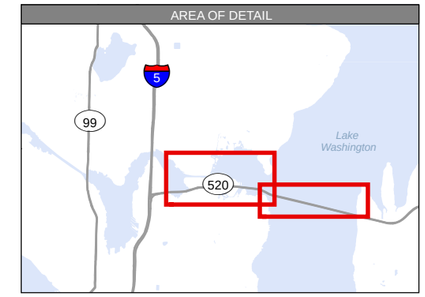
Montlake Area

The Montlake area would require considerably more in-water and overwater construction compared to Options A and L. The roadway through the Montlake area under Option K would be wider than Option A. This increased width is primarily to accommodate the depressed SPUI and the separate access ramps to and from the twin Montlake Cut tunnels. The SPUI would be constructed below the high water elevation of the lake.

The lower approach elevation in the Washington Park Arboretum would require approximately 328 5-foot-diameter, in-water, drilled shaft piles and approximately 2,160 micropiles in the transition zone to the SPUI to support the new roadway. These 10-inch-diameter micropiles would be supported by the drilled shaft structures.







Operational Open Water Effect

- Fill Effect
- Fill Effect - Aquatic Wetlands
- Shade Effect
- Shade Effect - Aquatic Wetlands

Construction Open Water Effect

- Shade Effect
- Shade Effect - Aquatic Wetlands
- Existing Roadway
- Stream
- Park

N

0 250 500 1,000 Feet

Source: King County (2005) GIS Data (Streams and Streets), King County (2007) GIS Data (Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 3-12. **Construction and Operational Effects of Option K on Open Water**

I-5 to Medina: Bridge Replacement and HOV Project

The in-water effects from piles and micropiles occur within the footprint of the SPUI and are not identified separately in Exhibit 3-11. It is assumed that the drilled shafts in the SPUI area would be installed within a large cofferdam encompassing the entire SPUI footprint.

The SPUI would also require extensive ground-disturbing excavation work along the Washington Park Arboretum shoreline, as well as the construction of retaining walls extending out into the water, which would also increase the potential risks of water quality effects from runoff from the extensive area of exposed soils; however, construction BMPs would minimize such risks.

West Approach Area

As in the Montlake area, construction activities in the west approach area would have a greater potential to directly and indirectly affect fish and aquatic habitat than the other options and suboptions. In addition to the substantial construction activity required in the shallow water and nearshore areas of this geographic area, Option K would result in substantial construction activity in the riparian and shoreline habitat of the Washington Park Arboretum and Lake Washington.

In the west approach area, 8.5 acres of overwater habitat would be shaded by the construction work bridges and the detour bridge, resulting in more shading than Options A or L (see Exhibits 3-9 and 3-12). The detour bridge and the work bridges would require approximately 2,800 piles, occupying approximately 8,790 to 12,590 square feet of lake bed, depending on pile-diameter size (see Exhibit 3-11). The pile driving associated with the overwater construction structures could affect fish in the area, although the shallow depths and confined area would likely limit the potential effect to fish in the area south of Marsh Island. Some of this pile-driving activity would also occur in upland areas, although there would still be a potential for the underground sound waves to resurface under the water (sound flanking) and produce sound levels that could affect aquatic species. However, these sound levels would likely be of a reduced intensity.

Option K would also include a lowered profile (lower than existing) across Foster Island with a land bridge over the top of the highway. This would require excavation of the east and west shorelines of the island, as well as extensive excavation across the island to place the roadway foundation below the existing grade. This would likely result in extensive disturbance of the riparian and upland plant communities.

Construction of Option K would clear some trees and shrubs along portions of the shoreline under the bridge structure, potentially exposing these areas to increased erosion. However, most of the area is protected from wave action by boats using the Montlake Cut, so the effects would be reduced. WSDOT would revegetate the affected areas after construction and stabilize any exposed shoreline areas to minimize adverse effects.

Option K Suboptions

The primary differences between Option K and its suboptions would occur in the Montlake and Portage Bay geographic areas. In the Portage Bay area, an eastbound off-ramp to Montlake Boulevard would be constructed. This would result in the installation of three additional in-water piles near the southeast shoreline of the bay. Compared to Option K, its suboptions would only slightly increase the effects to fish and aquatic habitat from construction.

Option L

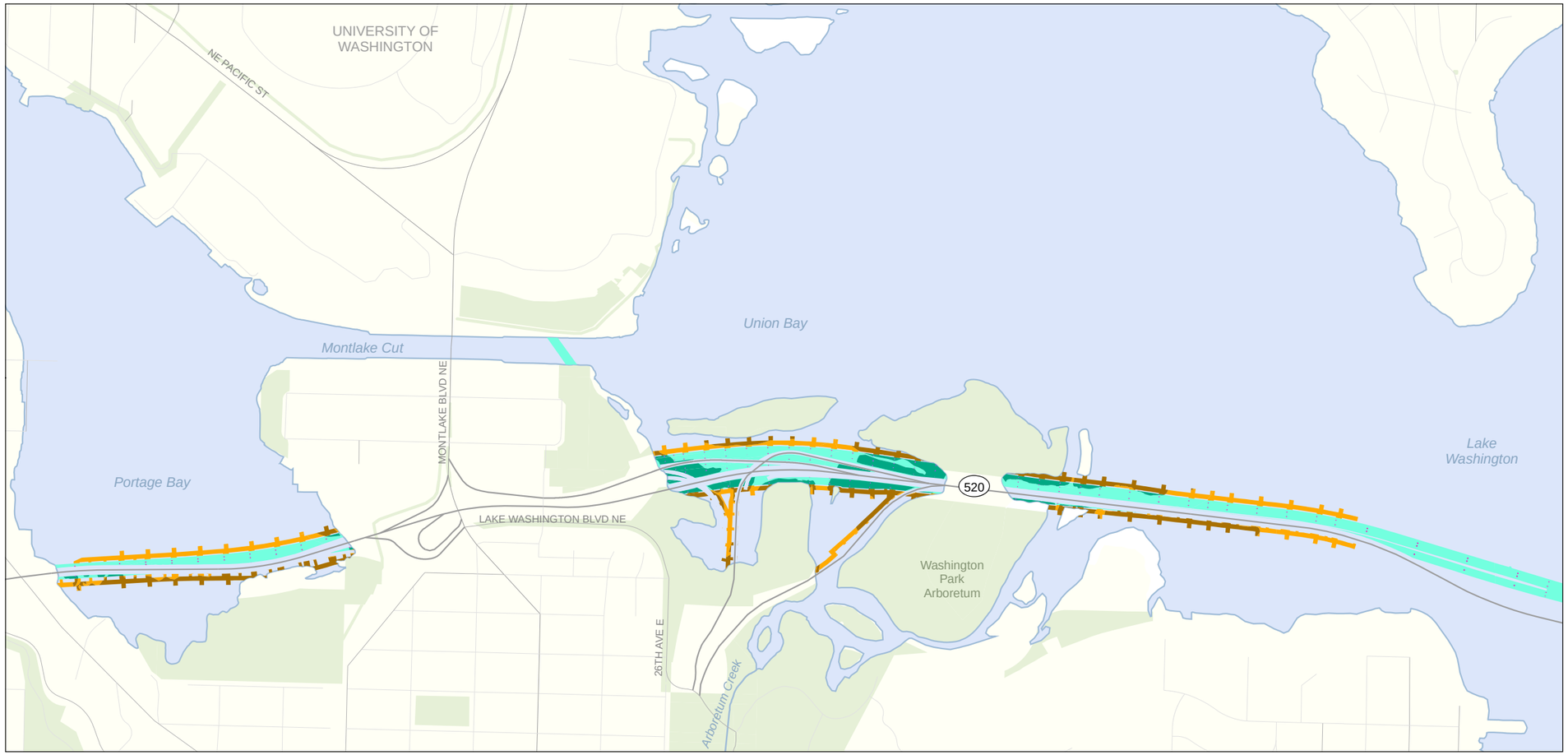
As with the other options, Option L would include the construction of work bridges, permanent in-water pier footings and columns, overwater bridge structures, and removal of existing bridge structures. In-water and overwater construction activities under Option L would be similar to those described for Option A (see Exhibit 3-13).

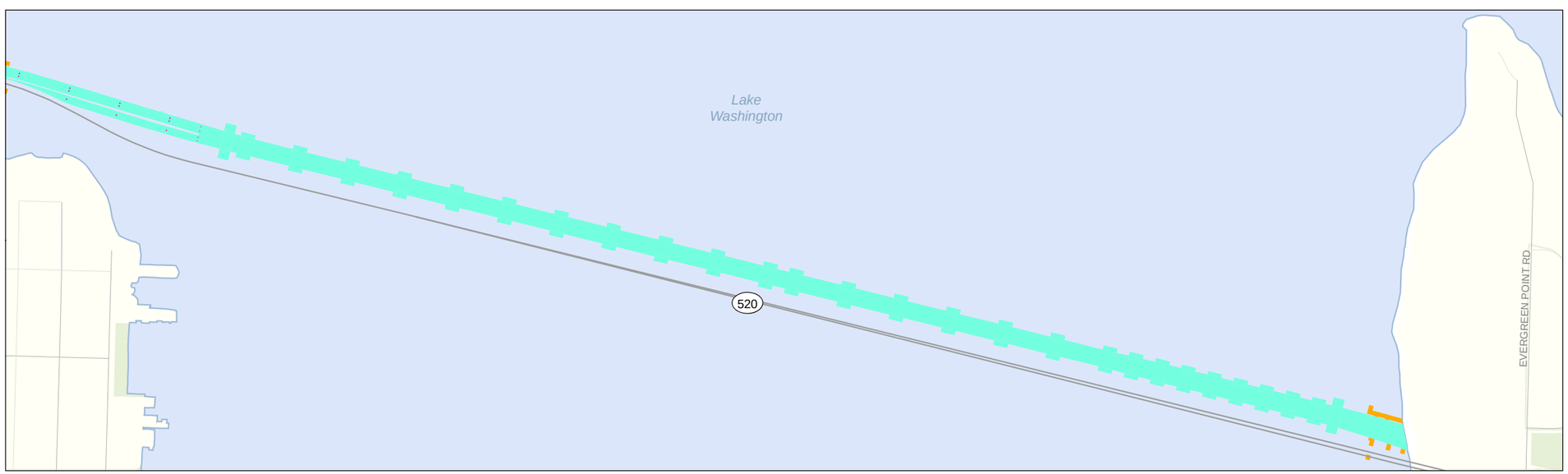
Portage Bay

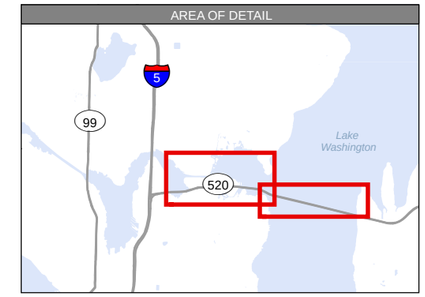
The number of piles (704) supporting the work bridges in this geographic area would be slightly less than for Option A and slightly more than for Option K (see Exhibit 3-11). The area occupied by these piles would range between approximately 2,210 and 3,450 square feet depending on pile-diameter size (24 or 30 inch). The amount of shading from construction work bridges and would be the same for all three options in Portage Bay, approximately 3.0 acres (Exhibits 3-9 and 3-13).

