16 February 2006

SR 520 Bridge Replacement and HOV Project Draft EIS

6-Lane Alternative Options

Addendum to Ecosystems Discipline Report

Washington State Department of Transportation

SoundTransit

U.S. Department of Transportation
Federal Highway Administration

SR 520 Bridge Replacement
and HOV Project EIS
6-Lane Alternative Options

Addendum to the Ecosystems Discipline Report

Prepared for

Washington State Department of Transportation
Federal Highway Administration
Sound Transit

Lead Author

Parametrix, Inc.

Consultant Team

Parametrix, Inc.
CH2M HILL

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Contents

List of Exhibits

Acronyms and Abbreviations

BMP	best management practice
Ecology	Washington State Department of Ecology
GPS	Global Positioning System
LWD	large woody debris
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

Introduction

This addendum to the *Ecosystems Discipline Report* (Parametrix 2004; Appendix E to the *Draft SR 520 Replacement and HOV Project Environmental Impact Statement* [Draft EIS]) describes the affected environment and environmental consequences to wetlands, fish, and wildlife resources from the three options to the original 6-Lane Alternative. The 6 Lanes with Pacific Street Interchange and the Second Montlake Bridge options are in Seattle, and the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option is on the Eastside. These options are described in depth below.

What are the key points of this report?

Wetlands

Seattle

Both the 6 Lanes with Pacific Street Interchange and the Second Montlake Bridge options would result in approximately the same of amount of permanent fill (~0.2 acre) in the Seattle area wetlands as described for the original 6-Lane Alternative in the *Ecosystems Discipline Report*. All permanent effects to wetlands from the original 6-Lane Alternative or its options would be mitigated according to the regulations in effect at the time of project permitting.

The 6 Lanes with Pacific Street Interchange option would have slightly greater overall direct shading effects than the original 6-Lane Alternative. The Second Montlake Bridge option would have the same effect on wetlands as the original 6-Lane Alternative.

Eastside

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would have a larger effect on wetlands compared to the original 6-Lane Alternative; approximately 7.8 acres would be filled. The original 6-Lane Alternative would result in only approximately 6.4 acres of fill in wetlands.

Fish Resources

Seattle

Bridge Shadow Effects on Fish

Both the 6 Lanes with Pacific Street Interchange and Second Montlake Bridge options would place a new bridge across the migratory path of anadromous salmonids produced in Lake Washington.

The 6 Lanes with Pacific Street Interchange option would include an additional bridge over Union Bay at the eastern mouth of the Montlake Cut. This Union Bay Bridge would include additional support columns on either side of the navigation channel, and a diffuse shadow over the migratory route of Chinook salmon and other anadromous salmonids.

The Second Montlake Bridge option would place a new 58-foot-wide, low level (32 to 48 feet above water) bridge with a solid deck over the Montlake Cut. This bridge would cast a darker shadow than the existing Montlake Bridge and much darker shadow than the Union Bay Bridge because of its relatively low level and its location over the narrowest portion of the Cut where there are steep shoreline slopes.

The widths and heights and, therefore, the shadows of the bridges over the shorelines and aquatic habitat of the Portage Bay, Union Bay, and Arboretum areas would vary between the two options and the original 6-Lane Alternative.

All fish reaching the location of the new bridges would have previously passed under numerous bridges, many casting darker shadows. Therefore, the new bridges would probably not have a detectable effect on fish. The differences in shadows would not have detectably greater negative or positive effects on fish resources than the original 6-Lane Alternative.

Support Columns

The number and size of support columns in water aquatic habitat of these areas would be greater for the 6 Lanes with Pacific Street Interchange option than the original 6-Lane Alternative because of the additional bridge over Union Bay. The amount of benthic soft bottom habitat replaced by vertical concrete habitat would be greater than with the original 6-Lane Alternative, thereby reducing production of invertebrate prey for fish. The new columns would provide large, smooth vertical surfaces within the water column that would not be

likely to provide attractive habitat for smallmouth bass or other salmonid predators.

Stormwater (Water Quality) Effects on Fish

The 6 Lanes with Pacific Street Interchange option would increase the overall net impervious surface in the Union Bay area and relocate the stormwater treatment and discharged sites. Elimination of the Montlake Interchange on-ramps and off-ramps would reduce the amount of stormwater discharged to the eastern part of the Portage Bay Basin (Treatment Facility PB-2 in Exhibit 22 of the *Water Resources Discipline Report*; Parametrix 2005a) and to the western portion of the Union Bay Basin (Treatment Facility UB-1 in Exhibit 22 of the *Water Resources Discipline Report*; Parametrix 2005a). Stormwater falling on either the new Union Bay Bridge or the second Montlake Bridge would be collected and treated as part of the stormwater system for this portion of the project. No changes in water quality that could affect fish are anticipated.

Stormwater generated by impervious surface areas in Portage Bay and Union Bay (Arboretum) would be collected and treated prior to discharge for the 6 Lanes with Pacific Street Interchange option. This option would also collect and treat stormwater generated along the widened Montlake Boulevard (25th Avenue Northeast) north of Northeast Pacific Street. Flow control and water quality treatment as specified in the *Highway Runoff Manual* (WSDOT 2004) by the stormwater treatment system would be provided for the additional impervious surface areas for both Seattle project area options. No treatment of stormwater currently occurs within these areas.

Eastside Streams

Stormwater (Water Quality and Quantity) Effects on Fish

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would add approximately 3.2 acres of additional impervious surface to Eastside stream sub-basins, as compared to the original 6-Lane Alternative. However, there would be no substantial negative effects on fish from water quality and quantity because stormwater would be treated and detained before discharge to Eastside project area streams, as described in the *Water Resources Technical Memorandum*.

Culvert (Connectivity and Channel Loss) Effects on Fish

The original 6-Lane Alternative would result in a net loss of approximately 220 linear feet of open channel habitat, as the result of six required culvert extensions. In comparison, the South Kirkland Park-and-Ride Transit Access –108th Avenue Northeast option would result in a net loss of 50 feet of open channel habitat because of the removal of several existing culverts would offset new culvert extensions. Three culverts (112, 101, and 75 feet long) would be completely removed as part of the South Kirkland Park-and-Ride Transit Access –108th Avenue Northeast option. As with the original 6-Lane Alternative, all WSDOT fish barrier culverts within the project area would be replaced or upgraded to be fully passable by fish, leading to a substantial improvement in fish passage within several project area streams.

Riparian Vegetation

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would permanently remove 21,706 square feet of riparian vegetation (due to placement of fill) at seven Eastside streams. Overall, there would be approximately 20 percent more riparian buffer loss than under the original 6-Lane Alternative.

Wildlife

In the Seattle project area, the 6-Lane Alternative options would remove less vegetation (from -2.2 to -4.3 acres) than the original 6-Lane Alternative, but would result in more shading of vegetation (1.9 to 2.1 acres). In the Eastside project area, the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would remove more vegetation (+2.3 acres) than the original 6-Lane Alternative. Neither the original 6-Lane Alternative nor the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would result in shading effects on vegetation in the Eastside project area.

The 6-Lane Alternative options would result in essentially the same noise levels near the roadway from highway operation, and consequent disturbance to wildlife, as the original 6-Lane Alternative.

Minor differences in barriers and obstructions to wildlife movement among the 6-Lane Alternative options and original 6-Lane Alternative would occur due to differences in bridge height and elevated roadway and the presence/absence of two bridges (the Union Bay Bridge and the second Montlake Bridge). For example, flying bald eagles, peregrine

falcons, and other state-listed and state-priority bird species could be affected.

Highway operation effects on federally and state-listed species occurring in the project area would be similar among the 6-Lane Alternative options and the original 6-Lane Alternative. As noted above, some bird species could be affected. The 6-Lanes with Pacific Street Interchange option would shade an additional 2.1 acres of wetlands compared to the original 6-Lane Alternative. This could reduce habitat quality for great blue herons, hooded mergansers, and wood ducks, state priority species that may use these shaded areas.

Similar to the original 6-Lane Alternative, stormwater treatment and detention for each of the options would minimize effects on wildlife in both Seattle and on the Eastside.

The Pacific Street Interchange option would construct the Union Bay Bridge, which could adversely affect bird and wildlife behavior in the vicinity of Marsh Island.

The Second Montlake Bridge option would construct a second bridge over the Montlake Cut, which could cause some additional disturbance to birds in the area.

What options are being considered in this addendum?

6 Lanes with Pacific Street Interchange Option

This option would remove the Montlake interchange along SR 520 and would construct a new interchange at Pacific Street, just east of the Montlake interchange. Exhibit 1 shows the proposed lane configuration for this option.

The new interchange would be primarily located over the WSDOT-owned peninsula near the Washington Park Arboretum. A new on- and off-ramp to and from the north would extend to Pacific Street at the University of Washington. A column-supported ramp of four general-purpose lanes (two lanes in each direction) extending over Union Bay (referred to as the Union Bay Bridge in this addendum) from the new interchange would touch down at the University of Washington Husky Stadium parking lot before joining the intersection of Pacific Street and Montlake Boulevard. At that intersection, the roadway would be

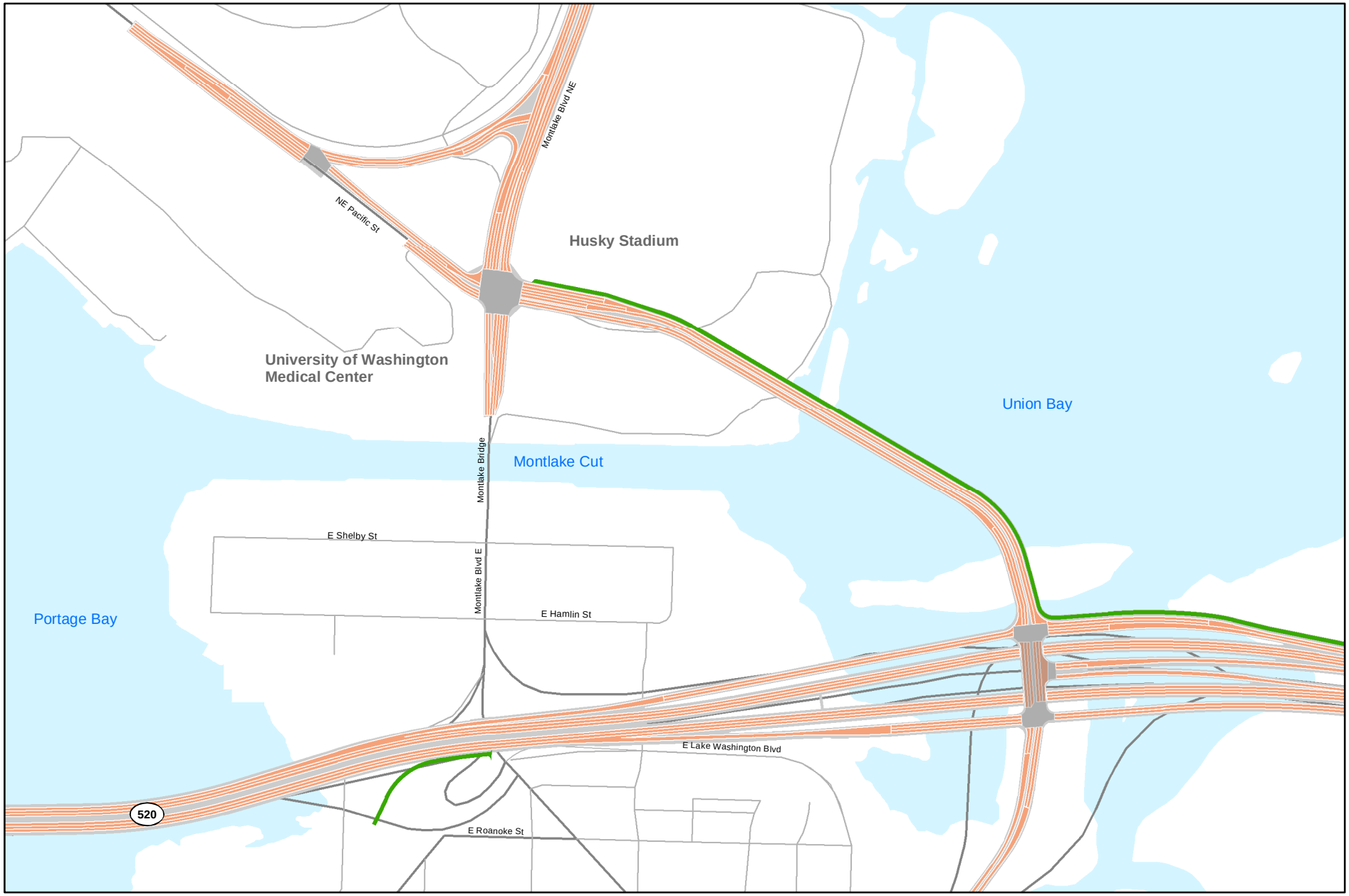

Exhibit 1. **Lane Configuration of the 6 Lanes with Pacific Street Interchange Option**
SR 520 Bridge Replacement and HOV Project

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lowered 8 to 10 feet from the existing elevation to provide vehicle-only access. The intersection would be covered to allow pedestrian access above and away from vehicular traffic.

The roadway on Montlake Boulevard north of Pacific Street would be widened to the east until just south of Northeast 45th Street. The navigational channel crossed by the new Union Bay Bridge would be the same width as the existing Union Bay reach (175 feet), with a vertical clearance of either 70 or 110 feet.[1] Columns would be placed just outside the width of the ship canal to avoid navigation hazards.

Ramps to and from Lake Washington Boulevard would still be included in this option; however, their footprint would be slightly different from the original 6-Lane Alternative. The ramp connections to and from Lake Washington Boulevard and to and from the Union Bay Bridge would construct a full diamond interchange, as opposed to a partial diamond interchange under the original 6-Lane Alternative. This full diamond interchange would provide more access to and from Lake Washington Boulevard. No access to or from SR 520 would be provided at Montlake Boulevard.

From Montlake Boulevard to I-5, SR 520 would be six lanes wide (three in either direction). The profile of the Portage Bay Bridge would not differ under this option from the original 6-Lane Alternative. Buses would access SR 520 via the Union Bay Bridge through the University area, providing for a more direct connection between buses and the proposed Sound Transit North Link Station at Husky Stadium. Instead of connecting to the Montlake interchange as in the original 6-Lane Alternative, the bicycle/pedestrian path would follow the Union Bay Bridge from SR 520 and would end at the Pacific Street interchange, close to the Burke-Gilman Trail.

Second Montlake Bridge Option

The intent of the Second Montlake Bridge option is to narrow the SR 520 footprint through the Montlake neighborhood, while providing for transit (bus) access from SR 520 to the University of Washington.

[1] The establishment of a new governing clearance would prevent any vessel with a higher clearance requirement from traveling east from the Montlake Cut to Lake Washington north of the Evergreen Point Bridge. Before establishing a new governing clearance, the Coast Guard will consider whether vessels requiring a higher clearance have an essential use in north Lake Washington. Two vessels with a vertical clearance higher than 70 feet are known to travel this part of the lake. No vessels with a vertical clearance higher than 110 feet travel this part of the lake.

Exhibit 2 shows the propose lane configuration for this option, which would be the same as the No Montlake Freeway Transit Stop option, except that it would also include a second Montlake bridge across the Montlake Cut. This bridge would be a parallel bascule (draw) bridge located just east of the existing Montlake Bridge. One bridge would carry northbound traffic, and one would carry southbound traffic.

South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option

The intent of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option is to improve access for buses to the South Kirkland Park-and-Ride from eastbound SR 520 and from the South Kirkland Park-and-Ride to westbound SR 520. This option, which is shown in Exhibit 3, would add a new transit/HOV-only westbound on-ramp from 108th Avenue Northeast and a new transit/HOV-only eastbound off-ramp to 108th Avenue Northeast.

The footprint of SR 520 east of Bellevue Way would be widened slightly to accommodate the new ramps. Both 108th Avenue Northeast and Northup Way would be widened and improved under this option. One lane would be added to 108th Avenue Northeast between the eastbound on-ramp and 38th Place Northeast. Along with the additional through lane on 108th Avenue Northeast, the northbound leg of the 108th Avenue Northeast/Northup Way intersection would be channelized to include two exclusive left-turn lanes, a through lane, and a shared through/right-turn lane.

There is also a possibility for adding a westbound second left-turn lane at the 108th Avenue Northeast/Northup Way intersection to facilitate clearing the left-turn queue and serving a higher number of westbound left-turn and through trips.

Exhibit 2. **Lane Configuration of the Second Montlake Bridge Option**

SR 520 Bridge Replacement and HOV Project

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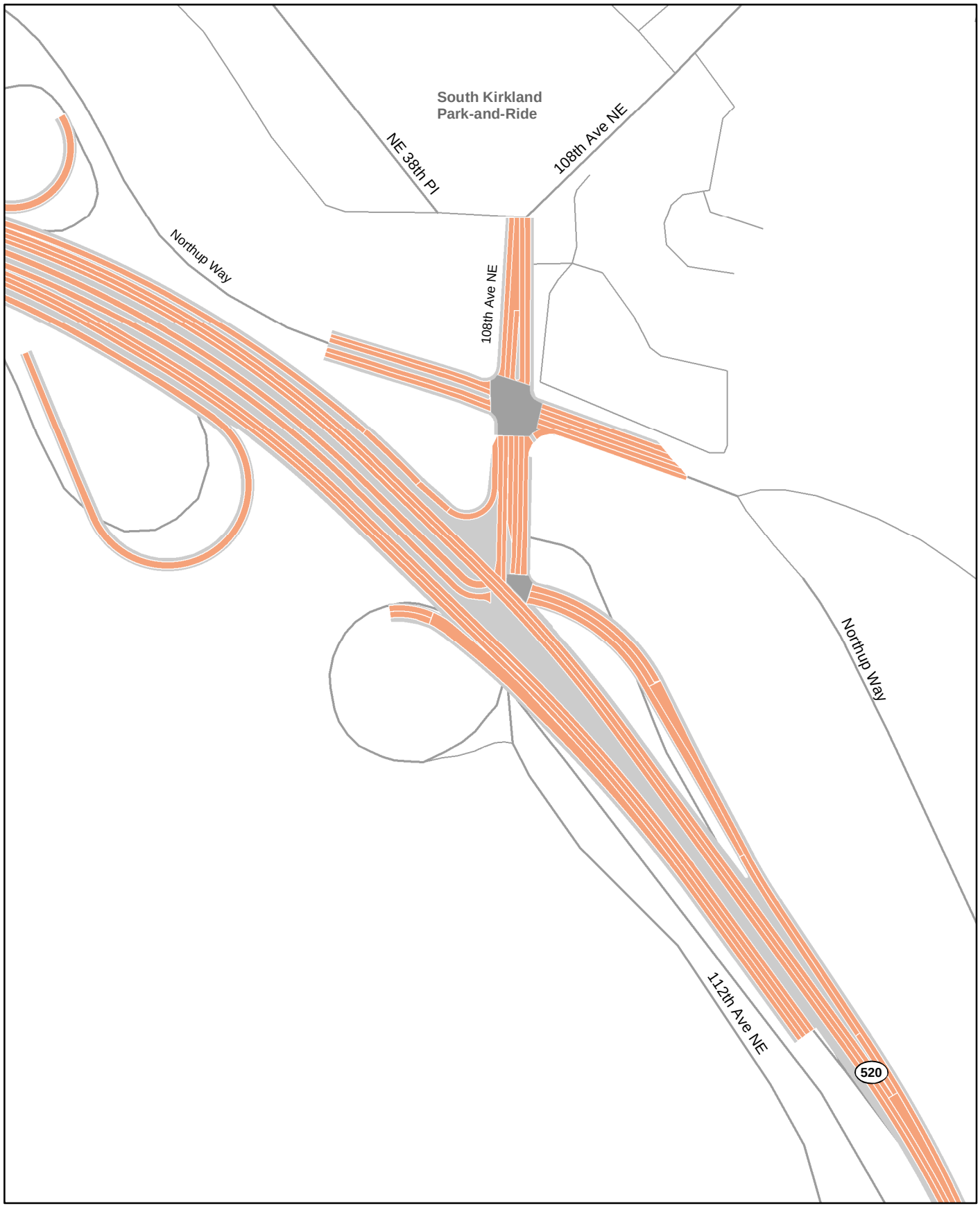

Exhibit 3. **Lane Configuration for the South Kirkland Park-and-Ride Transit Access - 108th Avenue Northeast Option**
SR 520 Bridge Replacement and HOV Project

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Wetlands

Affected Environment

How was information on wetlands collected?

The ecosystems discipline team collected additional information for this analysis using the same methodology described in the *Ecosystems Discipline Report*.

Where in the project area do wetlands occur and why?

Wetlands in the Seattle and Eastside project areas were previously described in the *Ecosystems Discipline Report.* Exhibits 14 and 16 of the *Ecosystems Discipline Report* list the wetlands in the Seattle and Eastside project areas, respectively. Exhibits 15 and 17 in the *Ecosystems Discipline Report* show the locations of the wetlands in the Seattle and Eastside project areas, respectively.

Seattle

For this analysis, the Seattle project area has been expanded beyond Portage Bay, Montlake Cut, and the Arboretum to include new wetlands located along the western and northern shorelines of Union Bay. These wetlands may be affected by the 6-Lane Alternative options. These wetlands are described below.

Exhibit 4 shows the general location of the wetlands that are adjacent to or on the University of Washington campus. These wetlands were evaluated because detained and treated stormwater from the proposed Union Bay Bridge (part of the 6 Lanes with Pacific Street Interchange option) and improvements to Lake Washington Boulevard would be discharged to Union Bay via the University Slough on the east campus of the University of Washington (University of Washington 2001). The University Slough intersects wetland areas along the Lake Washington shoreline in the east campus (east of Montlake Boulevard). See the *Addendum to Water Resources Discipline Report* for a description of the stormwater system in this area.

The flat areas of the University of Washington east campus were created when the Hiram M. Chittenden Locks were built in 1916. An original delta area became a cattail marsh; the marsh is underlain by peat deposits. Now known as the Union Bay Natural Area, this land is bounded on the southeast and south by Lake Washington, on the west by parking lots and athletic fields, on the north by the university's ceramic and metal arts facility, and on the east by the university's Center for Urban Horticulture. The marsh was used as a landfill (the former

Montlake Landfill) until the mid-1960s, when the City of Seattle began closure. A minimum 2-foot cap of clean soil was spread over the area, graded, and seeded; closure was completed in 1971. Since then, subsidence of the deep, spongy peat substrate underlying the landfill has led to the development and expansion of wetlands (University of Washington 2001).

The 55-acre Union Bay Natural Area encompasses landward and shoreline wetlands. This report describes the shoreline wetlands because they may be affected by the project. Additional information is available in the *University of Washington Master Plan Seattle Campus Final Environmental Impact Statement* (University of Washington 2001).

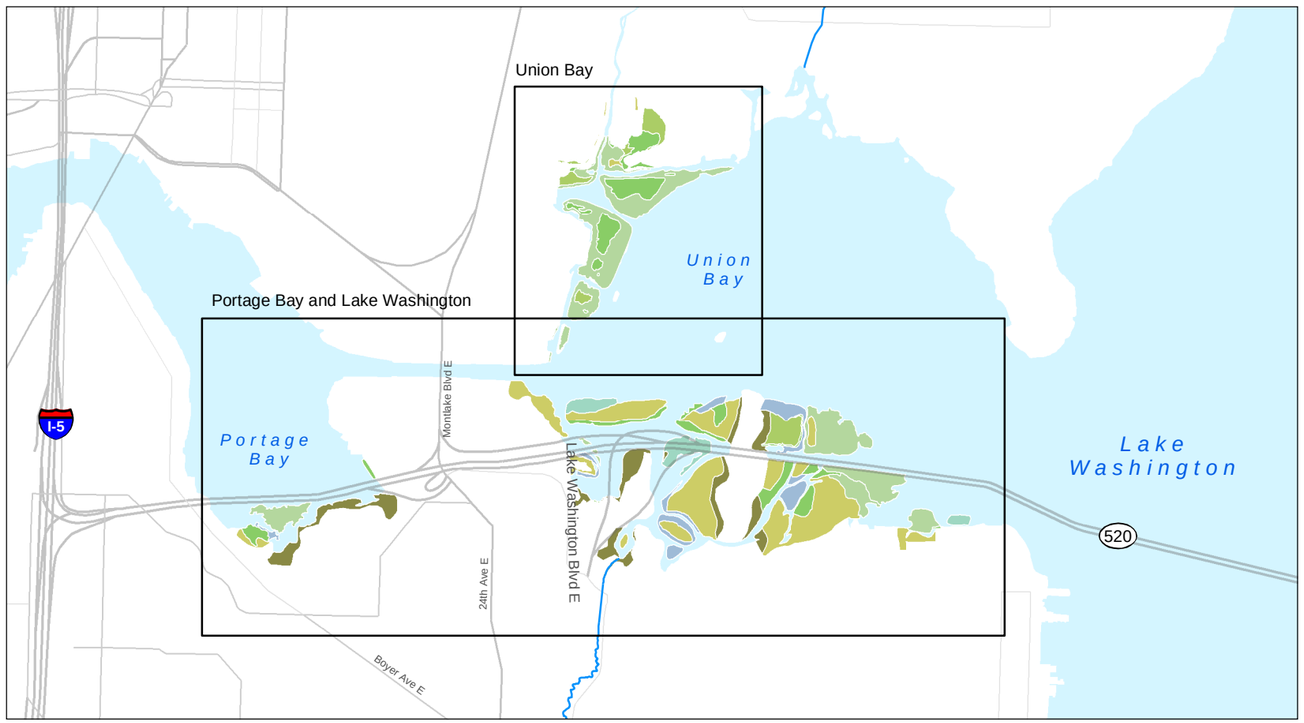
The Union Bay shoreline wetlands system runs from the east end of the Montlake Cut to Laurelhurst. This system comprises emergent, scrub-shrub, forested, and aquatic-bed wetlands. Emergent and some scrub-shrub wetlands dominate the western portion of this shoreline area. The eastern shoreline area, from the Center for Urban Horticulture to Laurelhurst, consists of scrub-shrub and forested wetlands.