Montlake Area

Under Option L, the Montlake interchange and the Lake Washington Boulevard ramps would be replaced with a new elevated SPUI at the Montlake shoreline. A bascule bridge would span the east end of the Montlake Cut from the new interchange to the intersection of Montlake Boulevard NE and NE Pacific Street. Similar to Option A, the construction of the bascule bridge would likely result in limited effects on fish and aquatic habitat because the construction activities would require limited in-water work, except for maneuvering and anchoring barges in the Montlake Cut to install the pre-fabricated bridge spans.







Operational Open Water Effect

- Fill Effect
- Fill Effect - Aquatic Wetlands
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- Shade Effect - Aquatic Wetlands

Construction Open Water Effect

- Shade Effect
- Shade Effect - Aquatic Wetlands
- Existing Roadway
- Stream
- Park

N

0 250 500 1,000 Feet

Source: King County (2005) GIS Data (Streams and Streets), King County (2007) GIS Data (Water Bodies), CH2M HILL (2008) GIS Data (Parks). Horizontal datum for all layers is NAD83(91); vertical datum for layers is NAVD88.

Exhibit 3-13. **Construction and Operational Effects of Option L on Open Water**

I-5 to Medina: Bridge Replacement and HOV Project

There would be no construction work bridges and, as a result, no shading from construction.

West Approach Area

Construction of Option L would require an estimated 1,984 piles to support the work bridges through the west approach area, which is approximately the same as for Option A and less than for Option K (see Exhibit 3-11). The amount of area occupied by these work bridge piles is also similar to Option A. The overwater construction structures would be in place for approximately 4.5 years. These construction activities would be similar to the other options.

The amount of shade from the construction work bridges (7.0 acres) would be less than the other two options (see Exhibits 3-9, 3-11, and 3-13).

Option L Suboptions

Suboptions for Option L would include adding a left-turn movement from Lake Washington Boulevard for direct access to SR 520 and adding capacity on northbound Montlake Boulevard NE to NE 45th Street. Therefore, the differences between Option L and its suboptions would occur in the Montlake geographic area in an upland area. There would be no likely difference in potential effects of construction activities on fish or aquatic resources.

Lake Washington Area

The floating portion of the Evergreen Point Bridge would be the same for all options and suboptions. It would be built on floating pontoons over deep open-water habitat where bridge columns are not feasible and would be anchored in place between 160 and 190 feet north of the existing bridge. It also would be secured with pontoons and anchors. Construction on the lake would take place from barges and boats and would include connecting the longitudinal pontoons in pairs to complete the 6-lane floating bridge.

Approximately 54 anchors would be used to secure the new bridge in place. The two main anchor types are (1) gravity anchors for harder lake bed materials and sloped areas (near the shores), and (2) fluke anchors for soft bottom sediments and flat areas (middle of the lake). Both types of anchors would be connected to the floating pontoons with steel cables.

Gravity anchors consist of large concrete blocks stacked on top of one another to provide the necessary weight to hold the pontoons in place.

Fluke anchors are installed using a combination of their own weight and water or air-jetting to set them below the mud line.

The installation of new bridge anchors could disrupt lake bed sediments and the organisms living in them. These sediments and organisms would be displaced and the organisms might die or disperse to adjacent areas. However, these effects would be localized and short term. Water quality in the immediate vicinity of the in-water construction activities could become turbid, although such turbidity would probably not reduce lake productivity or directly harm fish and invertebrates.

The installation of the fluke anchors would likely result in greater turbidity levels. However, the expected low currents in the deep portions of the lake would limit the distribution of the turbidity plume and minimize potential effects on fish and other aquatic resources.

Temporary anchors would also be used to hold the pontoons in place before they are finally positioned along the new bridge alignment. Potential temporary anchor types include toggle anchors and pile anchors, which are driven into the ground, and ship anchors, which are lowered to the mud line with cranes. Steel cables would connect all types of anchors to the floating pontoons. These temporary anchors would likely not substantially affect the lake bed sediments, although the placement could result in the loss of aquatic organisms living on or in the sediments.

If pile driving is used in shallow water areas (typically <20 feet deep) to install anchors, underwater sound levels resulting from pile driving could result in injury or mortality to fish occurring in the area. However, such activities would occur during the approved in-water construction windows, and sound-reducing BMPs would minimize the effects of increased sound levels.

Once traffic shifts to the new floating bridge, the existing floating bridge would be dismantled and pontoon sections towed away and reused for other purposes or demolished and recycled at an undetermined location. However, there would be a period of 12 to 16 months when two bridge structures are floating in Lake Washington. Increased structures as well as construction equipment would have more intensive effects on fish in the area than during operation

(see the Construction Techniques and Activities Discipline Report [WSDOT 2009d]). The existing pontoon anchors would be abandoned in place on the lake bed.

East Approach Area

The new roadway would connect with the new roadway alignment proposed for the Medina to SR 202 Project. Construction would take place from work bridges and barges. Cofferdams would be installed, and bridge substructure and superstructure would be built as previously described for the overwater structures in the Seattle area.

The shoreline of Lake Washington at the existing and proposed east end of the Evergreen Point Bridge was identified in the past as a place where sockeye salmon have spawned based on WDFW map records. The map records were from the mid 1970s. No recent formal surveys have been conducted to determine whether spawning sockeye have used the area. Prior to initiating new spawning studies, a shoreline habitat survey was conducted to determine whether suitable spawning habitat existed in the area. The aquatic habitat survey found limited suitable (gravel) spawning habitat (Parametrix 2009). Much of the nearshore areas contain relatively consolidated sediments, while the offshore areas consist primarily of sandy substrate with moderate to dense patches of aquatic vegetation. Neither of these typical habitat types appears to provide the preferred spawning habitat conditions for sockeye beach spawning.

The construction process would require work bridges and falsework. The work bridges would require approximately one hundred and twenty-five 24- or 30-inch-diameter hollow steel piles, and the falsework would require an additional 40 piles. These piles would occupy approximately 520 to 810 square feet of lake bed. This could result in the loss of spawning habitat during the construction period, if the support piers are installed in preferred spawning habitat. In-water construction activities would occur during approved in-water construction windows, which would minimize the effects on sockeye spawning. The shading produced by these construction structures, as well as construction noise and lighting, could disturb sockeye beach spawning in the vicinity. Approximately 0.3 acre of open water habitat would be shaded from construction work bridges during construction (see Exhibits 3-9 and 3-10). However, it is likely that environmental permit requirements would restrict potential fish-disturbing activities during the expected spawning season.

The construction of new in-water bridge support piers and removal of existing bridge piers could also affect spawning habitat, should such habitat occur in the area where the shafts would be installed.

Bridge Maintenance Facility

The Lake Washington area would also include construction of a bridge maintenance facility under the east approach area. This facility would consist of an upland facility constructed in the hillside, as well as a pier and berth extending approximately 100 feet offshore for a maintenance vessel (Exhibit 3-14).

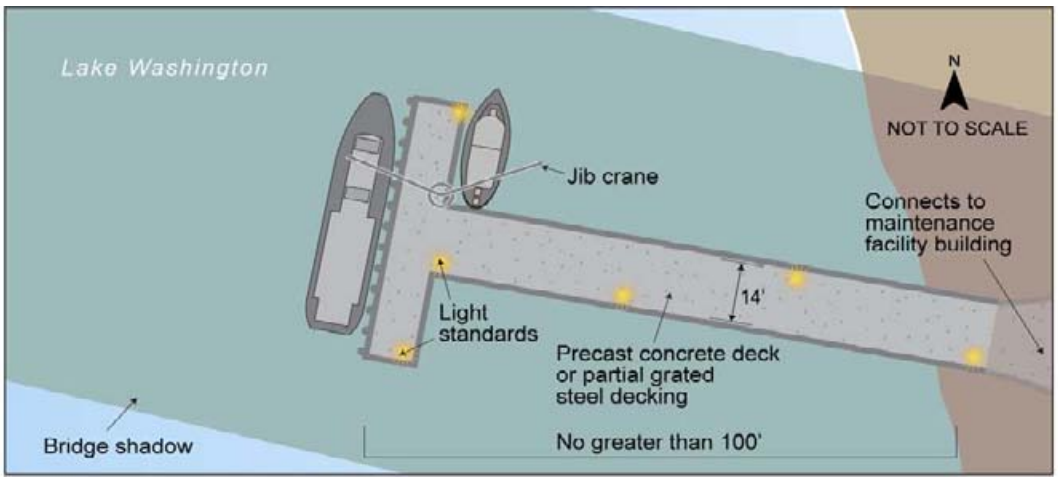

Exhibit 3-14. Conceptual Plan View of Bridge Maintenance Facility Dock

The existing operations have this vessel moored at approximately mid-span on the north side of the bridge. However, the mid-span would no longer be accessible for maintenance access to the boat.