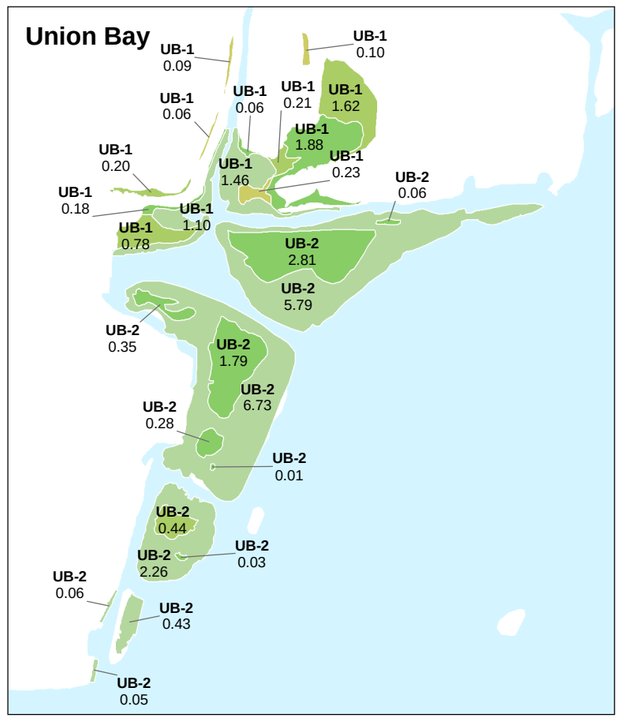
Dominant vegetation in the emergent wetland area includes common cattail (*Typha latifolia*), yellow iris (*Iris pseudacorus*), purple loosestrife (*Lythrum salicaria*), soft rush (*Juncus effusus*), field horsetail (*Equisetum arvense*), water plantain (*Alisma plantago-aquatica*), and reed canarygrass (*Phalaris arundinacea*). The scrub-shrub wetlands are dominated by Himalayan blackberry (*Rubus discolor*), Pacific willow (*Salix lucida* var. *lasiandra*), Sitka willow (*Salix sitchensis*), red-osier dogwood (*Cornus sericea* ssp. *sericea*), red alder (*Alnus rubra*), and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*).

Forested wetlands along the Union Bay shoreline are dominated by black cottonwood, red alder, Pacific willow, Sitka willow, and giant horsetail (*E. telmateia*). The aquatic bed wetland areas are dominated primarily by white water lily (*Nymphaea odorata* var. *odorata*), yellow pond lily (*Nuphar luteum* ssp. *polysepalum*), and Eurasian water-milfoil (*Miriophyllum spicatum*).

Noxious weeds in the shoreline wetland area include yellow iris, purple loosestrife, Himalayan blackberry, white water lily, and Eurasian water-milfoil. During the winter, these shoreline wetlands are exposed to wave erosion when the water level in the lake is lowered by up to 2 feet to facilitate repair and cleanup along the Ship Canal and the shoreline (University of Washington 2001).

The University Slough extends from Wahkiakum Lane north to 45th Avenue Northeast. The banks of the slough are dominated by native and non-native invasive species, including Himalayan blackberry, willows, reed canarygrass, black cottonwood, Scots broom (*Cytisus scoparius*), red alder, and horsetail. The water and





Wetland Class

- L1AB - Limnitic Aquatic Bed
- L2AB - Littoral Aquatic Bed
- L1AB/L2AB
- PFO - Forested
- PSS - Scrub-Shrub
- PEM - Emergent
- PEM/PSS

Source: City of Seattle (2003) GIS Data (Wetlands); City of Bellevue (2004) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91), vertical datum is NADV88. Field updates by Parametrix, 2002-2004.

Note: Wetlands are labeled by name and/or class, and acreage.

N

0 250 500 1,000 Feet

Exhibit 4. **Locations of Wetlands in The Seattle Project Area**

SR 520 Bridge Replacement and HOV Project

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saturated areas are composed of common cattail, yellow iris, lesser duckweed (*Lemna minor*), purple loosestrife, hardstem bulrush (*Scirpus acutus*), and pond lily (University of Washington 2001).

Eastside

The *Ecosystems Discipline Report* described all wetlands of the Eastside project area.

What functions do project area wetlands provide?

Seattle

Wetlands in the Seattle project area provide a number of valuable functions, which were described in Exhibit 18 of the *Ecosystems Discipline Report*. Similar functions apply to the wetlands in the Union Bay Natural Area on the north side of Montlake Cut (Exhibit 5).

All of these wetlands help to improve water quality; however, their location in the lower watershed limits their potential to alter flood flows or store flood waters. The dense vegetation in these wetlands retains sediments and nutrients, which enter as runoff from adjacent upland areas and paved roads. The University Slough wetlands rate higher than others in the Seattle project area, because they are directly connected to stormwater outfalls and have a long linear feature that allows settling of sediments and nutrients prior to reaching Lake Washington. 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.

Exhibit 5. Summary of Wetland Functions in the Seattle Project Area

	Wetland Functions[a]					
Wetlands	Flood Flow Alteration	Sediment, Nutrient, and Toxicant Removal	Erosion Control and Shoreline Stabilization	Production/ Export of Organic Matter	Habitat Suitability	Social Values
PBN-1	Low	Moderate	High	Moderate	Moderate	Moderate
PBS-1, LWN-1 through N-4, LWS1-S-4	Low	Moderate	High	High	High	High
Union Bay	Low	High	High	High	High	High

Note: The wetlands in the Seattle project area are primarily lacustrine fringe; therefore, this exhibit does not provide a breakdown by hydrogeomorphic class.

[a] Functions rated using the WSDOT Best Management Practice method; this information is available upon request.

The dense vegetation also contributes fine organic material and woody debris to Lake Washington; the larger wetlands (LWN-1 through N-4, LWS-1 through LWS-4, and Union Bay north wetlands) provide more organic material than the smaller ones.

The Seattle project area wetlands, including the Union Bay north wetlands, also provide habitat for a variety of wildlife, from invertebrates to mammals. Relatively stable water levels, dense emergent and shrub vegetation, snags and floating logs, and relatively undisturbed forested and shrub buffers all contribute to the habitat suitability of these wetlands. Habitat functions and associated wildlife species were described in the *Ecosystems Discipline Report*.

Because of their proximity to Seattle, and to the Washington Park Arboretum and University of Washington in particular, these Seattle project area wetlands provide opportunities for both educational and recreational use. Wetland PBS-1 and the Lake Washington wetlands provide greater social value than PBN-1 because they are larger and more complex.

Eastside

All wetland functions in the Eastside project area were described in the *Ecosystems Discipline Report.*

Potential Effects of the Project on Wetlands

What methods were used to evaluate potential effects on wetlands?

The ecosystems discipline team used similar methods for assessing effects on wetlands from the various options that they used for the original 6-Lane Alternative. These methods were described in the *Ecosystems Discipline Report*.

How would the 6-Lane Alternative options permanently affect wetlands?

The types of effects on wetlands (such as filling, shading, or clearing) that would occur to wetlands from the 6-Lane Alternative options would be the same as for the original 6-Lane Alternative. Areas of wetland fill or alteration under each option in the project area are described in this section and summarized in Exhibit 6.

There would be no change to the proposed project in the Lake Washington project area. Therefore, all options would have the same effects as the original 6-Lane Alternative on the floating bridge portion of the Evergreen Point Bridge. These effects were described in the *Ecosystems Discipline Report*.

Exhibit 6. Total Effects on Wetlands under the Original 6-Lane Alternative Compared to the 6-Lane Alternative Options

	Seattle			Eastside	
	Original 6-Lane Alternative	6 Lanes with Pacific Street Interchange Option	Second Montlake Bridge Option	Original 6-Lane Alternative	South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option
Fill by Wetland Category (in acres)					
I	0.2	0.2	0.2	<0.1	<0.1
II				0.7	0.7
III				5.7	7.1
IV				<0.1	<0.1
Subtotal	**0.2**	**0.2**	**0.2**	**6.4**	**~7.8**
Shade by Wetland Category (in acres)					
I	1.3	1.6	1.3	0	0
Subtotal [a]	**1.3**	**1.6**	**1.3**	**0**	**0**
Total Fill and Shade in Buffers	6.0	5.3	6.0	11.6	12.7

[a] Total shade effect (loss of vegetation cover) was calculated in acres from the northernmost edge of the bridges and ramp decks to the southernmost edge. For the original 6-Lane Alternative, it was assumed that the deck would provide complete cover over the land or water surfaces vertically projected from the deck to the surface. The 6 Lanes with Pacific Street Interchange option would contains gaps between the structures. However, for comparison to the original 6-Lane Alternative, the shade effects reported in the table are the gross amount, not including the gaps. These gaps would reduce the overall shade effect for these two options.

Seattle

How much wetland area would be filled or shaded as a result of the project?

6 Lanes with Pacific Street Interchange option

This option would have more effects on wetlands than the original 6-Lane Alternative, primarily because of shading effects over wetlands. Exhibit 7 shows areas of wetlands that would be affected by the 6 Lanes with Pacific Street Interchange option.

The 6 Lanes with Pacific Street Interchange option could shade a total of 7.8 acres of Category I wetlands. Total shade effect was calculated from the northern most edge of the bridges and ramp decks to the southern most edge (Exhibit 8). For the original 6-Lane Alternative, the ecosystems discipline team assumed that the bridge structures could shade 6.7 acres of wetlands by providing complete cover over the land or water surfaces vertically projected downward from the deck to the surface. The 6 Lanes with Pacific Street Interchange option, however, also would contain gaps between the structures, totaling 1.5 acres. These gaps would allow direct and indirect light to reach the ground and water surface and support vegetation growth.

An ongoing study is evaluating the effects of light intensity on vegetation in the Arboretum (Parametrix 2005b). The preliminary results of this study show that vegetation is currently growing under existing bridge structures in partial shade and in indirect light. Only very low bridges completely shade out all vegetation.

The results of this study indicate that complete loss of vegetation from shading would be much less than originally reported. Complete shading may only occur in a small portion of the affected area. Partial shading would occur in most of the remaining area. However, a large portion of the area partially shaded by the proposed bridges would still receive sufficient diffuse light to support plant growth. In addition, gaps between the bridge structures would allow indirect and direct light to reach the surface. The removal of existing bridges would expose currently shaded areas to full sun.

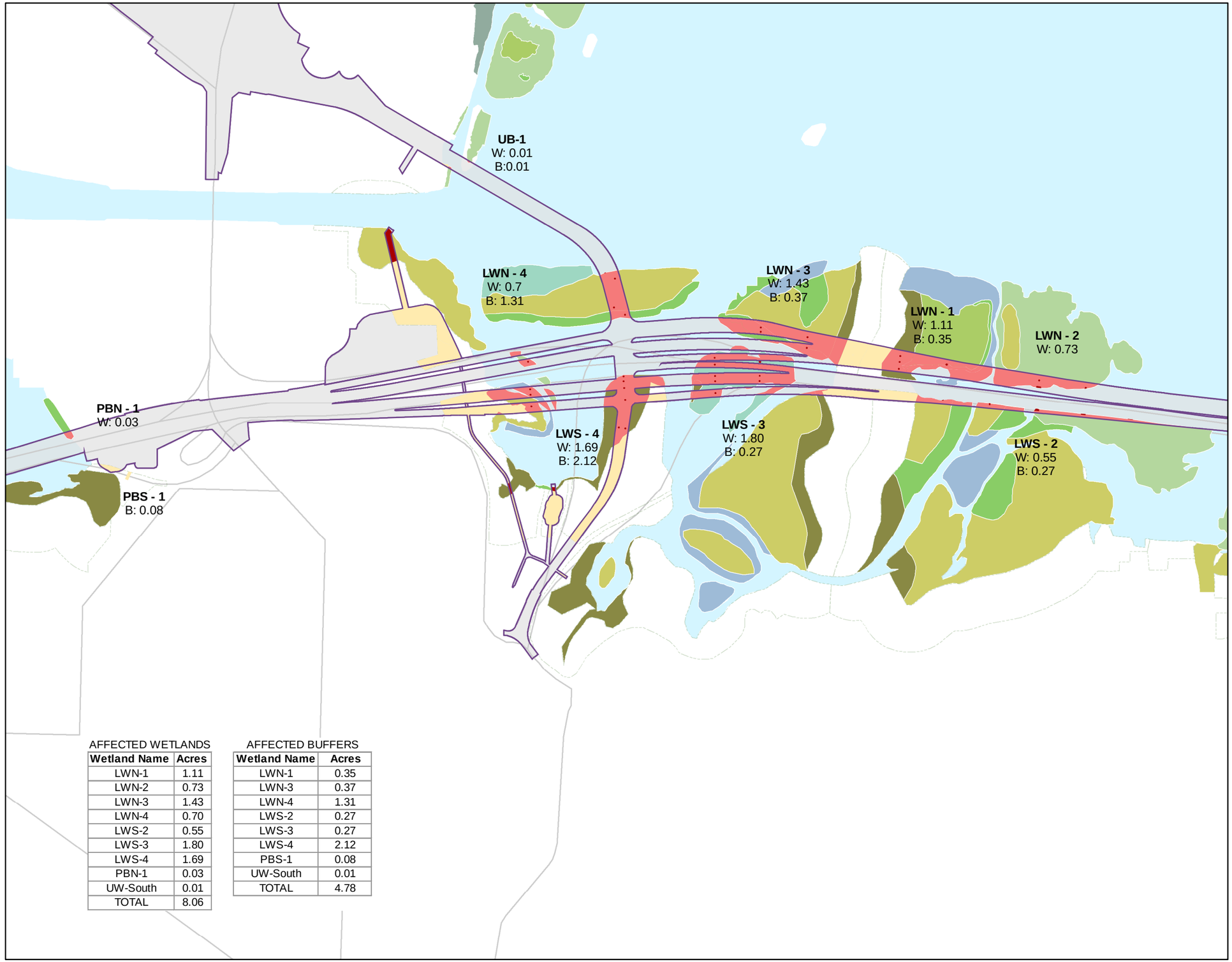
In summary, some areas would be well vegetated, while others may only have sparse cover under the original 6-Lane Alternative. An estimate of approximately 20 percent, or approximately 1.3 acres, of the original shade effect would be devoid of plant cover with the original 6-Lane Alternative. Similarly, approximately 1.6 acres would be completely shaded from the 6 Lanes with Pacific Street Interchange option. This estimate is based on the data collected in the field and other observations of the study area.