Construction activities would include excavation and embankment work, retaining wall construction, and roadway paving. Appropriate sediment-control BMPs would be implemented to prevent the discharge of sediment from the disturbed construction areas into Lake Washington.

The dock would be constructed on concrete columns, with textured concrete and grated steel decking. The construction activities would consist of installing seven 3-foot-diameter columns approximately 40 feet apart. The boat berth would be constructed at approximately the normal low lake water level, supported by four 3-foot-diameter columns. Construction techniques associated with the deck are similar to in-water techniques previously described for other fixed portions of the bridge.

The maintenance dock was described in the 2006 Draft EIS, but its design and layout have changed somewhat since that time. The current dock design concept would provide moorage for two workboats with a T-shaped dock. The dock itself would be designed to survive a 100-year storm event, the same type of event used to design the new floating bridge. The dock design would also seek to minimize environmental effects such as shading and shoreline armoring. The maintenance facility dock design includes a wave barrier along the offshore portion of the structure and the boat slip area to protect boats from being damaged during major storm events and to allow safe boat access under a wide range of weather conditions. This barrier would be installed after the dock and berth sections are completed. It would be lowered in place with a crane and attached to the southern side of the dock. The barrier would not reach to the lake bed, so the installation is not expected to disturb the substrate.

Eastside Transition Area

Work planned for the eastern portion of SR 520 between Evergreen Point Road and 92nd Avenue NE in Yarrow Point would include moving the Evergreen Point Road transit stop west to the lid at Evergreen Point Road, adding new lane and ramp striping from the Evergreen Point lid to 92nd Avenue NE, and moving and realigning traffic barriers as a result of the new lane striping. The restriping would transition the I-5 to Medina Project improvements into the improvements to be completed as part of the Medina to SR 202 Project. These activities are not expected to affect either fish or aquatic habitat.

How would in-water construction activities affect fish and aquatic resources?

For all the options, substantial in-water pile-driving activities would be required to construct work bridges in shallow-water areas that are not accessible by barge. The underwater sound levels generated during pile-driving activities could disturb or alter the behavior and habitat of fish and other aquatic species and, in some instances, cause injury or mortality.

Adult salmonids migrating through the project area to their spawning grounds may be affected by in-water construction activities, particularly pile driving. Although adult Chinook pass through the Ship Canal in 2 or fewer days (Fresh et al. 1999, 2000) and sockeye average 6 days (Newell and Quinn 2005), high summer temperatures and dissolved oxygen levels in the Ship Canal and Lake Union have

been shown to delay or alter migration timing and, in extreme conditions, likely contribute to pre-spawn mortality. Elevated in-water noise levels from project construction activities could be an additional stressor on fish, potentially affecting fish migration behavior (timing and routes). However, based on the relatively fast migration times of adult salmonids through the Ship Canal and the employment of noise attenuation BMPs to reduce in-water noise, additional effects due to construction noise would likely be relatively minor.

The type and magnitude of effects on fish and other aquatic species depend on a wide range of factors including the type and size (diameter) of pile, type of pile-driving hammer, pile-driving duration, sound attenuation method, size and number of surface waves, depth of the site, sound-minimization BMPs employed, geologic conditions that govern the penetration rate of the pile, and the penetration depth required. These variables influence either the magnitude of the initial sound or affect the attenuation of the sound as it radiates out from the source. The magnitude of potential effects on aquatic species also decreases with range, because sound levels attenuate with distance from the source.

Two general types of pile-driving hammers (impact and vibratory) are expected to be used for the project. Impact hammers use various mechanical methods to pound the piles into the substrate, while a vibratory pile driver uses an oscillatory motion and heavy weight to force the pile into the substrate. These differences result in substantially different underwater sound characteristics and potential effects on aquatic species. Vibratory hammers typically produce substantially lower sound levels, with a slower rise time (time for the noise wave form to rise from 10 to 90 percent of its highest peak) and lower sound frequencies. As a result, the pile-driving sound levels from the vibratory hammer are less intense and spread over a longer time period, thereby minimizing the potential to harm aquatic organisms (Teachout 2007).

Some of the pile-driving activities can be accomplished using a vibratory hammer to minimize in-water sound levels. However, some impact pile driving (proofing) would be needed to achieve adequate load-bearing capacity for the piles. After the construction is completed, the temporary piles would be removed with a vibratory hammer.

Impact pile driving of hollow steel piles would likely produce peak sound levels around 212 decibels (dB), exceeding the presumed single

pile-strike injury threshold for fish (206 dB) (WSDOT 2009h). Pile driving would also exceed the fish disturbance threshold for cumulative sound exposure level (SEL) for multiple strikes (150 dB root mean square [RMS]) and/or injury thresholds for fish (smaller than 2 grams [g], (183 dB_{Peak}) or larger than 2 g (187 dB_{Peak}).

The ranges of pile-driving sound levels are predicted to be much higher than the disturbance threshold for fish; however, this prediction assumes open-water conditions within direct line of sight of the pile-driving activity and no obstructions. When underwater sound waves encounter an obstruction, such as a land mass, they are stopped or reflected. Therefore, the relatively confined setting of Portage Bay and the Arboretum area would effectively contain the sounds generated by pile-driving activities within the bay. Most fish within the bay could be disturbed to some degree by the pile-driving activities. Those fish occurring within the injury threshold zone could also be physically harmed by pile-driving activities. These potential effects do not take into account methods or BMPs that would minimize the sound levels or enhance the attenuation rate of the sound levels generated by the pile driving. Site-specific evaluations were conducted in October 2009 to assess the sound levels generated by pile driving in Portage Bay, Union Bay, and Lake Washington and to identify appropriate BMPs to minimize the potential effects of pile driving on fish and other aquatic species. Specific in-water construction periods would also be established through the project permitting process to minimize potential effects of pile driving and other in-water construction activities on salmonid species. Results of the studies were not available prior to the preparation of this document, but will be included in the Final EIS.

What are drilled shafts and shaft caps?

A drilled shaft refers to an augered hole in the ground or substrate filled with reinforced concrete to form a structural foundation component. A shaft cap is a concrete structure on top of multiple concrete shafts to provide greater support to a column than a single shaft. Shaft caps are typically placed at the mud line in shallow-water areas, or at the water surface elevation in deeper water applications.

Despite the minimization measures planned for the pile-driving activities in the study areas, the total number of work bridge piles needed and the overall duration of pile-driving activity would likely have a negative effect on fish and other aquatic organisms in the area.

In addition to the pile-driving activities, in-water construction would also include installing temporary cofferdams to isolate some work areas from the aquatic environment and minimize the overall effects (Exhibit 3-14).

Cofferdams are generally constructed with steel sheet piling vibrated into the mud with a vibratory hammer, typically to approximately 20 feet below the mud line. The area within the cofferdam is then de-watered to effectively isolate additional construction activities from the aquatic environment (see Exhibit 3-15). While the cofferdams are intended to minimize biological and water quality effects from construction, the de-watering process can result in stranded fish within the enclosure. To minimize such effects, WSDOT fish handling and exclusion protocols would be implemented (WSDOT 2009i).

Exhibit 3-15. Dewatering Cofferdam

Water generated during de-watering, from either cofferdams or from upland excavation sites, would be stored either in temporary treatment ponds or in portable steel tanks. Water would be stored for a sufficient amount of time to allow particles to settle, or chemical flocculants could be used to reduce suspended particles before the water is discharged to the stormwater system.

Construction would also include installing upland and in-water bridge support structures (piers). This construction would vary based on geological conditions, groundwater depth, water depth (if the structure is placed in water), and weight of the superstructure including the load it would carry. Substructure foundation types anticipated for this project include spread footings (upland only), drilled shafts, and water line or mud line shaft caps (see Construction Techniques and Activities Discipline Report [WSDOT 2009d]).

The most common substructure foundation type would be individual drilled shafts. The columns that would support the new bridge would be constructed on either individual drilled shafts, or on a shaft cap supported by multiple drilled shafts (Exhibit 3-16). The construction area for the individual drilled shafts would be isolated from

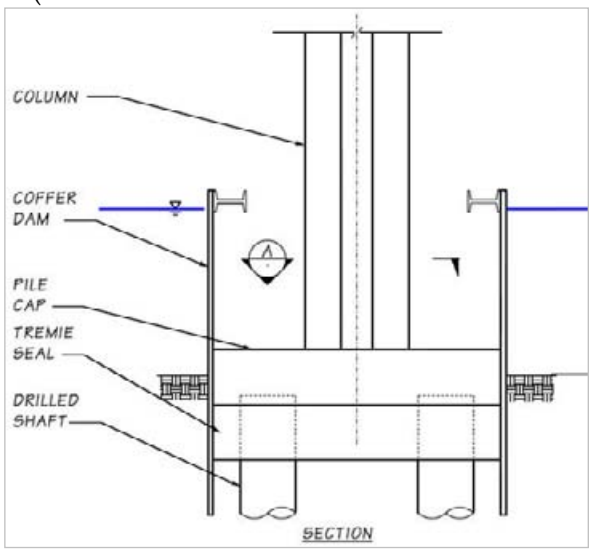

Exhibit 3-16. Cross Section of Drilled Shaft Cap and Column Configuration

the water by a steel casing or large hollow pipe vibrated into the mud and extending up above the water line. After augering the sediment within this isolation casing, a reinforcing-steel shaft cage would be inserted and concrete pumped into the casing. The accumulating concrete would displace any water in the casing, which would be collected and treated and appropriately disposed. The casing pipe would gradually be lifted out of the shaft excavation but would remain partially in place to form the top of the shaft. The support column would then be constructed on top of the completed shaft.