Most of the shading effects under the 6 Lanes with Pacific Street Interchange option would occur over Marsh Island, forested wetlands LWS-4 on the WSDOT-owned peninsula, and on the north side of the alignment as it crosses Foster Island (Exhibit 7). The degree of the shading intensity would be somewhat greater than the original 6-Lane Alternative over Foster Island, because although the height of the bridge would not change (Exhibit 9), it would be wider and contain gaps.

Columns supporting the bridge structures would directly fill wetlands (Exhibit 10). The 6 Lanes with Pacific Street Interchange option would fill 0.2 acre of wetlands, the same as with the original 6-Lane Alternative. Additional bridge columns would be built in open water areas.

This option would not directly affect University Slough or the wetlands in the Union Bay Natural Area. However, a small shoreline wetland near the University of Washington Waterfront Activities Center would be partially shaded by the Union Bay Bridge. No effects to water quality would occur because stormwater would be treated prior to release to Ravenna Creek and the University Slough. These indirect effects would be similar to the original 6-Lane Alternative.

Effects on wetland buffers would decrease by about 10 percent, primarily because of less shading from ramps in the Arboretum. For more information on wetlands, see the *Ecosystems Discipline Report, Wetlands* section.



AFFECTED WETLANDS

Wetland Name	Acres
LWN-1	1.11
LWN-2	0.73
LWN-3	1.43
LWN-4	0.70
LWS-2	0.55
LWS-3	1.80
LWS-4	1.69
PBN-1	0.03
UW-South	0.01
TOTAL	8.06

AFFECTED BUFFERS

Wetland Name	Acres
LWN-1	0.35
LWN-3	0.37
LWN-4	1.31
LWS-2	0.27
LWS-3	0.27
LWS-4	2.12
PBS-1	0.08
UW-South	0.01
TOTAL	4.78

6 Lanes with Pacific Street Interchange Option Footprint

Affected Wetlands - Fill

Affected Wetlands - Elevated Roadway

Affected Wetland Buffer

Wetland Class

L1AB - Limnitic Aquatic Bed

L2AB - Littoral Aquatic Bed

L1AB/L2AB

PFO - Forested

PSS - Scrub/Shrub

PEM - Emergent

PEM/PSS

Unclassifed

Wetland Buffer

Source: City of Seattle (2003) GIS Data (Wetlands); City of Bellevue (2004) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91), vertical datum is NADV88. Field updates by Parametrix, 2002-2004.

Note: Wetlands are labeled with wetland name and affected wetland (W) and buffer (B) acreage.

N

0 250 500 Feet

Exhibit 7. **Affected Wetlands under the 6 Lanes with Pacific Street Interchange Option**
SR 520 Bridge Replacement and HOV Project

Exhibit 8. Approximate Widths (feet) of Original 6-Lane Alternative and Options at Shoreline Crossings in Seattle

Location	Original 6-Lane Alternative	6-Lane with Pacific Street Interchange Option	Second Montlake Bridge Option
Portage Bay			
West shoreline	148	136	148
East shoreline	280	125	280
Foster Island			
West shoreline	270	320	270
East shoreline	210	230	210
Union Bay			
South side	NA	100	58
North side	NA	90	58
Lake Washington			
East shoreline	180	180	180

Exhibit 9. Approximate Distance (feet) from Bottom of Bridges to Water Surface, Original 6-Lane Alternative and Options in Seattle

Location	Original 6-Lane Alternative	6 Lanes with Pacific Street Interchange Option	Second Montlake Bridge Option
Portage Bay			
West end	66	66	66
Mid-span	27	27	27
East end	12	12	12
Arboretum Area			
West end	14	14	14
East end	48	48	48
Ship Canal	**NA**	**70 or 110**	**38 - 42**

NA = not applicable

Exhibit 10. Approximate Numbers of Concrete Columns for the 6-Lane Alternative Options

Location	Original 6-Lane Alternative	6 Lanes with Pacific Street Interchange Option	Second Montlake Bridge Option
Portage Bay	54 (10-ft diameter) 4,240 ft^2	36 (10-ft diameter) 3,600 ft^2	36 (10-ft diameter) 3,600 ft^2
West approach, Evergreen Point Bridge	162 (10-ft diameter) 12,720 ft^2	120 (10-ft diameter) 9,420 ft^2	120 (10-ft diameter) 9,420 ft^2
Ship Canal / Union Bay	0	4 (25 x 25 ft square) 2,500 ft^2	0
East highrise, Evergreen Point Bridge	8 (10-ft diameter) 628 ft^2	8 (10-ft diameter) 628 ft^2	8 (10-ft diameter) 628 ft^2

This option would likely require similar compensatory mitigation as the original 6-Lane Alternative for effects on wetlands, including shoreline wetlands.

Second Montlake Bridge Option

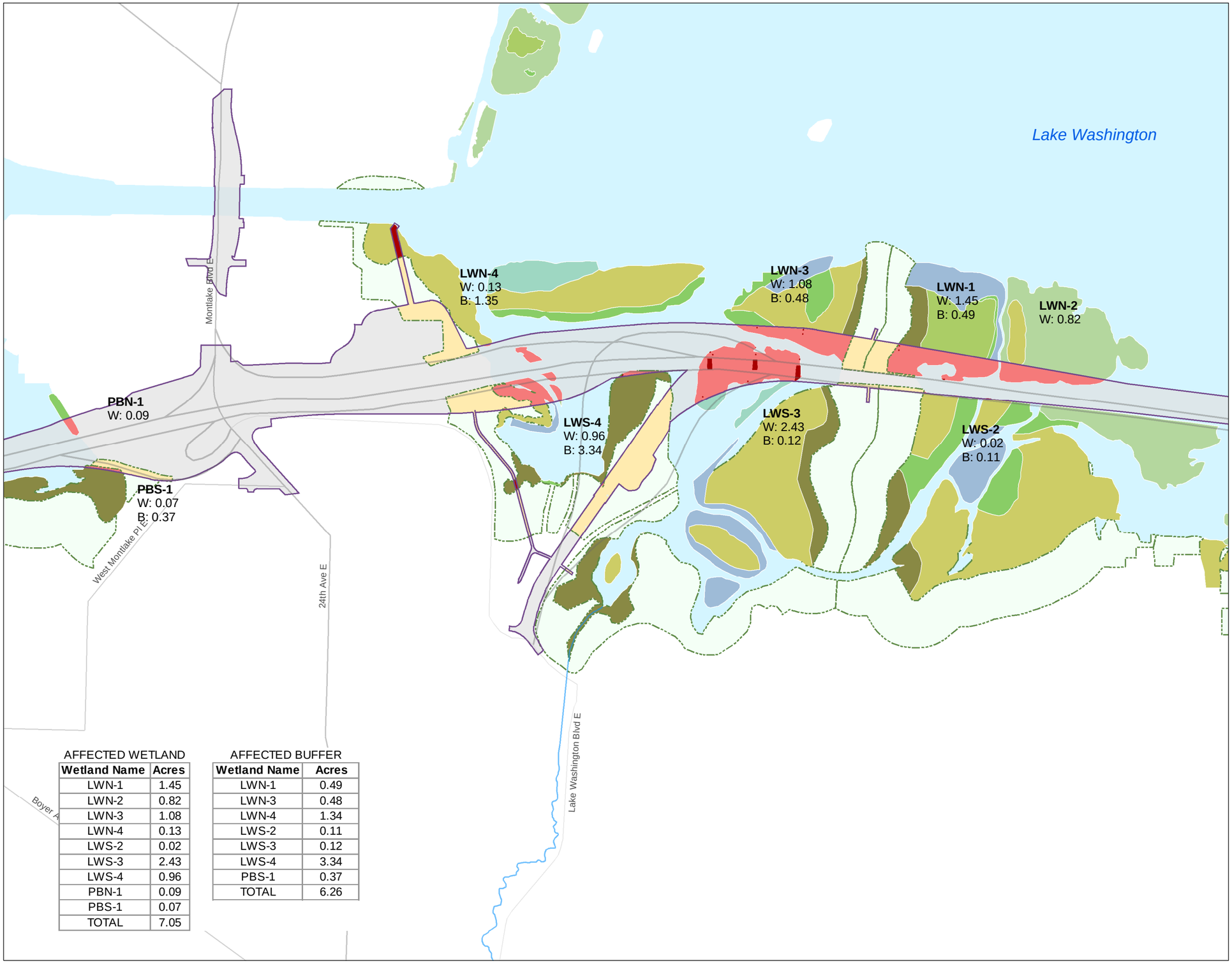
This option would only alter the original 6-Lane Alternative in the vicinity of the Montlake Bridge. Exhibit 11 shows the wetlands that would be affected by the Second Montlake Bridge option. The Second Montlake Bridge option would not differ from the original 6-Lane Alternative in its effect on wetlands and buffers (Exhibit 6).

How would the options affect the hydrologic functions of Seattle wetlands?

The effects on hydrologic functions of wetlands in the Seattle project area were described in the *Ecosystems Discipline Report*. In summary, the relatively small increases in impervious surface would not affect the water levels or duration of saturation/inundation in these wetlands. Stormwater treatment facilities and replacement wetlands would mitigate for water quality functions currently provided by the project area wetlands.

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

Wetland vegetation would be lost due to filling, and vegetation cover and structure would be reduced by shading from the original 6-Lane Alternative as well as the options. These effects would reduce the availability and quality of wetland habitat



AFFECTED WETLAND

Wetland Name	Acres
LWN-1	1.45
LWN-2	0.82
LWN-3	1.08
LWN-4	0.13
LWS-2	0.02
LWS-3	2.43
LWS-4	0.96
PBN-1	0.09
PBS-1	0.07
TOTAL	7.05

AFFECTED BUFFER

Wetland Name	Acres
LWN-1	0.49
LWN-3	0.48
LWN-4	1.34
LWS-2	0.11
LWS-3	0.12
LWS-4	3.34
PBS-1	0.37
TOTAL	6.26

- Second Montlake Bridge Option Footprint
- Affected Wetlands - Fill
- Affected Wetlands - Elevated Roadway
- Affected Wetland Buffer

Wetland Class

- L1AB - Limnitic Aquatic Bed
- L2AB - Littoral Aquatic Bed
- L1AB/L2AB
- PFO - Forested
- PSS - Scrub/Shrub
- PEM - Emergent
- PEM/PSS
- Wetland Buffer

Source: City of Seattle (2003) GIS Data (Wetlands); City of Bellevue (2004) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91), vertical datum is NADV88. Field updates by Parametrix, 2002-2004.

Note: Wetlands are labeled with wetland name and affected wetland (W) and buffer (B) acreage.

N

0 250 500 1,000 Feet

Exhibit 11. **Affected Wetlands - Second Montlake Bridge Option**

SR 520 Bridge Replacement and HOV Project

for invertebrates, amphibians, birds, and mammals compared to existing conditions.

Eastside

Areas of wetland fill or alteration under in the Eastside project area are described below and summarized in Exhibit 6.

How much wetland area would be filled as a result of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option?

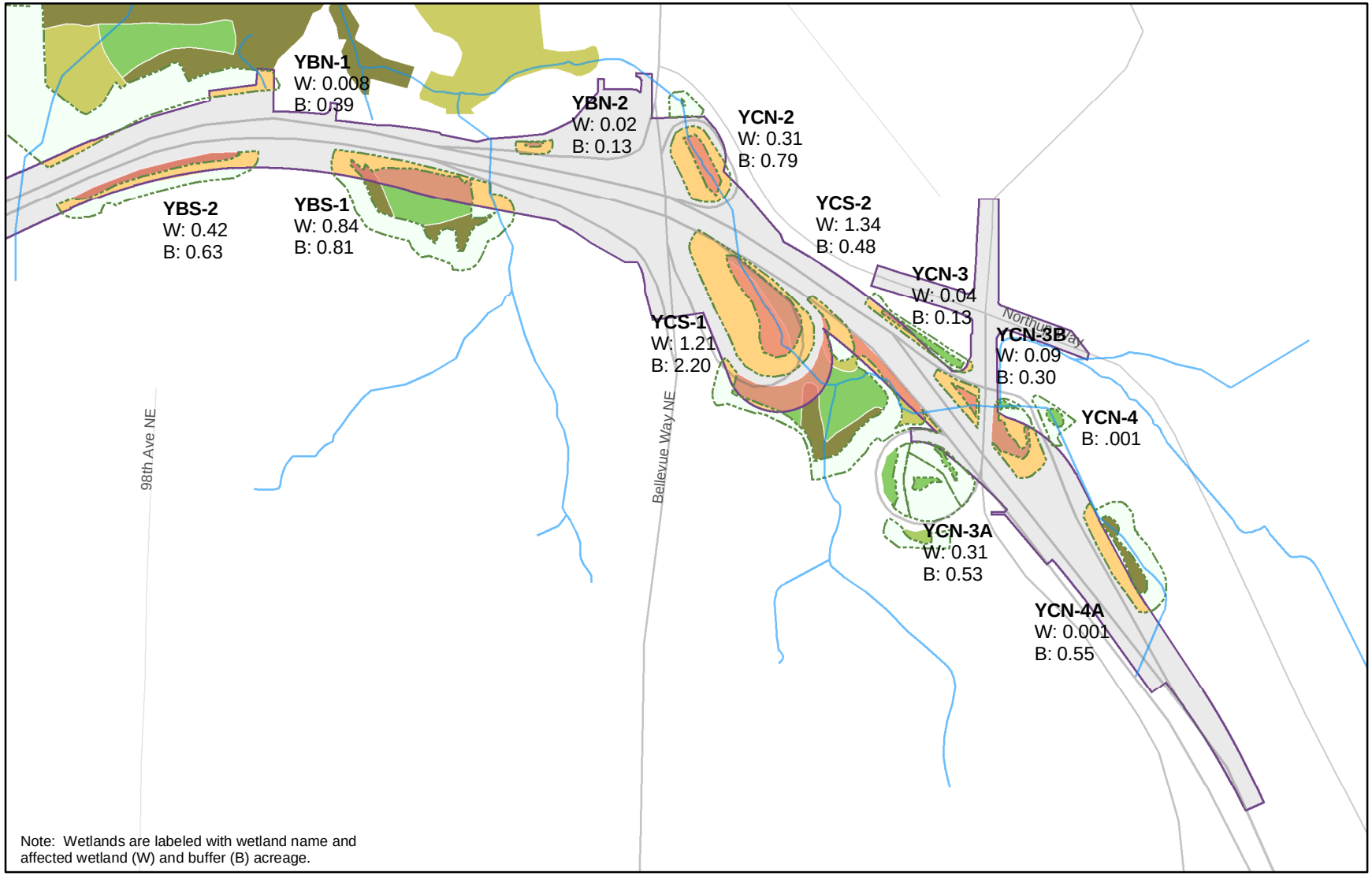
The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would fill an additional 1.4 acres of wetlands on the Eastside beyond the original 6-Lane Alternative (Exhibit 6). The wetland areas that would be affected by this option are shown on Exhibit 12. Most of the additional fill would occur because of the expansion of the eastbound off-ramp to northbound Bellevue Way, where it crosses Wetland YCS-2. The reconfiguration of the eastbound on-ramps at 108th Avenue Northeast would also fill all of wetland YCN-3A. Effects on buffers would be approximately 1.1 acres more under this option than with the original 6-Lane Alternative (Exhibit 6).