Shaft caps are typically constructed at or below the mud line in shallow water applications, or at the water line for deeper areas. The construction of a shaft cap configuration is similar to the individual shaft process, except that multiple shafts are often constructed within a cofferdam and a shaft cap constructed later to span the shafts.

Regardless of the type of substructure, adequate construction BMPs, such as the use of cofferdams, are expected to be implemented to minimize the potential adverse effects on fish or aquatic habitat.

In-water construction activities might generate some turbidity plumes from disturbance of the bottom sediments. Increased turbidity could occur during installation of the work bridge piles, although turbidity risks are more likely to occur during removal of the work bridge support piles. Turbidity is also a potential concern for the BMPs implemented for other construction concerns. For example, bubble curtains and cofferdams may disturb sediment and increase turbidity levels even though they are intended to minimize construction effects.

Increased turbidity can alter the behavior of aquatic species, impair their ability to capture prey, and in severe cases cause physical injuries, such as gill abrasion in fish. However, relatively calm and protected waters in Portage Bay and the Arboretum area are unlikely to cause the substantial dispersion of any suspended sediment from construction activities, thereby limiting the overall potential to affect aquatic species or habitat conditions. The substantial anchoring depths would also likely limit potential effects because fewer species typically occur in the deeper areas of the lake.

Other potential short-term construction effects could include spills of hazardous materials (for example, oil and gasoline), chemical contaminants, or other materials. All pollutants would be handled in a manner that would not contaminate surface water in the study areas.

No maintenance or fueling of construction equipment, vehicles, or vessels would be allowed within 200 feet of the area waterways to reduce the risk of spills of petroleum and hydraulic fluids in sensitive areas. Materials that modify pH, such as cement, cement grindings, and cement saw cutting, would be managed or isolated to minimize the spread of these materials by surface water runoff or other means of entering the area waterways. The selected contractor would be required to submit a spill prevention and control plan before beginning work.

How would construction lighting affect fish and aquatic habitat?

Lighting associated with nighttime highway construction could affect the distribution and behavior of fish, depending on intensity and proximity to the water. The effects from lighting would be the same for all options. Responses to light are not universal for all species of fish—some species school and move towards light sources, some predatory fish are adapted for hunting in low light intensities, and others are attracted to higher light intensities (Machesan et al. 2005). Petersen and Gadomski (1994) observed that the rate of capture of subyearling Chinook salmon by northern pikeminnow was inversely related to light intensity, with about five times more salmon captured during times of relative darkness than during periods with high light intensity. Ali (1959) found that the threshold for juvenile salmon feeding, minimum prey capture, and schooling behavior were dependent upon specific light intensities, and maximum prey capture for chum and pink fry occurred at intensities equivalent to dawn and dusk light levels.

Masur and Beauchamp (2006) observed that increased levels of light at night would increase both the risk of predation and the foraging ability of visual feeding planktivores (including juvenile salmonids) in Lake Washington. Artificial lighting could also affect the migration rates of fish passing through the study area. Slower migration rates through the area, when combined with the ambient light levels, could result in greater exposure of fish to predators.

Nighttime construction activities would increase the amount of artificial lighting in the area during construction periods. Construction lighting would have a greater intensity and would typically be closer to the water surface than the existing bridge lighting, potentially resulting in greater behavioral changes. The work lights would be in addition to the existing bridge lights and light from the surrounding area.

The potential effects of construction lighting on fish behavior and predator-prey relationships could be greater in the shallow water areas,

which occur in much of the study area, where the light could affect the entire water column. However, construction lighting is expected to be concentrated in the work areas, decreasing effects from light with distance from the work area. This would provide varying light levels across the project alignment, and fish would choose different light conditions for different activities such as rearing or migrating. Any effects of construction lighting would be similar for all three options.

How would demolition of existing structures affect fish and aquatic resources?

The demolition of existing structures would be essentially the same for all three options. The demolition of existing structures involves breaking, crushing, and cutting structures for disposal. Demolition debris would be disposed of consistent with federal, state, and local laws and ordinances.

Demolition debris from the project would be transported by trucks, barges, and tugs. However, most of this transportation would likely occur by barge and tugboat due to the ease of access from the water to most of the study area and the resulting efficiency of this type of transport. The transport route would likely be through the Montlake Cut and the Ballard Locks to disposal sites or transfer facilities accessible by water. However, some material could be brought to temporary transfer facilities at the north and south ends of Lake Washington. Because of the large amount of disposal material and transport by land and water, multiple disposal sites would likely be used. The contractor would be responsible for this disposal; therefore, specific disposal sites are not known. It is also expected that a substantial amount of the demolition material would be salvaged or recycled.

Overwater demolition would require special precautions to prevent debris or concrete-laden water from entering Lake Washington. Standard overwater and in-water construction and demolition BMPs would be implemented in accordance with environmental regulatory permit requirements. Nets, tarps, platforms, scaffolds, blankets, barges, and floats could be used to contain debris. In addition, vacuums, diverters, absorption materials, holding tanks, and drainage systems could be used to contain concrete-contaminated water. Cofferdams would also be used to isolate in-water work areas from the aquatic environment. Therefore, this process would likely have limited potential to affect either fish or aquatic habitat in the area. In-water

structures would be cut off as close to the mud line as possible, leaving foundations intact.

Pontoon Construction and Transport

The pontoons built and stored in Grays Harbor as part of the Pontoon Construction Project could be towed from a moorage location in Grays Harbor to Puget Sound for outfitting or could be towed directly to Lake Washington for immediate incorporation into the floating bridge. Towing would occur as weather permits during the months of March through October.

Most of the supplemental stability pontoons required for a new 6-lane floating bridge would be constructed as part of the I-5 to Medina Project. The additional pontoons (approximately 44) might be constructed at the existing CTC facility in Tacoma and/or at a new facility in Grays Harbor being developed as part of the Pontoon Construction Project. The supplemental stability pontoons could be towed from the construction location to Lake Washington for incorporation into the floating bridge. For additional information about these locations and about pontoon construction, please see the Pontoon Construction Project Ecosystems Discipline Report (WSDOT 2009e).

Pontoons may be stored in Puget Sound until needed for construction. These temporary storage sites could be at existing commercial shipping or mooring facilities regularly used by large vessels or barges. Therefore, the temporary storage of the pontoons would be consistent with their typical facility operations. Some pontoons may be outfitted with an elevated bridge superstructure in Puget Sound, while others would be outfitted in Lake Washington. Outfitting and some pontoon storage might occur at Todd Shipyard or similar shipyards in Puget Sound. The outfitted pontoons could then be towed from Puget Sound to Lake Washington between May and August. One pair of longitudinal pontoons may be towed through the Ballard Locks at a time.

It is expected that typical navigation routes used by commercial tugboat operators would be employed to tow the pontoons from Grays Harbor. This would include the navigation channel through the Ship Canal. Therefore, the towing process would likely be similar to existing shipping traffic along all areas of the transport route. The relatively slow speed expected to be achieved by towing these large rectangular pontoons would further minimize the potential for affecting aquatic

resources. Therefore, the transport process would probably not measurably increase the potential for affecting fish or aquatic habitat.

Fish species in the marine environment are not discussed in this report. Marine mammals protected by the Marine Mammal Protection Act are discussed in the Wildlife Resources section of this report. Additionally, the project would involve towing pontoons from the CTC site or existing commercial or industrial docks located at as yet unidentified locations within Puget Sound. See the Pontoon Construction Project Ecosystems Discipline Report (WSDOT 2009e) and the Construction Techniques Discipline Report (WSDOT 2009d) for more project-related information.

How may tugboat operation associated with pontoon transport affect habitat?

A short-term disturbance to soft sediment and increase in turbidity, caused by propeller wash from tugboats, might occur during the removal and transport of the pontoons. However, the sites are located within industrial waterfront areas, adjacent to shipping channels, where similar operations regularly occur. Thus, tugboat operations associated with removal and transport of the supplemental stability pontoons would not measurably alter existing conditions and would have a minimal effect on fish and aquatic habitat compared to existing vessel traffic.

How would fish stranding or entrainment be avoided at the pontoon construction sites?

It is assumed that the fish collection and removal procedures would meet NOAA Fisheries and WDFW standards at the likely supplemental stability pontoon construction sites. All pumps or outlets, if used to convey water to and/or from the site to fish-bearing waters, would be screened according to NOAA Fisheries standards. When a set of pontoons is complete, the basin would be flooded in a controlled manner with water entering the facility through a hydraulic control structure designed per NOAA Fisheries standards to avoid potential effects to fish. The maximum intake velocity of flow through the hydraulic control structure for flooding the casting basin would be 0.4 foot per second. After the basin is flooded, the access gates within the casting basin would be opened and the pontoons floated out and transported by tugboat to a temporary storage area or directly to Lake Washington.

Fish could potentially enter the casting basin each time the access gates open, because the gates would remain open for several days during the pontoon removal process. The sites would be designed to facilitate collection or removal of any fish that may be retained as the gates are closed and pumped out.

What are the effects on water quality from the possible pontoon construction sites?

Stormwater from impervious surfaces associated with the casting basin and ancillary areas would increase pollutant loading and flow. Sediment ponds and biofiltration swales would capture stormwater from the site. When a set of pontoons is complete, the work area would be thoroughly cleaned and pressure washed. Wash water would be collected and treated within the water quality facilities before being discharged to receiving waters.

Additional potential effects on water quality could include the spill of hazardous materials (for example, oil and gasoline), chemical contaminants, nutrients, or other materials into waters in the casting basin vicinity. Control of hazardous materials is a standard provision in construction contracts and permits and would be addressed with BMPs. The contractor would be required to submit a spill prevention and response plan prior to the commencement of operations. Also, if an oil or contaminant spill were to occur from the tugboat during the removal and transport of the pontoons, U.S. Coast Guard regulations would be implemented.

It is assumed that all water collected on the supplemental stability pontoon construction site would be handled and treated in accordance with state water quality requirements. Water handling and treatment systems would be designed, as appropriate, for sediment and pH according to the 2008 *Highway Runoff Manual* (WSDOT 2008b) for water quality. All features would accommodate a 10-year design storm event.

How could pontoons storage affect fish?

The constructed pontoons would be stored until they could be transported to Lake Washington. For storage, the pontoons could be breasted together in rafts anchored at an established deep-water moorage site in Grays Harbor or existing commercial shipping or moorage facilities regularly used by large vessels or barges. Therefore, the temporary storage of the pontoons would be consistent with their typical operations.

Potential effects on benthic invertebrates and aquatic vegetation growth due to shading from pontoon rafts would be minimal because the storage would occur at deep-water sites (that is, 30 to 40 feet deep) or at existing moorage facilities. Fish may be affected because of the potential of the pontoon rafts to attract piscivorous birds (such as terns) that may nest on the pontoons. Nest clearing or deterrent measures, such as covering the pontoons with chicken wire, could help keep birds away from the pontoons. The pontoons could be stored in areas in which the large rafts would have minimal effect on tidal exchange, currents, or substrate distribution.

The stored pontoons could provide a hard structure in an aquatic environment that would serve as habitat for invertebrates and fish. This could be positive or negative depending on whether the pontoons attracted native or nonnative invasive species. To ensure that no invasive aquatic species would be transported out of Grays Harbor on the pontoons, WSDOT would monitor the pontoons for aquatic species growth and clean the pontoons prior to transport. No substantial aquatic species growth would likely occur during the transport process, and any incidental fouling organisms would die and decompose in the freshwater lake environment.

Phased Implementation Scenario

If the project were delivered in phases, effects on fish and aquatic habitat would be similar to those described for the full build out of the 6-Lane Alternative. However, phasing could prolong the duration of effects. It is possible that some habitat areas may be affected more than once if work has to occur in the same area but in different phases.

How would operation of the project affect fish resources?

No Build Alternative

No physical, chemical, or biological changes to Lake Washington would occur from the No Build Alternative. Under the No Build Alternative, SR 520 would continue to operate as it does today, with no new facilities added or removed. This alternative would continue to shade aquatic habitat areas, which could affect habitat quality or habitat uses by some fish or other aquatic species.

Operational effects are effects that would occur while the new bridge, roadways, ancillary facilities, and any mitigation features are in use.

The existing structure is typically less than about 8 feet above the water surface from the eastern portion of the Portage Bay Bridge to about

2,000 feet east of Foster Island. The existing structure also includes the eastbound on-ramp and portions of the unused R.H. Thomson Expressway ramps in the Washington Park Arboretum area. Salmonids are generally believed to avoid shaded habitat areas under overhead structures, while other fish (for example, smallmouth bass) appear to be attracted to such areas.

Under the No Build Alternative, the quantity and quality of water entering waterways in the study area would not change. Currently, runoff from the existing structures discharges directly to Portage Bay and Union Bay, and runoff is not treated before being discharged. This untreated runoff carries pollutants from automobiles (such as petroleum products and metal from tires and brake linings). Untreated runoff from the roadway would continue to be discharged. This would result in a continuing negative effect on water quality adjacent to and downstream of SR 520, in Portage Bay and Lake Washington, and tributary streams—areas where fish and other aquatic species occur.

If the existing bridge were to remain in operation until 2030, traffic volumes would increase by approximately 17 percent over 2008 levels. Please refer to the Transportation Discipline Report (WSDOT 2009f) for more information about predicted traffic volumes and travel patterns, and the Water Resource Discipline Report (WSDOT 2009a) for more details on changes to water quantity and quality in the project vicinity.

6-Lane Alternative

The 6-Lane Alternative options would place new structures within or adjacent to the shorelines and open-water areas that support fish species within the Lake Washington watershed. The primary potential operational effects of these structures on fish habitat in the study area would relate to changes in the amount and location of overwater shade and the placement of new additional impervious surfaces. These effects would result primarily from the widening of the roadway, operation of stormwater-treatment facilities, and artificial lighting.

How would overwater and in-water structures affect fish and aquatic resources?

Seattle

The proposed project would build new structures and/or maintain existing structures within the shoreline and open-water habitats that support various fish species.

All options and suboptions would substantially increase the amount of overwater and in-water structures compared to existing conditions

(Exhibits 3-17 and 3-18). Shading of the water column (in-water shading) could directly or indirectly affect fish, including native salmonids, by reducing the growth of aquatic vegetation in shallower areas. In the West Approach area, the shadow of the bridge may delay, but not prohibit, outmigration of juvenile salmonids (Celedonia et al. 2008a). However, past studies in Lake Washington have indicated that the influence of in-water shading on fish behavior is complex and it varies by width and height of the structures, species, time of year, and other factors.

Exhibit 3-17. Total Area (acres) of Overwater Structure that Would Cause Shading Effects, by Option and Suboption

Option	Portage Bay Area	Montlake Area	West Approach Area	Floating Bridge	East Approach Area	Total
No Build	3.1	0.2	11.0	11.6	0.4	26.3
Option A[a]	5.7	0.2	15.9	25.6	1.8	49.2[b]
Suboptions[a]	5.7	0.2	18.2	25.6	1.8	51.5[b]
Option K[a]	4.6	0	16.8	25.6	1.8	48.8[c]
Suboptions[a]	4.6	0	16.8	25.6	1.8	48.8[c]
Option L[a]	4.8	1.8	18.3	25.6	1.8	52.3[d]
Suboptions[a]	4.8	1.8	18.3	25.6	1.8	52.3[d]

[a] Represents the total area of overwater structures of each option and suboption compared to existing overwater structures.

[b] Includes 2.8 acres of shading of aquatic bed wetlands within open water. Effects on these resources and associated mitigation action are discussed in the *Wetlands* section of this report.

[c] Includes approximately 2.3 acres of shading effects on aquatic bed wetlands within open water. Effects on these resources and associated mitigation actions are discussed in the *Wetlands* section of this report.

[d] Includes approximately 3.6 acres of shading effects on aquatic bed wetlands within open water. Effects on these resources and associated mitigation actions are discussed in the *Wetlands* section of this report.

The intensity of the shade would vary based on the height of the overwater structure above the water surface (Exhibit 2-16). The relationship between structure height and width on shading is complex. In general, however, a design that increases the overwater height would at least partially compensate for the increased bridge width common to all options and suboptions.

Option A

Option A and its suboptions would result in almost double the area of overwater structures compared to the No Build Alternative (see Exhibit 3-17). However, compared to the other options, Option A would result in more overwater shading than Option K but less than Option L.

Option A would have the least amount of substrate occupied by support piles (see Exhibit 3-18).

Exhibit 3-18. Estimated Numbers of Concrete Columns for Portions of the Proposed Bridges and Area of Substrate Occupied, by Option and Suboption

Alternative	Portage Bay	West Approach	East Approach	Total
No Build (Existing)	119 (1,890 sq/ft)	404 (6,590 sq/ft) [a]	14 (350 sq/ft) [a]	537 (8,830 sq/ft)
Option A	47 (18,020 sq/ft) [a]	187 (5,290 sq/ft)	4 (450 sq/ft)	238 (23,760 sq/ft)
Option A and Suboptions	47 (18,020 sq/ft) [a]	214 (6,050 sq/ft)	4 (450 sq/ft)	265 (24,520 sq/ft)
Option K	42 (17,850 sq/ft) [a]	928[b] (97,890 sq/ft)[c]	4 (450 sq/ft)	974 (116,190 sq/ft)
Option K and Suboptions	48 (18,160 sq/ft) [a]	928[b] (97,890 sq/ft)[c]	4 (450 sq/ft)	980 (116,500 sq/ft)
Option L	48 (18,160 sq/ft) [a]	185 (9,150 sq/ft)	4 (450 sq/ft)	237 (27,760 sq/ft)
Option L and Suboptions	48 (18,160 sq/ft) [a]	185 (9,150 sq/ft)	4 (450 sq/ft)	237 (27,760 sq/ft)

[a] Area includes footings or shaft caps at the mud line supporting the columns.

[b] Columns range from 2 to 7 feet in diameter in Option K, while the other options range from 6 to 10 feet.

[c] Area includes the entire in-water fill of the submerged roadway entering the single-point urban interchange (SPUI). Many columns driven into the lakebed would be underneath the submerged roadway for support.

Portage Bay

Under Option A, the existing 4-lane Portage Bay Bridge would be replaced with a bridge that would include three eastbound and three westbound lanes, along with a westbound auxiliary lane. Compared to the other options and suboptions, Option A and its suboptions would have about 1 acre of additional overwater structure in Portage Bay due to the auxiliary westbound lane (see Exhibit 3-17).

The proposed Portage Bay Bridge would have a minimum width of approximately 115 feet; it would be at least 40 feet wider than the existing bridge. The proposed bridge would have fewer in-water columns than the existing bridge, but a larger overall footprint (square feet) due to the larger column diameter. In some cases, the columns would have shaft cap foundations that would occupy a greater area of the lake bed than an individual column (Exhibit 3-18).

The Option A bridge deck (road grade) would be approximately the same height as the existing roadway on the western half of the Portage Bay Bridge (Exhibit 2-16).

The proposed bridge height (approximately 48 feet) would, however, likely be sufficiently high to allow natural vegetation to grow underneath (Parametrix 2009). Mature trees (40 to 80 feet high) currently grow on the west shoreline within the shadow of the existing Portage Bay Bridge. The eastern half of the proposed bridge would be approximately 5 feet higher than the existing bridge and typically between 13 and 16 feet above the water. Between the increased width and height, the proposed bridge could reduce the light levels under the structure compared to the existing conditions (see Exhibit 2-16).