How would the project affect the hydrologic functions of Eastside wetlands?

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would effect the hydrologic functions of wetlands similar to the original 6-Lane Alternative for all Eastside project area basins (see *Ecosystems Discipline Report*), except Yarrow Creek Basin. Additional impervious surface would be added in Yarrow Creek Basin and could decrease infiltration and groundwater support to wetlands in the vicinity of the 108th Avenue Northeast/SR 520 Interchange. These wetlands, however, are primarily riparian and receive hydrologic support from Yarrow Creek, and therefore would not be affected. In addition, all stormwater entering Eastside streams from this option would be collected and treated for water quality before discharging to the streams. This treatment would meet water quality standards in Eastside streams, as discussed in the *Ecosystems Discipline Report*.

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

YCS-2 and YCN-3A are riparian wetlands associated with the mainstem of Yarrow Creek. Yarrow Creek is potentially used by coho salmon. The riparian wetlands produce and export organic matter to Yarrow Creek, where it can be used by stream invertebrates. These wetlands also provide habitat for passerine birds and connectivity to upstream reaches. The additional loss of riparian wetlands along Yarrow Creek from this option would increase effects on stream and habitat functions.



Source: City of Seattle (2003) GIS Data (Wetlands); City of Bellevue (2004) GIS Data (Wetlands). Horizontal datum for all layers is NAD83(91), vertical datum is NADV88. Field updates by Parametrix, 2002-2004.

Wetland Class

- L1AB - Limnitic Aquatic Bed
- L2AB - Littoral Aquatic Bed
- L1AB/L2AB
- PFO - Forested
- PSS - Scrub/Shrub
- PEM - Emergent
- PEM/PSS
- Wetland Buffer
- Affected Wetland Buffers
- Affected Wetlands
- South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option Footprint

N

0 250 500 1,000 Feet

Exhibit 12. **Affected Wetlands - South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option**
SR 520 Bridge Replacement and HOV Project

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Currently, blockages downstream preclude coho salmon from using the affected stream reaches adjacent to YCS-2 and YCN-3B. Replacement of existing culverts proposed by the original 6-Lane Alternative and the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option to remove downstream blockages would make the upstream reaches accessible to salmon. The benefits of the improved culverts would partially offset the loss of riparian wetlands.

How would project construction temporarily affect wetlands?

Seattle

Construction-related effects in Seattle would be similar for the original 6-Lane Alternative and each of the 6-Lane Alternative options. In the Seattle project area, the construction areas and timing for the Second Montlake Bridge option would be the same as the original 6-Lane Alternative. These effects were described in the *Ecosystems Discipline Report*. However, the 6 Lanes with Pacific Street Interchange option would also include construction of a bridge over Montlake Cut and Union Bay.

Each option would construct temporary bridges, work platforms, and a detour bridge over Portage Bay, Union Bay, and Lake Washington. Construction in these areas would take 4 to 5 years. Construction of these temporary structures would clear and shade approximately 3 acres of palustrine and lacustrine Category I wetlands (0.5-acre forested, 0.5-acre scrub/shrub, 0.4-acre emergent, and 1.5-acres lacustrine) and 0.8 acre of buffer. Approximately 1,800 steel piles would be driven in wetland and aquatic habitat areas to support the temporary bridges. The Portage Bay temporary bridge would be 30 feet wide and located on the north and south sides of the existing bridge. The Union Bay/Arboretum temporary bridge would be 60 feet wide and located on the south side of the existing bridge. Construction of the second Montlake Bridge would occur from land. Barges may be used for short periods.

The additional work structures required for the 6 Lanes with Pacific Street Interchange option would necessitate greater temporary effects on Category I wetlands in the Arboretum and Union Bay areas. The duration of in-water construction would be 4 to 7 seasons, depending on the final construction staging option. Construction of the 6 Lanes with Pacific Street Interchange option would temporarily shade approximately 0.4 acre more wetlands than the original 6-Lane Alternative. An additional 0.16 acre of wetland buffer would be shaded or cleared by this option.

Eastside

In the Eastside project area, the construction staging areas for the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would be located within the project footprint, and, therefore, the effects are accounted for in the *Potential Effects of the Project* section. This approach is similar to the analysis for the original 6-Lane Alternative in the *Ecosystems Discipline Report*.

Wetlands Mitigation

What has been done to avoid or minimize negative wetlands effects?

WSDOT has designed the options to minimize permanent and temporary effects similar to the original 6-Lane Alternative. Specific aspects of the design and best management practices (BMPs) that have been incorporated to avoid and minimize effects on wetlands were described in the *Ecosystem Discipline Report*.

How could the project compensate for unavoidable negative effects on wetlands?

Compensatory mitigation would be a component of the original 6-Lane Alternative and the three options. It would be used to replace the area and functions of wetlands permanently filled or shaded. Measures also would be provided to mitigate for the temporary loss of wetland and buffer functions from construction activities. Buffers would be designated to ensure the success of the wetland mitigation. The goal of the compensatory mitigation would be to achieve no net loss of wetland area, functions, and values.

Compensatory wetland mitigation would be designed to meet current applicable requirements for replacing affected wetlands at the time of permit application. Washington State Department of Ecology (Ecology) recently recommended increased replacement ratios (Granger et al. 2005). Ecology identified several forms of compensatory mitigation. For the purposes of this report, mitigation will be the creation of new wetlands or restoration of previously existing wetlands with the same category as impacted wetlands. WSDOT (1993) recognized the high degree of difficulty in restoring or creating Category I wetlands and may need to increase wetland compensation. Granger et al. (2005) generally recommended restoring or replacing the area of filled Category I wetlands at a 4:1 (restoration or creation: fill) ratio. Category II wetlands would be replaced at a 3:1 ratio, Category III wetlands at a 2:1 ratio, and Category IV wetlands at 1.5:1 ratio. Mitigation ratios would increase if mitigation included rehabilitation or enhancement.

The mitigation estimates provided in Exhibit 13 are based on the total area of affected wetlands, which includes both fill and shading effects. Shaded wetlands would be mitigated at a 1:1 ratio (filled wetlands constitute a loss of wetland area, while shaded wetlands continue to provide some functions but at a different level).

Exhibit 13. Comparison of Compensatory Wetland Mitigation for Total Project Effects (in acres)[a]

		Seattle		Eastside
	Original 6-Lane Alternative	6 Lanes with Pacific Street Interchange Option	Second Montlake Bridge Option	South Kirkland Park-and-Ride Option
Mitigation: Fill Ratio by Category[a]				
I (4:1)	0.8 (0.2)	0.8 (0.2)	0.8 (0.2)	0.8 (0.2)
II (3:1)	2.1 (0.7)	2.1 (0.7)	2.1 (0.7)	2.1 (0.7)
III (2:1)	11.4 (5.7)	11.4 (5.7)	11.4 (5.7)	14.2 (7.1)
IV (1.5:1)	0.15 (<0.1)	0.15 (<0.1)	0.15 (<0.1)	<0.1 (0.15)
Sub-total	**14.4 (6.7)**	**14.4 (6.7)**	**14.4 (6.7)**	**17.2 (7.8)**
Mitigation: Shade Ratio by Category[b]				
I (1:1)	1.3 (1.3)	1.6 (1.6)	1.3 (1.3)	0
Total Mitigation	**15.7**	**16.0**	**15.7**	**17.2**

[a] The mitigation ratios for filling wetlands in this table reflect creation of replacement of wetlands based on Ecology (2005). Actual ratios may be slightly higher or lower, depending on the regulations in effect at the time of permitting. Enhancement of existing wetlands at a 1:1 ratio may be used to compensate for shading effects on project wetlands.

[b] These are net shading acres, which equals the total width of the bridges and roadway less the gaps between the structures.

Mitigation for wetland fill and shading for the 6 Lanes with Pacific Interchange option would be 16.0 acres, while the Second Montlake Bridge option would require 15.7 acres of mitigation. The South Kirkland Park-and Ride Transit Access – 108th Avenue Northeast option would require 17.2 acres of mitigation (Exhibit 13).

In comparison, construction of the original 6-Lane Alternative would require approximately 14.4 acres of wetland creation or restoration and 1.3 acres of wetland enhancement for a total of 15.7 acres (Exhibit 13).

After construction of the SR 520 Bridge Replacement and HOV Project is complete, the areas temporarily affected by construction would be restored and replanted with appropriate vegetation.

Federal and state agencies do not require mitigation for wetland buffers, but some local governments do. Proposed buffer mitigation would be designed in conjunction with local governments to address their requirements.

Compensatory mitigation requirements would be met with a combination of wetland creation/restoration and wetland and buffer enhancement and preservation. WSDOT would select mitigation sites based on watershed characteristics, size of the site, the ability of the site to mitigate for project effects, and other factors. Some potential mitigation options in Seattle include:

- Enhancing wetlands at the University of Washington Center for Urban Horticulture. This could include planting native trees and shrubs on areas near or adjacent to the lakeshore to provide habitat for birds, wetland-dependent mammals, and amphibians, as well as organic export functions.
- Restoring a portion of the WSDOT-owned peninsula near the Arboretum by removing existing highway ramps, excavating fill material, and replanting with native trees, shrubs, and herbs.
- Replanting wetlands and buffers within the footprint of the existing SR 520 roadway with native species when the roadway and columns are removed.

Any of these Seattle project area mitigation options could provide educational opportunities for local residents, especially if interpretive trails and signage were to be provided.

Mitigation opportunities on the Eastside would be investigated in conjunction with the watershed-based analysis conducted by WSDOT (Gersib et al. 2004). Because of the large area of affected wetlands and required compensation ratios, mitigation may occur outside of the Eastside project area.

Fish Resources

This section describes the affected aquatic habitat, fisheries resources, and environmental consequences of the three options to the original 6-Lane Alternative.

Affected Environment

The potentially affected aquatic environment would remain basically the same as that previously evaluated for the original 6-Lane Alternative, with a few additions for the new options described in the following sections.

What additional information was collected for this analysis?

The ecosystems discipline team collected information about aquatic and fish resources using the same methods as described in the *Fish Resources* section of the *Ecosystems Discipline Report*. The team collected and reviewed documented information on fish species and their distribution and habitat within the expanded project area, and reviewed available literature, such as peer-reviewed articles in scientific journals, technical reports, and data from various state, county, and city agencies. Additional information on observations of salmonids in Eastside streams was provided by the Muckleshoot Indian Tribe.

In addition, biologists surveyed and characterized the instream habitat of the South Tributary of Yarrow Creek on the Eastside. Stream habitat survey procedures generally followed the current King County Level I (Basic) stream survey methods and guidelines (King County 1991). The habitat survey measured or described instream habitat features, riparian vegetation, streambank stability, substrate composition, and fish passage obstructions up to about 500 feet upstream and downstream of the SR 520 corridor. This methodology was consistent with previous stream surveys. Fish stream usage was determined, in part, from existing data and by contacts with local resource agency representatives as well as visual observations of fish and instream habitat quality. The survey occurred in September 2005.

What additional aquatic habitat would potentially be affected in Seattle?

The aquatic habitat of University Slough would potentially be affected by stormwater discharge under some of the options. University Slough is one of three drainage channels constructed for the east campus of the University of Washington. It extends from Northeast 45th Street, between the University's soccer field and driving range, south to the marshes of Union Bay, and ends at Wahkiakum Lane.

The slough was excavated through what used to be the Montlake Landfill. Formerly the Ravenna Landfill, the landfill was used by the City of Seattle for residential and industrial solid waste from 1926 to 1966. It was closed 5 years later and overlaid with 2 feet of clean soil. Some of the land has been built on by the University of Washington; the rest consists of fields, marsh, wetlands, and the University's Montlake parking lot.