Forty-seven in-water columns are needed to support the Portage Bay Bridge, with 19 supported by individual drilled shafts and 28 supported by multiple shafts and shaft cap structures. These columns would replace the 119 columns currently supporting the Portage Bay Bridge.

The proposed shaft caps would consist of a 35-foot-square concrete block situated on or slightly below the lake bed and typically supported by four drilled shafts. All 47 bridge columns are 8 feet in diameter and, along with the shaft caps, would occupy approximately 18,020 square feet (0.4 acre) of bottom substrate. This would represent approximately a tenfold increase in displaced substrate surface area compared to the existing bridge structures (Exhibit 3-18).

Montlake Area

Option A includes a bascule bridge across the Montlake Cut, constructed perpendicular to the Montlake Cut. A smaller area of bridge structure would be over the water as compared to the more angled alignment for Option L. In addition, the Option A bascule bridge would be about 7 feet narrower (53 feet) than the Option L bridge (60 feet) (see Exhibit 3-10). This would result in less over-water shading.

The Option A bascule bridge would be approximately 10 feet lower above the water than Option L and the existing bridge, which would at least partially offset the benefits of a narrower bridge.

West Approach Area

The new bridge would be approximately 57 feet wider than the existing roadway. Option A would affect the nearshore and open-water habitat edge. The replacement bridge would range from approximately 14 to 19 feet higher above the water than the existing bridge from Montlake to just east of Foster Island. Option A would start about 19 feet higher than the existing structure at Foster Island, decrease to about 4 feet

higher between 800 and 1,700 feet west of the island, and increase to about 12 feet higher approaching the West Highrise (see Exhibit 2-16).

Similar but larger support columns and roadways would replace those now existing. While the total number of in-water columns would be less than half of the existing columns, the larger size would result in a similar square footage of occupied substrate area (see Exhibit 3-18).

Option A Suboptions

The Option A suboptions would add several additional ramps in the Washington Park Arboretum area and change the elevation. These additional ramps result in a wider overall bridge structure between Montlake and Foster Island, as well as 27 additional support piers. These piers would occupy approximately 760 more square feet of lake bed than Option A (see Exhibit 3-18).

Option A suboptions would also have a different slope profile than Option A. The bridge would have a constant grade of approximately 0.3 percent from Montlake to the West Highrise, similar to Option L (see Exhibit 2-16). This would result in a lower bridge structure from Montlake to just past Foster Island, compared to Option A, but a higher structure approaching the West Highrise.

Option K

Option K would have the lowest profile and widest overwater footprint compared to the other options (see Exhibit 3-12). It would therefore have the greatest potential for effects on fish resources and open-water habitat (see Exhibits 3-12 and 3-17).

Option K would have fewer overwater structures that could cause shading because it would include a tunnel under the Montlake Cut. Moreover, in the west approach area as part of the SPUI, the bridge is below the high water elevation so that it would result in fill rather than shade effects. Overall, Option K would result in less shading of open-water habitat but more fill than the other options (see Exhibits 3-12, 3-17, and 3-18). However, the lower profile would also result in greater effects from shading than the other options.

Portage Bay

As with Option A, the existing Portage Bay Bridge would be replaced with a wider structure. Both options would include six traffic lanes. Option K would not provide a westbound auxiliary lane, making the bridge approximately 12 feet narrower (approximately 1 acre less overwater shade area) than with Option A and Option L, and would

require five fewer in-water support columns (occupying approximately 170 square feet less substrate) (see Exhibit 3-18).

Montlake Area

The roadway through the Montlake area under Option K would be wider than either the No Build Alternative or Option A but not as wide as Option L. This increased width is primarily to accommodate the depressed SPUI and the separate access ramps to and from the twin Montlake Cut tunnels.

West Approach Area

The roadway would be lower than the other options at the east shoreline of the Washington Park Arboretum because of the SPUI configuration. This configuration would require some excavation along the Washington Park Arboretum shoreline and the construction of retaining walls extending out into the water. This lower elevation would result in filling the entire area rather than just fill from support piles. The substrate area occupied under the SPUI is included in the total fill calculation (90,500 square feet) for the structure, rather than in the column area totals (see Exhibit 3-18).

The bridge profile would be lower than existing conditions across Foster Island to allow for a landscaped lid over the top of the highway (see Exhibit 3-12).

Option K would maintain a low profile (below existing conditions) for approximately 2,000 feet east of Foster Island and would reach the peak elevation of the West Highrise at least 500 feet west of the existing structure. This peak would also be several feet lower than the existing highrise.

The low profile through this geographic area, particularly on the east and west shorelines of Foster Island and the Washington Park Arboretum western shoreline, would require approximately twice as many support columns as the existing structure and about 5 times more columns (928 columns) than Option A (187 columns). Most of the columns for Option K would be installed below the SPUI to support the concrete roadway structure. Option K would result in shading of approximately 16.8 acres from overwater structure in these areas (see Exhibits 3-12, 3-17, and 3-18).

Option K Suboptions

The suboptions for Option K would include an eastbound off-ramp to Montlake Boulevard. This would result in six additional in-water piles

near the southeast shoreline of Portage Bay and approximately 310 square feet of additional lake bed that would be occupied compared to Option K.

Option L

Option L has the highest overall bridge profile of the options. It would likely produce the least amount of additional shading effects on aquatic habitat or species (see Exhibits 3-13 and 3-17). With the exception of the new bascule bridge over the Montlake Cut, which has a clearance of approximately 57 feet high, Option L would not likely cause a major increase in overwater shading compared to Option K, which has a similar overwater footprint.

Portage Bay

Under Option L, the existing Portage Bay Bridge would be replaced with a wider structure, similar to Option K, because the bridge would not include a westbound auxiliary lane as in Option A. Effects would be less than under Option A and similar to those under Option K (see Exhibits 3-13 and 3-18).

Montlake Area

The roadway through the Montlake area under Option L would be up to approximately 250 feet wide, which is wider than either of the other options or existing conditions. This width is primarily to accommodate the elevated SPUI and various ramps to and from the Montlake Boulevard and the bascule bridge over the Montlake Cut. The bascule bridge would result in 1.8 acres of shading (see Exhibits 3-13 and 3-17).

West Approach Area

Option L would produce greater shading effects in the west approach geographic area than the other options (see Exhibits 3-13 and 3-17).

Option L would require fewer support columns than Option A, but the larger diameter columns would occupy substantially more lake bed. Option K would occupy more square feet of lake bed than Option L, because the SPUI approach structure for Option K would displace approximately 2.1 acres of existing lake bed (see Exhibit 3-18).

The Option L alignment would also have the highest profile in the west approach area, which is an important and well-used migration route for juvenile salmonids migrating along the western shoreline of the lake. Option L would typically be about 5 feet higher than the existing structure between Montlake and Foster Island. In the 2,700 feet of bridge immediately east of Foster Island, Option L would be about

11 feet higher than the existing structure, and this height differential would gradually increase toward the east, to about 17 feet higher near the West Highrise (see Exhibits 2-15 and 2-16). The higher bridge profile would result in less over-water shading

Option L Suboptions

Suboptions for Option L would include adding a left-turn movement from Lake Washington Boulevard for direct access to SR 520 and adding capacity on northbound Montlake Boulevard NE to NE 45th Street. The Option L suboptions would not result in more effects to fish and aquatic habitat than Option L.

Lake Washington

The floating portion of the Evergreen Point Bridge would be the same for all options and suboptions. It would be built over deep open-water habitat where bridge columns are not feasible and it would be anchored in place between 160 and 190 feet north of the existing bridge. Rows of three 10-foot-tall concrete columns would support the roadway above the pontoons, and the new bridge structure would be approximately 22 feet higher and approximately twice as wide as the existing floating bridge. The area of the floating bridge would be 25.6 acres.

Fish react to the presence of overwater and in-water structures. Object-oriented fish tend to congregate near the bridge and potentially move or migrate in the vicinity of the bridge across the lake until they reach the end of the floating portion. The Evergreen Point Bridge apparently does not prevent sockeye spawning because the spawning area on the shoreline at the east end of the bridge was identified after the bridge was already built. However, there is no information to determine if the bridge has an effect (positive or negative) on the use of the shoreline by beach-spawning sockeye.

Celedonia et al. (2008a) recently evaluated the migratory behavior of juvenile Chinook near the west approach of the Evergreen Point Bridge and found both migratory and holding behavior patterns near the bridge, with substantially variable behaviors within each general pattern. Approximately two-thirds of the tagged and actively migrating juvenile Chinook salmon tended to hold before migrating under the west approach area of the bridge. However, approximately half of these fish held for only a few minutes. In contrast, tagged fish that were not actively migrating (rearing) appeared to selectively choose to reside in areas near the bridge for prolonged periods. These fish were observed to often cross beneath the

Holding behavior refers to fish apparently choosing the area around the bridge as habitat, as opposed to actively migrating fish being delayed when encountering the bridge.

bridge to the north and later return to holding immediately adjacent to the bridge's southern edge (typically within approximately 65 feet from the bridge edge). These fish may have been using the bridge (that is, shadow and/or structure) as cover.

The fish tracking study continued for a second year in 2008 (Celedonia et al. 2009). Although the report has not been finalized, generally similar results were reported. In general, both years' studies indicated that although the bridge appeared to have some effects on the migration of some juvenile Chinook salmon, many of the fish showed little to no migration delay. It should be noted that only one salmonid species (Chinook salmon) were examined and that potentially confounding variables include fish origin (hatchery versus naturally spawned fish), seasonal effects (early season migration versus late season migration), and migration path location (fish were released only near the west approach). Despite the potential unknowns, this study data represents the best available science on juvenile salmon outmigration in the study area.