Before Lake Washington was lowered by 9 feet during the early twentieth century, Ravenna and Yesler creeks flowed into marshland north of where University Slough now terminates, and the land through which the slough would be placed was under the waters of Union Bay. Also, for many years Ravenna Creek had no surface water connection with University Slough because it was diverted into a King County Metro sewer pipe. Construction on a project that would reconnect Ravenna Creek to Union Bay by piping it underground to University Slough is now underway.

What are the general habitat characteristics of the Eastside project area streams?

The original 6-Lane Alternative and the South Kirkland Park-and-Ride Transit Access - 108th Avenue Northeast option alignment on the Eastside directly cross Fairweather Creek; Cozy Cove Creek; the tributary to Yarrow Bay; Yarrow Creek; and three tributary streams to Yarrow Creek—the West, East, and South tributaries. With the exception of the South Tributary to Yarrow Creek, the basic characteristics of these streams were described in detail in the *Ecosystems Discipline Report*. The South Tributary to Yarrow Creek was not within the original project area as defined in the *Ecosystems Discipline Report;* therefore, the stream is described below and in Exhibits 14 and 15.

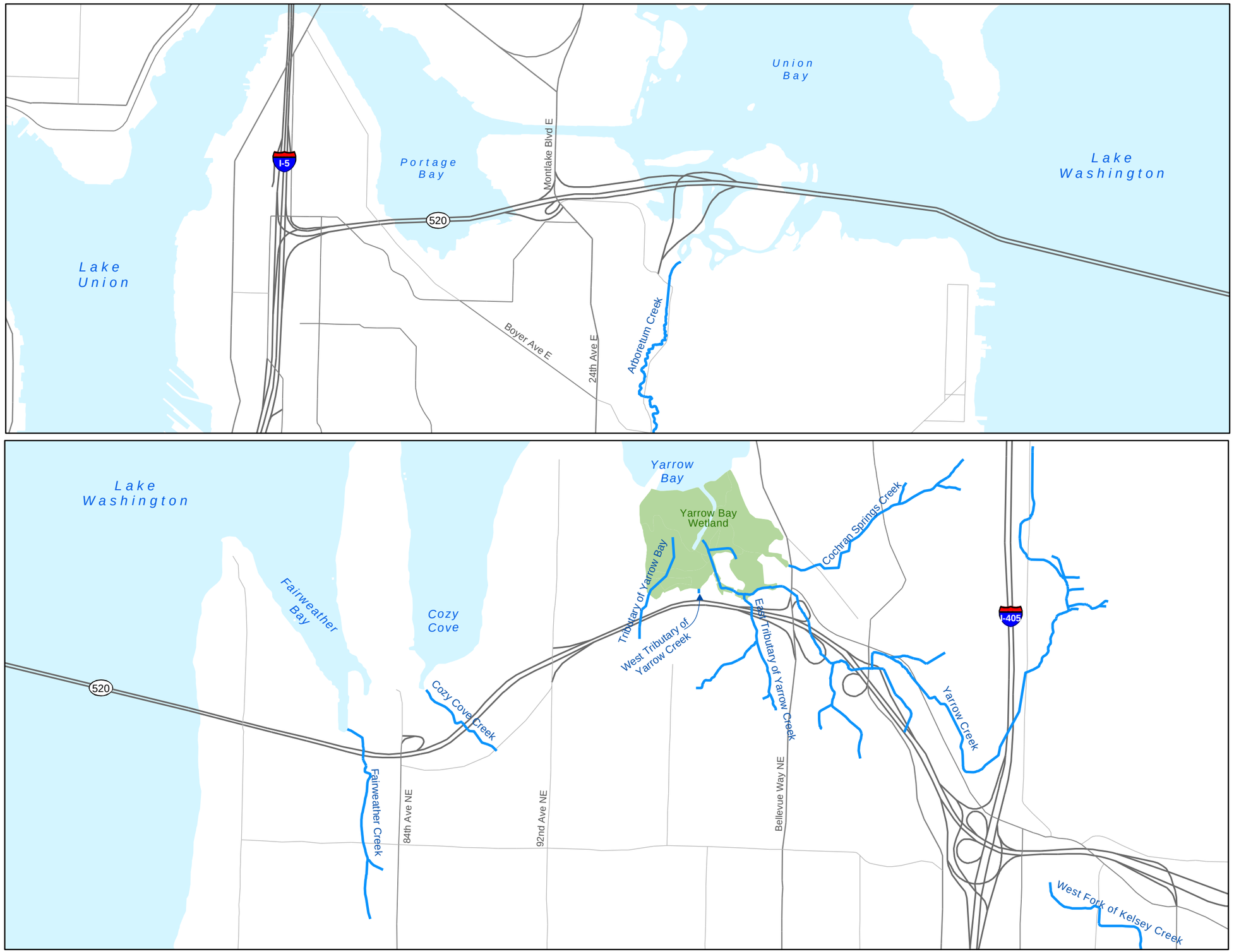

Exhibit 14. **Project Area Water Bodies**

SR 520 Bridge Replacement and HOV Project

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Exhibit 15. Habitat Conditions and Salmonid Distribution in the Surveyed Reaches of Streams Crossing the Proposed Project Corridor

Stream Name	Known or Presumed Fish Use[a]	Channel Morphology Conditions[b]	Substrate and Sediment Conditions[c]	Riparian Vegetation and Large Woody Debris Conditions[d]	Bank Conditions and Degree of Hydromodification[e]	Fish Passage[f]	Spawning Potential[g]	Rearing Potential[g]
Fairweather Creek	Cutthroat trout, Coho salmon	Poor	Fair	Poor	Poor	Good	Poor	Poor
Cozy Cove Creek	Cutthroat trout, Coho salmon	Poor	Fair	Poor	Poor	Poor	Poor	Fair
Tributary to Yarrow Bay	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Poor	Fair	Poor
Lower mainstem Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Good	Fair	Good
Tributary 2 to Yarrow Bay	Cutthroat trout, Coho salmon	Poor	Poor	Fair	Good	Poor	Poor	Poor
East Tributary to Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Fair	Fair	Good	Poor	Fair	Fair
South Tributary to Yarrow Creek	Cutthroat trout	Fair	Fair	Fair	Good	Poor	Good	Fair
Middle Reaches Yarrow Creek	Cutthroat trout, Coho salmon	Poor	Poor	Poor	Poor	Poor	Poor	Poor

[a] Fish use information based on King County and 25 authors (2001); Williams et al. (1975); StreamNet (2002); and 2002 Parametrix electrofishing results. Fish observations were obtained by a limited amount of recent fish sampling within project area streams. It should be noted that rigorous sampling efforts were not undertaken. This list is based solely on available fish presence data and available instream habitat.

[b] Ratings based on WSFPB (1992) and Peterson et al. (1992). Good = pools >50 percent of the low-flow surface, fair = 35 percent to 50 percent, poor = <35 percent.

[c] Ratings based on NMFS (1996). Good = dominant substrate gravel/cobble, low embeddedness and <12 percent fines; fair = gravel/cobble, moderate embeddedness and 12 to 17 percent fines; poor = silt/s, high embeddedness and >17 percent fines.

[d] Ratings based on NMFS (1996). Good = riparian reserves >80 percent and adequate refugia, fair = 80 percent to 90 percent and incomplete refugia, poor = <80 percent and inadequate refugia.

[e] Ratings based on Snohomish County (2002) and NMFS (1996). Good = <10 percent shoreline hardening or bank erosion, fair = 10 percent to 20 percent, poor = >20 percent.

[f] Ratings based on NMFS (1996). Good = fish passage at all flows, fair = at all but base/peak flows, poor = impeded at all flows.

[g] Spawning and rearing potential for coho salmon and cutthroat trout (as Chinook salmon distribution is limited to stream reaches downstream from the project corridor) were evaluated for the area immediately adjacent to the project corridor and evaluated on the basis of best professional judgment.

South Tributary to Yarrow Creek

The south tributary to Yarrow Creek is located within a new area affected by the South Kirkland Park-and-Ride Transit Access - 108th Avenue Northeast option. The stream originates southwest of the SR 520/I-405 Interchange and flows west parallel to 112th Avenue Northeast prior to crossing SR 520 in a culvert and continuing west to the confluence with the mainstem near 108th Avenue Northeast. The lower 600 feet of this stream are almost entirely contained in pipes (under the WSDOT maintenance facility and SR 520 off-ramp), which are fish passage barriers (Exhibit 16). However, immediately upstream of these pipes, a 500-foot-long reach of the tributary contains relatively high-quality spawning and rearing habitat. This reach has an intact riparian zone of mature mixed forest, large woody debris (LWD), and high-quality gravel and cobble substrate with riffle and pool habitat. The next 0.25 mile of habitat upstream of the perched pipe under SR 520 (a total fish passage barrier) is of fair quality and would offer some rearing opportunities for salmonids if made accessible (see the *Mitigation* section).

Potential Effects of the Project on Fish

Potential effects of the 6-Lane Alternative options would differ from the original 6-Lane Alternative within the Eastside and Seattle project areas, while the potential effects from these options on the floating bridge portion of the Evergreen Point Bridge and the WSDOT Bridge Operations Facility on the Eastside would be identical to those discussed in the *Ecosystems Discipline Report*.

What methods were used to evaluate effects?

The ecosystems discipline team evaluated the potential effects of the 6-Lane Alternative options to fish, and the existing aquatic habitat that supports the fish resources, by comparing each options' characteristics that would influence the aquatic habitat or, potentially, fish behavior. This method was also used in the *Ecosystems Discipline Report*.

Exhibit 16. Summary of Fish Passage Conditions Along Surveyed Streams of the Proposed Project Corridor

Stream Name	Culvert Location	WSDOT Culvert?	Culvert Description [a]	Culvert Length (feet)	Fish Passage Barrier?	Available Upstream Fish Habitat?[d]	Comments
Fairweather Creek	Two in-line culverts crossing under SR 520	Yes	North culvert is 48-inch-diameter, round concrete pipe. South culvert is 60-inch-diameter CMP	180	Partial [b]	Yes	Slope barrier [b]
Cozy Cove Creek	Culvert under SR 520	Yes	48-inch-diameter round CMP	170	Potential [c]	500 feet of low quality habitat	
Cozy Cove Creek	Culvert under Northeast 28th Street	No	24-inch-diameter round concrete pipe	Unknown	Total [c]	Unknown	Total fish passage barrier due to high perched culvert under Northeast 28th Street.
Tributary to Yarrow Bay	Culvert under SR 520	Yes	36-inch-diameter round CMP	300	Total [b,c]	No	Total fish passage barrier due to high perched outlet.
West Tributary (Tributary 1) to Yarrow Creek	Two culverts (not parallel) under SR 520	Yes	West culvert is 18-inch-diameter, round concrete. East culvert is 24-inch-diameter, round CMP	Unknown	Partial [c]	No	Partial barrier due to culvert perch and sediment in culvert outlets. The inlets of these culverts were not located and the pipes do not connect to a stream channel upstream of SR 520.
East Tributary (Tributary 2) to Yarrow Creek	Culvert under SR 520	Yes	48-inch-diameter CMP	350	Total [b,c]	Yes	Slope barrier [b]
East Tributary (Tributary 2) to Yarrow Creek	Under abandoned road, south of SR 520, 571 feet upstream of SR 520 culvert	No	36-inch-diameter CMP	80 (est.)	Partial [c]	Yes	Partial barrier due to culvert under abandoned road. Outlet is perched with steep approach and inlet has partially screened flow control device with inlet drop.
Yarrow Creek	Culvert inlet located under Lake Washington Blvd	Unknown	Dual concrete 48-inch-diameter, round concrete	370 (est.)	Potential [c]	Yes	The culverts are connected to an adjacent culvert that joins underground in stormwater structure.
Yarrow Creek	Westbound on-ramp to SR 520 (from northbound Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	115	Potential [c]	Yes	
Yarrow Creek	Westbound on-ramp to SR 520 (from northbound Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	100	Potential [c]	Yes	

Exhibit 16. Summary of Fish Passage Conditions Along Surveyed Streams of the Proposed Project Corridor

Stream Name	Culvert Location	WSDOT Culvert?	Culvert Description [a]	Culvert Length (feet)	Fish Passage Barrier?	Available Upstream Fish Habitat?[d]	Comments
Yarrow Creek	Culvert under SR 520	Yes	Dual concrete 48-inch-diameter, round CMP	200	Partial [b]	Yes	Velocity barrier [b]
Yarrow Creek	Culvert under south cloverleaf (eastbound SR 520 to Lake Washington Blvd)	Yes	Dual concrete 48-inch-diameter, round CMP	190	Potential [c]	Yes	
Yarrow Creek	Under SR 520 near 108th Avenue Northeast	Yes	Dual concrete 36-inch-diameter, round CMP	240	Partial [b]	Yes	Depth barrier [b]
Yarrow Creek	Under 108th Avenue Northeast, just north of SR 520	Yes	Dual 36-inch-diameter, round concrete	86	Unknown	Yes	
Yarrow Creek	Under westbound SR 520 off-ramp to Northeast 108th Avenue Northeast	Yes	Squash CMP, 48-inches wide by 28-inches high	75 (est)	Unknown	Yes	
South Tributary to Yarrow Creek	Under westbound SR 520 off-ramp to Northeast 108th Avenue Northeast	Yes	Dual 30-inch-diameter, round concrete	112	Potential [c]	Yes	
South Tributary to Yarrow Creek	Under WSDOT maintenance facility	Yes	36-inch diameter, round CMP	425	Potential [c]	Yes	
South Tributary to Yarrow Creek	Culvert under SR 520	Yes	36-inch diameter, round CMP	367	Total[b]	Yes	Culvert perched 2.5 feet[b]

[a] CMP = Corrugated Metal Pipe

[b] Data from WSDOT and WDFW (2003).