The new floating bridge would use larger pontoons than the existing bridge. The single 60-foot-wide pontoon configuration would be replaced with 75-foot-wide longitudinal pontoons, with fifty-two 50-foot-wide supplemental stability pontoons variously spaced out along the length of the floating bridge. When the pontoons are included, the width of the floating bridge would be almost three times wider than the existing structure, varying between 75 feet and 175 feet wide where the supplemental stability pontoons are located. In addition, the pontoons would have a typical draft of between 22 and 28 feet below the surface of the water; the existing pontoons have a typical draft of about 8 feet. While there would be more than double the amount of the open-water shading, the floating bridge would be located in deep water where the effects of shading would be minimized. The floating bridge portion of the project would occur away from the shorelines in relatively deep water. The potential effects from shading on fish and aquatic species are minimal given the relatively small size of the bridge structure compared to the size of the open-water portion of the lake. This habitat contains little to no aquatic vegetation and would not likely be a primary migration route for anadromous salmonids, although some surface-oriented migrating fish could travel along the perimeter of the floating portion of the bridge, rather than passing under it. However, the increased width and draft of the new bridge pontoons could present a greater barrier to fish migrating or foraging near the surface.

The existing Evergreen Point Bridge impeded the movement of Lake Washington surface water that is driven by winds. The force of northerly or southerly winds tends to increase the height of the water slightly on the upwind side of the floating bridges, thus forcing a small movement of water under and around the ends of the bridges. However, calculated velocities of this water movement, even under the "worst case" scenario of a 100-year design storm, would not be of a sufficient magnitude to substantially affect fish migration (Darnell 2009).

The new floating portion of the bridge would be about 130 feet longer than the existing floating bridge (equivalent to less than 2 percent of the existing pontoon length), and the depth (draft) of the new pontoons would increase 14 to 20 feet. However, based on the relatively small magnitude of the increase and considering overall lake volume, the increased size of the new pontoon structures is not expected to substantially increase the partial dam provided by the floating bridge. In summary, no available information indicated that the increased depth and length of the new bridge pontoons would substantially alter the movement of Lake Washington's surface water.

The current configuration of pontoons provides a relatively uniform surface in the upper water column that fish can use when accessing deeper water for foraging and rearing, or for crossing the lake. The variable spacing of the supplemental stability pontoons along the longitudinal pontoons of the new floating bridge could result in additional effects on fish migration or foraging/rearing behavior. The variable spacing would produce periodic recesses along the face of the pontoons, which would substantially increase the migration distance if fish followed the face of the pontoons. However, these recesses could also provide additional deepwater forage habitat for fish using the edge of the pontoons as cover.

East Approach Area

The east approach area structure would be identical for all options and suboptions. The bridge would be higher than the existing structure by approximately 13 feet along the majority of the approach. The east approach area would result in 1.8 acres of overwater shade and approximately 450 square feet of substrate would be occupied by support columns (see Exhibits 3-17 and 3-18).

Bridge Maintenance Facility

The bridge maintenance facility under the east approach consists of an upland facility and a dock with a wave barrier extending approximately 100 feet offshore. The maintenance facility dock would add overwater structure in the shallow nearshore environment, which could affect the migration and rearing behavior of juvenile salmonids in the area. There could also be a small loss of bottom habitat from the support columns.

The wave barrier could reduce wave action on the south side of the maintenance pier and change hydrodynamic conditions in the area. This could change the substrate characteristics around the structure and alter the size and intensity of waves along a portion of the shoreline. Changes in substrate characteristics could positively or negatively alter the suitability of the area for use by beach spawning sockeye. The low-elevation dock and wave barrier are also expected to affect the movement or migration of juvenile salmon and other fish occurring in the area. It could also create habitat for small mouth bass, which prey on juvenile salmonids.

As a solid structure, extending well below the surface of the water, the wave barrier could obstruct fish migrating through the area in the upper water column. Although the barrier would not extend into the shallow nearshore area, where many juvenile fish likely migrate, juvenile fish are also known to use offshore areas where cover habitat is available and as they mature. Migrating fish encountering the wave barrier could have to swim around or under the structure to continue their migration, potentially altering their preferred migration patterns. There is also a concern that the combination of the wave barrier and the dock structure could increase the predator habitat in the area, potentially affecting predation rates on juvenile fish.

Eastside Transition Area

There would be no operational effects on aquatic habitat in the Eastside transition area.

How would operational lighting affect fish?

The 6-Lane Alternative options and suboptions would have street lights on the fixed bridge structures and on the maintenance facility dock under the east approach area. There would be no street lights on the floating bridge from Foster Island to the east approach area to reduce the effects on fish. However, continuous pedestrian lighting is required for the proposed pedestrian/bike path on the floating bridge.

Celedonia et al. (2009) observed that juvenile Chinook salmon are attracted to areas adjacent to existing bridge lights, including areas on the other side of the bridge from the lights. This behavior may be associated with increased foraging opportunities. While these areas could also attract predator species (Tabor et al. 2004), Celedonia et al. (2009) found limited evidence of this behavior in the predator fish they studied. The proposed bridge lighting would be similar for all the options and suboptions and to existing conditions.

The proposed lighting on the fixed bridge structures would likely have similar effects on fish behavior as lighting from the existing bridge. The lights on the maintenance facility dock could have additional effects on the distribution of juvenile salmonids and potential predators. Low-elevation docks have been shown to provide habitat for some predator species, such as smallmouth bass (Tabor et al. 2004). If predators were attracted to the maintenance facility dock and the additional lighting also attracted juvenile salmonids, the rate of predation of these salmonids could increase for all options and suboptions compared to existing conditions.

How would operation of the project affect water quality?

Stormwater that runs off the SR 520 highway within the project vicinity is currently not treated before it is discharged into Lake Washington, Lake Union, and Portage Bay. Under the proposed options and suboptions, all stormwater from new and replaced impervious surfaces would be treated before being discharged into these water bodies. All options and suboptions would be designed in accordance with the 2008 *Highway Runoff Manual* (WSDOT 2008b). WSDOT would provide enhanced stormwater treatment under all options and their suboptions, where feasible and practical. The differences in total impervious (Exhibit 3-19) and pollution-generating impervious surfaces (PGIS) (Exhibit 3-20) and resulting pollutant loading (Exhibit 3-21) are described below for all options.

> What are pollution-generating impervious surfaces (PGIS)?
>
> Impervious surfaces are structures that prevent rain from naturally penetrating into the soil (such as sidewalks and road surfaces). Pollution-generating surfaces are those that have pollutants, such as grease and oil from automobiles.

Exhibit 3-19. Pre- and Post-Project Impervious Surface Areas, by Option

Option[a]	Existing Impervious Area (acres)	Net Additional Impervious Area (acres)	Post-Project Impervious Area (acres)	Net Percent Increase in Impervious Area
Option A	78.7	26.9	105.6	34%
Option K	84.8	35.0	119.8	41%
Option L	83.5	30.0	113.5	36%

Exhibit 3-20. Pollution-Generating Impervious Surface (PGIS) and Stormwater Treatment, by Option

PGIS	Option A	Option K	Option L
Existing Untreated PGIS (acres)	57.5	64.2	60.4
Replaced Treated PGIS (acres)	32.8	42	39.5
Removed PGIS (acres)	24.8	22.2	20.9
New Treated PGIS (acres)	44.7	51.3	47.5
Total Future PGIS (acres)	77.5	93.3	87.0
Total Future PGIS Treated (%)	100	100	100

Exhibit 3-21. Net Change in Pollutant Loading from Post-Project Pollution-Generating Impervious Surface (PGIS) Areas, by Option

Option	Total Suspended Solids (lb/yr)	Total Zinc (lb/yr)	Dissolved Zinc (lb/yr)	Total Copper (lb/yr)	Dissolved Copper (lb/yr)
Option A	-29,013	-41.6	-7.52	-6.47	-0.34
Option K	-32,074	-44.5	-7.0	-6.77	-0.14
Option L	-30,204	-42.1	-6.75	-6.42	-0.15

Under all options, the proposed project would treat 100 percent of post-project PGIS (Exhibit 3-20). The future treated stormwater would contain overall lower amounts of total suspended solids, total and dissolved zinc, and total and dissolved copper. However, some individual total discharge areas (TDAs) within each option would experience local increases in dissolved copper and dissolved zinc loading. All of the options would result in a decrease in the loading of dissolved zinc and copper. Detailed information and analyses of stormwater quality and pollutant loading are provided in Water Resource Discipline Report (WSDOT 2009e).

Option A

Option A would treat 100 percent of the 77.5 acres of total future PGIS in the study area. The total effect of Option A would be a net decrease in all pollutant constituents, including dissolved zinc and copper, to the overall receiving environment except for TDA 7 (increases in dissolved copper and zinc), TDA 8 (dissolved copper), and TDA 12 (dissolved copper). Spill containment systems, isolated from the direct stormwater conveyance system, would also be provided to collect and contain any

accidental spills within the lid areas across the project. Although a few individual stormwater discharge locations could have slight increases in pollutant loads of dissolved zinc and dissolved copper, any negative effects that might occur would likely be minor and limited to the area immediately downstream or surrounding the discharge point of treated runoff. Overall, stormwater discharges from Option A would not be expected to have a substantial negative effect on aquatic life within project water bodies, including Lake Washington.

Option K

Option K would treat 100 percent of the 93.3 acres of total future PGIS in the study area. As with Option A, there could be a net decrease in all pollutant constituents, including dissolved zinc and copper, to the receiving environment except for TDA 7 (increases in dissolved copper and zinc) and TDA 8 (dissolved copper). Similar spill containment systems as under Option A could collect and contain any accidental spills within the lid areas across the project. A few individual stormwater discharge locations could have slight increases in pollutant loads of dissolved zinc and dissolved copper. Any negative effects that might occur would likely be minor and limited to the area immediately downstream or surrounding the discharge point of treated runoff. Overall, stormwater discharges from Option K would not be expected to have a substantial negative effect on aquatic life within project water bodies, including Lake Washington.

Option L

Option L would treat 100 percent of the 87.0 acres of total future PGIS in the study area. As with Options A and K, all pollutant constituents would have a net increase, including dissolved zinc and copper, to the receiving environment except for TDA 7 (increases in dissolved copper and zinc), TDA 8 (dissolved copper), TDA 9 (dissolved copper), and TDA 12 (dissolved copper). Similar spill containment systems as under Options A and K could collect and contain any accidental spills within the lid areas across the project. A few individual stormwater discharge locations could have slight increases in pollutant loads of dissolved zinc and dissolved copper. Any negative effects that might occur would likely be minor and limited to the area immediately downstream or surrounding the discharge point of treated runoff. Overall, stormwater discharges from Option L would not be expected to have a substantial negative effect on aquatic life within project water bodies, including Lake Washington.

Suboptions

Specific data are not available for impervious surface or PGIS for the various suboptions. One hundred percent of the PGIS would be treated regardless of the option or suboption. Spill containment systems, as described above, would also be applied for all suboptions.

How would operation of the project affect water quantity?

As discussed in the Water Resource Discipline Report (WSDOT 2009a) and summarized in Exhibit 3-19, the project options would add between 44.7 and 51.3 acres of new PGIS within the project subbasins, which could affect stormwater discharge rates. However, under all options, negative effects on the hydrology within the study area are expected to be minimal due to the following factors:

- No stormwater treatment facilities would discharge to streams because all stormwater would discharge to Lake Washington, Union Bay, and Portage Bay. These are considered flow-exempt water bodies that do not require stormwater detention.
- The project would increase PGIS cumulatively in the eight TDAs 34 to 41 percent over the existing impervious surface in these TDAs. While this is a substantial increase within the project footprint, overall this represents only a small proportion of the total land surface draining to Portage Bay, Lake Union, the Ship Canal, and Lake Washington.[2] The environmental consequences of these increases are not measurable due to (1) the very high level of impervious surface already present in the study area (with approximately 63 percent of the land around Lake Union and Portage Bay made up of impervious surface), and (2) the fact that receiving water bodies are unaffected by increases in flow levels.

Changes in flow generated by increases in impervious surface can degrade aquatic habitats by changing stream shape (for example, under-cutting stream banks) and increasing sediment flow and deposition. Large water bodies such as Portage Bay, Lake Union, and Lake Washington are resistant to such changes in flow, and as such, are exempt from flow control regulations in the *Highway Runoff Manual*.

As a result, no negative effects on stream base flows would occur from the increased impervious surface from any of the options. Similarly, no measurable changes would occur to aquatic habitat and organisms due to stormwater runoff flows from the project.

[2] The total area draining to these water bodies was not quantified in this analysis due to the significant changes in original basins, with a number of the surface water features being placed in culverts, ditches, and underground pipes, and with extensive basin transfers. The existing drainage system transfers water from the surrounding landscapes directly to these major water bodies without further effects to stream structure.

Mitigation

Federal regulators, Washington state agencies (including WSDOT), and some local governments require that mitigation efforts follow a prescribed sequence:

- Avoid the effect altogether by not taking a certain action or parts of an action;
- Minimize effects by limiting the degree or magnitude of the action and its implementation by using appropriate technology or by taking affirmative steps to avoid or reduce impacts;
- Rectify the effect by repairing, rehabilitating, or restoring the affected environment;
- Reduce or eliminate the effect over time by preservation and maintenance operations during the life of the action;
- Compensate for the effect by replacing, enhancing, or providing substitute resources or environments; or
- Monitor the effect and take appropriate corrective measures.

Despite extensive avoidance and minimization measures, the 6-Lane Alternative options and suboptions would have unavoidable effects on fish, aquatic habitat, wetlands, and buffers.

What has WSDOT done to avoid or minimize negative effects?

WSDOT has designed the project to minimize the permanent and temporary effects of the proposed alternatives. Specific aspects of the design that have been incorporated to avoid and minimize effects on aquatic resources include the following:

- A pile-driving test program is planned to evaluate site-specific sound levels produced by impact pile driving and the effectiveness of available sound attenuation BMPs. This program would also determine the effectiveness of vibratory pile driving in the area to develop an overall strategy for minimizing underwater sound levels associated with constructing the work bridges.
- Bridge heights would be increased in many areas to allow more light under the elevated roadway sections. This could improve

aquatic habitat conditions in these areas and minimize potential negative effects in other areas.

- Stormwater treatment facilities would be constructed to treat roadway runoff before discharging to downstream aquatic habitat. This would improve water quality in the study area.
- Existing roadway ramps would be removed to offset some of the effects of new impervious surface and create areas for habitat restoration.
- The spacing of the columns for the bridge structures would be increased, and bridge spans would be longer to reduce the number of columns in aquatic habitats.
- Two existing residential docks adjacent to the East Highrise would be removed to mitigate for potential nearshore effects of the proposed maintenance facility dock and boat slip (see Exhibit 3-14).

Standard overwater and in-water construction and demolition BMPs would be implemented in accordance with environmental regulatory permit requirements. Specific in-water construction periods would also be established through the project permitting process to minimize potential effects of pile driving and other in-water construction activities on salmonid species.

During bridge construction, contractors would use BMPs (for example, cofferdams and construction work bridges) to avoid unintentional effects on habitat and water quality during column and bridge construction activities. Cofferdams or other appropriate measures would be used to isolate work areas from open-water areas, particularly for concrete-pouring activities. In addition, work bridges would be used to minimize the use of barges in shallow-water areas. Bibs would be used to contain falling debris during construction of the new bridge decking and demolition of the existing decking. Appropriate BMPs and sound attenuation methods would be developed in coordination with the regulatory agencies and environmental permitting processes, and they would be implemented to minimize potential effects of pile-driving activities.

Other BMPs would include the following:

- Implementing temporary erosion and sediment control measures and a stormwater management and pollution prevention plan

- Minimizing any spillage of concrete or other construction material into the water
- Operating construction equipment from work bridges and barges to minimize ground disturbance when working in or near sensitive areas
- Restoring cleared areas to preconstruction grades and replanting the areas with appropriate native herbaceous and woody species

What would be done to mitigate negative effects that could not be avoided or minimized?

Compensatory mitigation would be a component of all the options of the 6-Lane Alternative. Compensatory mitigation would be used to compensate for effects on fish and other aquatic resources from the increased in-water and overwater structures. The goal of the compensatory mitigation would be to achieve no net decrease in fish survival.

In cooperation with resource agencies, WSDOT would develop plans for habitat improvements, restoration, or construction to mitigate the effects of bridge construction, the increased width of shoreline and open-water crossings, and direct physical impacts from construction activities. Specific plans would be included in permit applications for construction of the I-5 to Medina Project.

Because of the different types of potential project effects on fish and aquatic resources, and because these potential effects would occur in several distinct habitat types (for example, open water versus shoreline), WSDOT may conduct specific mitigation activities at more than one location within the WRIA 8 watershed. The highly urbanized environment within the study area and Lake Washington, in general, influences the potential need for this type of mitigation strategy, which limits the number and sizes of available mitigation sites along the lake. This approach has several advantages:

- Multiple mitigation sites could be individually designed to focus on enhancing and/or providing specific categories of aquatic functions and values affected by the project (for example, shoreline habitat functions).
- Mitigation sites could be selected based on the life history requirements of important aquatic species (for example, salmonid migration). Also, mitigation design could address project effects

while improving previously identified limiting factors for the species of interest. Through this approach, increased survival or productivity of aquatic species could offset direct effects on aquatic organisms (for example, fish mortality from pile driving).

- Maintenance, monitoring, and adaptive management techniques might be more effective if they could be tailored to a specific mitigation site, based on the functions and values that would be created or enhanced.

Although specific mitigation activities would depend on the design option ultimately constructed, several types of general mitigation options are apparent. These include mitigation opportunities within Lake Washington and the important tributaries for fish production, such as the Cedar River or Bear Creek, as well as opportunities within Lake Union and the Ship Canal or the marine shorelines of WRIA 8. Although the specific fisheries functions and values supported within lacustrine, riverine, or marine areas differ somewhat, the primary mitigation goal would be to compensate for the project's physical and biological effects while enhancing the production and survival of fish species to the maximum extent practicable. Specific mitigation actions would support spawning, rearing, or migrating salmonids and could include the following:

- Restoring Lake Washington, Lake Union, or Ship Canal shoreline habitat that could include removal of existing overwater and in-water structures (docks or piers) and debris that provide in-water shade and may provide habitat for salmonid predators.
- Conducting shoreline improvements such as converting steep vertical shorelines that have bulkhead or riprap armoring to lower gradient beaches with sand-gravel substrate.
- Planting shoreline areas with nearshore native vegetation while removing invasive species (for example, Eurasian milfoil).
- Installing habitat features, such as large woody debris (LWD) or other natural/artificial habitat elements that could provide cover to migrating or rearing fish within Lake Washington or the Ship Canal. These habitat features could increase migration success and decrease predation on migrating juvenile salmonids.
- Enhancing key reaches of riverine spawning, rearing, and migration areas (located upstream of the project) through bank restoration,

riparian vegetation enhancement, substrate enhancement, and/or installation of habitat structure (such as LWD).

- Enhancing nearshore marine areas that support juvenile salmonids within WRIA 8. Specific activities may include enhancing shoreline structure, riparian reserves, aquatic macrophytes (for example, eelgrass), or overwater structures.
- Protecting functioning habitat through land acquisitions and easements.

What negative effects would remain after mitigation?

After construction of the I-5 to Medina Project is complete, the aquatic areas temporarily affected by construction would be restored, and riparian areas would be replanted with native vegetation. Although the existing in-water and overwater bridge structures would be removed to the mud line, the proposed project could result in a substantial increase in subsurface pile structures remaining below the lakebed. While some of this increase could be mitigated through the removal of similar structures elsewhere in the overall watershed, it is not practical to achieve a no net increase in these structures.