[c] Data from observations and measurements during site reconnaissance.

[d] Based on results of habitat surveys and best professional judgment

How would the 6-Lane Alternative options permanently affect fish resources?

Seattle

The 6-Lane Alternative options would have the same types of effects on fish resources as the original 6-Lane Alternative. However, there would be changes in the amounts and locations of effects resulting from bridge shading and support columns replacing benthic habitat. Most of these differences from the original 6-Lane Alternative would be the same for both Seattle options and would occur along the southern side of Portage Bay and in the shallow habitat between Montlake and Foster Island that is isolated from Union Bay by Marsh Island. These options would have different effects in the different locations where they each place a different bridge over the navigation channel near the east end of the Ship Canal. These bridges would have different shading effects in the navigation channel area, as described in following sections.

The primary effects of each of the 6-Lane Alternative options on fish and their habitat in the Lake Washington and Ship Canal portion of the corridor would be the changes in location, number, and size of bridge support columns. The larger columns (diameter <10 feet) would be more widely spaced than the existing (diameter < 4 ft) columns and located in the corridor that is generally immediately north of the existing bridge structures. Most of these support columns would be constructed in the shallow waters (< 10 feet deep) of Portage Bay (32 columns), Montlake to Foster Island (53 columns), and Foster Island to Lake Washington (35 columns), where invasive macrophytes (Eurasian milfoil and water lilies) are abundant. About 32 support columns would be constructed in the deeper open water on the western edge of Union Bay. Four support columns would be constructed adjacent to the navigation channel near the eastern entrance to the Ship Canal with the 6 Lanes with Pacific Street Interchange option, but not with the Second Montlake Bridge option.

Each of the new 6-Lane Alternative options would have fewer, but larger support columns in Portage Bay than the original 6-Lane Alternative due to the elimination of on- and off-ramps over the bay (Exhibit 10). There would also be 14 fewer support columns within the aquatic habitat of the west approach to the floating portion of the Evergreen Point Bridge. These changes would result in a decrease in the amount of benthic substrate filled by the support columns as compared to the original 6-Lane Alternative.

The widths and heights and, therefore, the shadows of the bridges over the shorelines and aquatic habitat of the Portage Bay, Union Bay, and Arboretum areas affected by the two options would be somewhat different than the original 6-Lane Alternative (Exhibits 8, 9, and 10). The effects of the new bridges on the aquatic habitat within Portage Bay, Union Bay, and Lake Washington would be due to the increased width and heights of the bridges. Higher and wider bridges would increase the amount of aquatic area shaded but reduce the intensity of shading. Open areas between eastbound and westbound lanes, and ramps over the Arboretum area would further reduce shading effects by decreasing the distances to shadow edges that would be fully exposed to sunlight. These changes in shading would be along the southern periphery of Portage Bay and over the isolated area between Montlake and Foster Island, where dense aquatic vegetation provides unfavorable habitat for juvenile salmonids and many other fish species.

The heights of the bridges over the shorelines would be the same with the Seattle options as the original 6-Lane Alternative (Exhibit 9).

Shading of aquatic habitat by bridge structures would be the same with each 6-Lane Alternative option over Portage Bay and much of the Union Bay area. The differences in shading would be primarily at the eastern entrance to the Ship Canal and within the Montlake Cut, as described in the following sections. The degree of changes in shading of shoreline habitat in the Portage Bay and Arboretum areas would not be likely to affect fish movement and habitat use. However, the fill of benthic habitat by support columns would reduce the area available for aquatic vegetation and benthic invertebrate production.

What are the unique effects of the 6 Lanes with Pacific Street Interchange option?

As identified above, the 6 Lanes with Pacific Street Interchange option includes a bridge over Union Bay near the entrance to the Montlake Cut that would not be included within the original 6-Lane Alternative nor in the Second Montlake Bridge option. This additional bridge (Union Bay Bridge) would be high (70 or 110 feet; Exhibit 9) and 100 feet wide, casting a diffuse shadow on the migratory route of anadromous salmonids leaving and returning to Lake Washington. Anadromous fish passing this location will have experienced a number of similar and darker shadows prior to reaching this point in their migration. Numerous bridges cross the Cedar River, Sammamish Slough, and Issaquah Creek, as well as the smaller tributaries where most of these juvenile salmon originate. Any juvenile salmonids traveling from the

southern half of Lake Washington are likely to have passed under both the I-90 and SR 520 bridges. The shadow of the Union Bay Bridge would not likely be sufficiently dark to produce a migration barrier.

The crossing of the east side of Foster Island would be somewhat wider with the 6 Lanes with Pacific Street Interchange option than with the original 6-Lane Alternative. The widths given in the Exhibit 8 includes gaps ranging from 10 to 40 feet wide between separate spans of the total bridge. In addition, the length of the shorelines crossed on the west side of Foster Island would also increase considerably with this option because the northern portion of the bridge would essentially run parallel with the southern shoreline of the island—the inner shoreline of Foster Island that has dense aquatic macrophyte beds growing up to the shore.

The 6 Lanes with Pacific Street Interchange option would place four additional support columns (25 by 25 feet) in Union Bay on the sides of the navigation channel, thereby increasing the amount of benthic habitat filled in this area. Overall the total area covered by the columns would be less than with the original 6-Lane Alternative (Exhibit 10). These changes would occur primarily in the shallow water habitat occupied by Eurasian milfoil and water lilies, and would not change habitat functions.

The additional support columns of the 6 Lanes with Pacific Street option would replace more benthic soft bottom habitat as compared to the original 6-Lane Alternative. Replacing the benthic habitat with vertical concrete columns would create conditions where invertebrate prey would be consumed by resident and migrating fish. The four 25 by 25 foot square columns adjacent to the navigation channel would occupy 2,500 square feet of bottom, and two additional 10-foot-diameter columns on the south side of Marsh Island would occupy 157 square feet of benthic habitat. The larger bridge support columns are unlikely to measurably affect smallmouth and largemouth bass populations that prey on migrating juvenile salmon. The new larger columns would provide large, smooth vertical surfaces within the water column that would not be likely to provide attractive habitat for smallmouth bass or other salmonid predators. These predators tend to favor more complex aquatic structures such as rock outcrops, boulders, and sunken logs (Munther 1970, Stein 1970, Pflug 1981, Muller and Rothaus 2001). The support columns would not enhance habitat characteristics shown by Stein (1970) and Pflug (1981) to be preferred by the two bass species in the Lake Washington and Lake Sammamish.

Smallmouth bass have been shown to prefer areas with sunken logs, stumps, brush, etc. with very few docks and sufficient shoreline water depth to permit utilization of heavy bank cover (Stein 1970). Largemouth bass prefer areas of moderate to dense aquatic vegetation and soft substrate with adjacent moderate to steep drop-offs (Pflug 1981).

The 6 Lanes with Pacific Street Interchange option would increase the overall net impervious surface in the Union Bay area and relocate the stormwater treatment and discharged sites. Elimination of the Montlake interchange on- and off-ramps would reduce the amount of stormwater discharged to the eastern part of the Portage Bay Basin (see Treatment Facility PB-2 in Exhibit 22 of the *Water Resources Discipline Report,* Parametrix 2005a) and to the western portion of the Union Bay Basin. This option would collect and treat some of the stormwater that currently falls on impervious surface in the Montlake Boulevard area north of the proposed Pacific Street interchange and is discharged untreated. This water would discharge primarily to University Slough. A slight improvement in Union Bay water quality would occur with this treatment of currently untreated stormwater.

What are the unique effects of the Second Montlake Bridge option?

The effects of the Second Montlake Bridge option would be the same as those of the original 6-Lane Alternative, with the addition of the new bridge spanning the Montlake Cut adjacent to the existing Montlake Bridge. The new bridge would add to the shading effects of the existing bridge over the Cut with a 58-foot-wide bridge deck 38 to 42 feet above the water surface (Exhibits 8 and 9). The second Montlake Bridge deck would have a solid surface rather than a grated surface like the existing bridge.

The second Montlake Bridge would allow less light to reach the water surface than the original 6-Lane Alternative because of its relatively low height above the water and its location within the narrowest portion of the Ship Canal and relatively steep shorelines of the Montlake Cut.

The effect of the second Montlake Bridge on anadromous fish passing this location would likely be similar to that of the Union Bay Bridge over the navigation channel. The fish will have experienced the same number of similar and darker shadows prior to reaching this point in their migration. The shadow of the second Montlake Bridge would be darker than the Union Bay Bridge shadow, but it is not likely to be

sufficiently dark to produce a migration barrier based on the prior experience of many of the fish.

Eastside

What are the effects of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option?

The general types of potential effects on Eastside project area fish habitat from the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would include construction of a bridge operations facility, replacement of culverts that cross SR 520, increased impervious surfaces, and removal of riparian vegetation. However, this alignment would extend further to east than the original 6-Lane Alternative. Therefore, the magnitude of potential impacts on culverts, riparian vegetation, and stormwater within Eastside project area streams would be somewhat greater with this option as compared to the original 6-Lane Alternative.

Culverts

In addition to serving as fish passage barriers, culverts may also affect habitat processes by obstructing wood, water, and sediment. Culverts may also affect stream productivity by limiting fish access and affect habitat-forming processes if not properly designed. The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would replace or extend culverts to accommodate widening of the roadway. However, the number of culverts requiring lengthening and the magnitude of the lengthening would be greater than the original 6-Lane Alternative because of differences in the configuration of the SR 520/108th Avenue Northeast interchange (see Exhibits 17 and 18). Approximately 338 linear feet of open-channel habitat would be lost due to culvert extensions in this area. Up to 288 linear feet of open channel would be created from the potential removal and shortening of several existing culverts; therefore, the net decrease of open channel may be as little as 50 linear feet, or about 170 linear feet less than the potential net channel loss from the original 6-Lane Alternative. In addition, three potential barrier culverts not directly affected by the proposed project would be upgraded to fully fish passable (see the *Mitigation* section).

Exhibit 17. Summary of Effects of South Kirkland Park-and-Ride Transit Access–108th Avenue Northeast Option on Eastside Culvert Crossings

Parameter	Original 6-Lane Alternative	South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option
Number of culvert lengthenings/additional culverts	6	8
Number of culvert shortenings/removals	1	3
Linear feet of culvert lengthenings/additional culverts	310	338
Linear feet of culvert shortenings/removals	90	288
Potential net channel loss from culvert reconfiguration	220	50

As with the all of the build alternatives, these new culverts would be designed and constructed to be fully passable by fish in accordance with Washington Department of Fish and Wildlife (WDFW) guidelines (WDFW 2003); fish passage conditions would improve overall fish passage where the five affected streams cross SR 520. These improvements would likely more than compensate for the net loss of open-channel fish habitat resulting from culvert lengthening with this option.

Stream Water Quantity

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would add approximately 3.2 acres of additional impervious surface to Eastside stream sub-basins, as compared to the original 6-Lane Alternative, mostly in the vicinity of the SR 520/108th Avenue Northeast interchange (see the *Addendum to Water Resources Discipline Report*). This translates into an over 21 percent increase in new impervious surface in the Eastside project area compared to the original 6-Lane Alternative. All of the increase would occur in the Yarrow Creek Basin.

The effects on stormwater quantity with this option would be identical to the original 6-Lane Alternative for the other Eastside basins (see the *Ecosystems Discipline Report*). In the Yarrow Creek Basin, peak flows may be slightly increased in duration; however, all stormwater would be detained before release into Yarrow Creek. Furthermore, effects on fish species from these small changes in peak flows would be similar to those from the original 6-Lane Alternative, and are not expected to be detrimental to fish.

Exhibit 18. Detailed Effects of South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option on Eastside Culvert Crossings

Stream Name	Station Location (4-Lane)[a]	Fish Passage Barrier	Original 6-Lane Alternative		South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option	
			Linear Feet of Pipe Extension Required	Proposed Actions[b]	Linear Feet of Pipe Extension Required	Proposed Actions[b]
Fairweather Creek	265+50	Partial[c]	41	Replace or retrofit culvert to be fully fish passable[c]	41	Replace or retrofit culvert to be fully fish passable[c]
Cozy Cove Creek	284+00	Potential[d]	40	Replace or retrofit culvert to be fully fish passable[c]	40	Replace or retrofit culvert to be fully fish passable[c]
Tributary to Yarrow Bay	318+20	Total[c,d]	5	Ameliorate erosion problem at outlet as project mitigation	5	Ameliorate erosion problem at outlet as project mitigation
Tributary 2 to Yarrow Bay	328+50	No stream is present upstream of SR 520	None	None	None	None
East Tributary to Yarrow Creek	337+50	Total[c,d]	80[e]	Replace or retrofit culvert to be fully fish passable[c]	66	Replace or retrofit culvert to be fully fish passable[c]
Mainstem Yarrow Creek	None	Potential[d]	None, but stormwater discharge site	None (possible project mitigation site)	None, but stormwater discharge site	None (possible project mitigation site)
Mainstem Yarrow Creek	180 feet above northwest ramp	Potential[d]	None	Replace or retrofit culvert to be fully fish passable[c] as project mitigation	None	Replace or retrofit culvert to be fully fish passable[a] as project mitigation
Mainstem Yarrow Creek	354+50 (northwest ramp)	Potential[d]	43 [e] (Possibility to remove up to 90 feet of existing culvert	Remove old culvert. Install fully fish passable culvert.	35 (Possibility to remove up to 101 feet of existing culvert	Remove old culvert. Install fully fish passable culvert.
	354+50	Partial[c]	101 [e]	Replace or retrofit culvert to be fully fish passable[c]	136	Replace or retrofit culvert to be fully fish passable[c]
Mainstem Yarrow Creek	360+00 (southeast ramp)	Potential[d]	None	Replace or retrofit culvert to be fully fish passable[c] as project mitigation	13	Replace or retrofit culvert to be fully fish passable[c]
Mainstem Yarrow Creek	365+50	Partial[c]	None	Replace or retrofit culvert to be fully fish passable[c] as project mitigation	2	Replace or retrofit culvert to be fully fish passable.[c] Realign 104 linear feet of stream channel to south.[f]
Mainstem Yarrow Creek	Under 108th Avenue NE	Potential[d]	None	NA (outside alternative alignment)	None	Potential culvert replacement and stream realignment as project mitigation

Exhibit 18. Detailed Effects of South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option on Eastside Culvert Crossings

Stream Name	Station Location (4-Lane)[a]	Fish Passage Barrier	Original 6-Lane Alternative		South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option	
			Linear Feet of Pipe Extension Required	Proposed Actions[b]	Linear Feet of Pipe Extension Required	Proposed Actions[b]
Mainstem Yarrow Creek	Under 520 Off-ramp to 108th Avenue NE	Potential[d]	None	NA (outside alternative alignment)	None (Remove all 75 feet of existing culvert).	Remove culvert. Potentially realign stream as project mitigation
South Tributary to Yarrow Creek	Under 520 Off-ramp to 108th Avenue NE	Potential[d]	None	NA (outside alternative alignment)	None (Remove all 112 feet of existing culvert).	Remove culvert. Potentially realign stream as project mitigation
South Tributary to Yarrow Creek	376+00	Total[d]	None	NA (outside alternative alignment)	None	Potential to replace or retrofit culvert to be fully fish passable[a] as project mitigation

[a] Station locations are based on the 4-Lane Alternative in order to remain consistent with the *Ecosystems Discipline Report*.

[b] Culverts would be designed to be fully fish passable according to WDFW (2003).

[c] Classified by WSDOT and WDFW (2003).

[d] Classified based on site reconnaissance.

[e] These impacts are greater than originally listed in Table 49 of the 6-Lane Alternative Options Report.

[f] The channel will require realignment to the south to avoid impacts from the expanded alignment on the south side of SR 520.

CMP = Corrugated Metal Pipe
NA = Not Applicable

Stream Water Quality

With the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option, the effects on stormwater quality would be identical to the original 6-Lane Alternative for all Eastside project area basins (see *Ecosystems Discipline Report*) except Yarrow Creek Basin. Additional impervious surface would be added in Yarrow Creek Basin.

Similar to the original 6-Lane Alternative, all stormwater entering Eastside streams from this option would be treated to improve water quality before discharging to the streams. This treatment would aid in meeting water quality standards in Eastside streams, as discussed in the *Ecosystems Discipline Report*. The greater amount of pollution-generating impervious surface from this option as compared to the original 6-Lane Alternative is expected to result in slightly greater pollutant loading. With the application of BMPs, however, no differences in the effects on aquatic species are anticipated.

Riparian Vegetation

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would permanently remove 21,706 square feet (0.50 acres) of riparian vegetation (due to placement of fill) at seven Eastside streams (see Exhibit 19). This includes the relocation of about 104 feet of the mainstem Yarrow Creek to the south, between the Bellevue Way and 108th Avenue Northeast interchanges with SR 520. Overall, there would be approximately 20 percent more riparian buffer loss than under the original 6-Lane Alternative. The type of riparian buffer impacts to Eastside project area streams with this option would be similar to those discussed for the original 6-Lane Alternative (minor effects on the Eastside streams' ability to recruit LWD, contribute

Exhibit 19. Riparian Buffer Effects on Eastside Streams from Proposed Project[a]

Stream	Original 6-Lane Alternative (sq ft)	South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option (sq ft)
Fairweather Bay Creek	5,337	5,337
Cozy Cove Creek	4,317	4,317
Tributary of Yarrow Bay	1,040	1,040
Tributary #2 of Yarrow Bay	5,822	5,822
East Tributary of Yarrow	866	865

Exhibit 19. Riparian Buffer Effects on Eastside Streams from Proposed Project[a]

Stream	Original 6-Lane Alternative (sq ft)	South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option (sq ft)
Creek		
Yarrow Creek	371	3,189
South Yarrow Creek	0	1,136
Totals	17,753	21,706

[a] The riparian buffer impact numbers do not include areas that are within wetlands or wetland buffers, which were calculated in the wetlands section of this report.

organic material to downstream waters, and regulate temperature), except in the mainstem Yarrow Creek and South Tributary to Yarrow Creek, where effects would be slightly greater due to a greater amount of clearing. Riparian effects from the stream relocation on the mainstem Yarrow Creek would be minimal because existing vegetation in the area is predominantly reed canarygrass, with no tree component. In individual cases where effects on riparian vegetation along the streams would include removal of large shrubs and trees that provide substantial shading (for example, along the mainstem Yarrow Creek), revegetation would occur where feasible (see the *Fish Resources Mitigation* section for details).

How would project construction temporarily affect fish resources in the project area?

Seattle

The 6 Lanes with Pacific Street Interchange option would have similar construction effects on fish resources as the original 6-Lane Alternative except for construction of the Union Bay Bridge, which would require up to a year to construct. Pier columns would be cast in place on either side of the Ship Canal navigation channel, with work conducted from barges. The roadway sections would be brought in by barge and lifted into place. The presence of work barges during active work periods would be the only construction effect.

The second Montlake Bridge foundation construction would occur on land and have no effect on fish resources. Prefabricated roadway sections of the bridge would be transported to the site on barges and lifted into place. Barges would be in place for two separate week-long

durations to place these sections. Additional work might also be conducted at the site from barges. Overall, the Second Montlake Bridge option would have similar effects on fish as the original 6-Lane Alternative.

Eastside

South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast Option

Construction of the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option could temporarily affect streams in the Eastside project area. These effects, which include increased sedimentation and altered streamflow, are discussed in more detail in the following section. This option would have the same types of construction effects on streams crossed by SR 520 on the Eastside as the original 6-Lane Alternative.

The South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would affect more linear feet of stream and require more culvert replacements/removal than the original 6-Lane Alternative (see Exhibits 17 and 18). In addition, this option would require the relocation of about 104 feet of stream to the south, between the Bellevue Way and 108th Avenue Northeast interchanges with SR 520. Therefore, there would be a somewhat greater chance of effects on fish or fish habitat from direct disturbance, flow diversion, or downstream sedimentation. However, these effects would be minimized by construction timing and by application of the BMPs and conservation measures discussed for the original 6-Lane Alternative.

How would project construction from the 6-Lane Alternative options affect federally listed species and federal species of concern?

The 6-Lane Alternative options in Seattle would have the same effects on federally listed fish species (Chinook salmon and bull trout) as the original 6-Lane Alternative, except that they may occur over a longer duration. Construction of the 6 Lanes with Pacific Street Interchange option could take up to 7 years, or 2 years longer than the original 6-Lane Alternative. Construction effects on Chinook and bull trout with the Second Montlake Bridge option would be the same as the original 6-Lane Alternative.

As discussed for the original 6-Lane Alternative, the presence of Chinook salmon and bull trout is limited or absent within the Eastside

project area. Therefore, construction activities (including fish passage barrier removal and stormwater facility construction) from the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option would have a minimal effect on these species. In addition, as discussed for the original 6-Lane Alternative, the use of specific construction methods combined with avoidance/minimization of effects on sensitive areas where feasible would result in minimal effects on any juvenile or adult coho salmon present within Eastside project area streams.

Mitigation

What would be done to avoid or minimize potential negative effects on fish species or aquatic habitat?

Measures to minimize and avoid permanent and construction effects and the recommended BMPs of the three 6-Lane Alternative options would be identical to those discussed for the original 6-Lane Alternative.

How could the project compensate for unavoidable negative effects on fish or aquatic habitat?

Effects on fish and aquatic habitat from the three 6-Lane Alternative options would be compensated with similar methods as the original 6-Lane Alternative. In cooperation with resource agencies, WSDOT would develop plans for habitat improvements, restoration, or construction to mitigate the effects of bridge construction and the increased width of shoreline and shallow water crossings. Specific plans would be included in permit applications for construction of the proposed project.

In the Seattle area, restoration of shoreline habitat could modified to provide shoreline areas with sand-gravel substrate that is devoid of invasive weeds, such as Eurasian milfoil and white water lily to support rearing/migrating juvenile salmonids. Existing information for juvenile salmon in Lake Washington indicates they tend to rear and migrate in shallow water along sandy-gravel beaches devoid of the invasive macrophytes that are common in the project's Union Bay area (Pisakowski and Tabor 2000, Tabor et al. 2004a and 2004b). Therefore,

constructing new shallow water habitat could provide an enhanced migration corridor where all anadromous salmonids produced in the Lake Washington watershed enter the Ship Canal.

On the Eastside, WSDOT could compensate for culvert lengthening and stream buffer effects on streams by upgrading identified WSDOT fish passage barrier culverts that are not directly impacted (require lengthening). For the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option (see Exhibits 17 and 18), up to three culverts could be upgraded, thereby further improving fish passage conditions in the project area.

WSDOT would address stream buffer effects of the local critical areas regulations. Two approaches could be implemented for mitigating the effects of clearing riparian vegetation within stream buffers.

With the first approach, native riparian vegetation would be planted to improve habitat and provide stream shading along each of the streams where vegetation would be cleared. The extent of riparian planting would likely be dictated by the extent of the clearing effects with interplanting of currently vegetated areas to increase plant density.

The second approach to mitigating effects on riparian vegetation within stream buffers would involve larger-scale revegetation along fish-bearing streams within or adjacent to the immediate project area. With this approach mitigation could be concentrated along a stream where substantial salmonid use is confirmed and where stream reaches have been identified as lacking in riparian vegetation, stream shading, LWD, or bank stability.

For fish-bearing streams with larger buffer effects, priority would be given to revegetating the remaining stream buffer at the same place vegetation was cleared. The combination of both onsite and offsite mitigation would largely maintain existing riparian functions of streams along the proposed project alignment, while substantially improving riparian quality and fish habitat at one or more mitigation sites.

A potential riparian mitigation site that would meet the criteria discussed for larger-scale sites exists on the mainstem of Yarrow Creek, located on the south side of SR 520 between the Bellevue Way and 108th Avenue Northeast interchanges. This 500-foot-long reach has been affected by invasive, nonnative vegetation, is dominated by reed canarygrass, and demonstrates a high risk of elevated stream

temperatures. Habitat complexity is lacking, with relatively uniform glide habitat, silt and sand stream substrate, and no LWD. The removal of reed canarygrass and replanting the riparian zone with native shrubs and trees (potentially including red alder, willow, red osier dogwood, and salmonberry) would substantially improve this reach's stream functions and provide increased stream shading, LWD recruitment, and litter fall. Assuming a 25-foot-wide buffer on both sides of the stream, approximately 25,000 square feet of buffer mitigation could be achieved on this site. Mitigation could occur in this location for the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option, and the stream would need to be relocated to the south, thereby allowing riparian mitigation to be combined with this activity.

An additional Eastside mitigation activity primarily suited to the South Kirkland Park-and-Ride Transit Access – 108th Avenue Northeast option exists on the South Tributary to Yarrow Creek. The two downstream culverts on this tributary could be removed as fish passage mitigation, and the stream could be daylighted. The banks of the newly established channel would then be planted with native shrubs and trees to establish a functioning riparian buffer.

Wildlife and Habitat

Affected Environment

How was information on wildlife habitat and wildlife occurrence collected?

The ecosystems discipline team collected information using the same methodology described in the *Ecosystems Discipline Report*.

What are the landscape cover types and wildlife habitat characteristics of the project area?

The landscape cover types and wildlife habitat types under the 6-Lane Alternative options are the same as described in the *Ecosystems Discipline Report*. However, the 6-Lane Alternative options would include new affected environment areas, which are described in the following paragraphs.

Additional potentially affected environments in Seattle include the vicinity of the second Montlake Bridge under the Second Montlake Bridge option and the vicinity of the Pacific Street interchange and Union Bay Bridge under the 6 Lanes with Pacific Street Interchange option (Exhibit 20). These areas consist mostly of Urban Matrix cover type with roads and building (cover type categories are defined and discussed in the *Wildlife and Habitat* section of the *Ecosystems Discipline Report*). However, these areas also include open water habitats at Union Bay and the Ship Canal that provide habitat for a variety of wildlife, including waterfowl and other water birds, beaver, and foraging bald eagles.

Do any federally listed wildlife species occur in the project area?

As discussed under the original 6-Lane Alternative in the *Ecosystems Discipline Report*, one federally listed wildlife species (the bald eagle) occurs in the 6-Lane Alternative options project area. Nest sites for the bald eagle are the same as described for the original 6-Lane Alternative in the *Ecosystems Discipline Report*

Do any other wildlife species of special interest occur in the project area?

No other wildlife species of special interest occur only in the additional project area under the 6-Lane Alternative options. Consequently,

occurrence of these species in the additional project area would be the same as described for the original 6-Lane Alternative in the *Ecosystems Discipline Report*.

How are these protected species distributed within the project area?

The additional project area in Seattle is used by foraging bald eagles, a federally listed threatened species, and also may be used for foraging by other wildlife species of special interest (i.e., peregrine falcon, western grebe, great blue heron, hooded merganser, or wood duck).

Do WDFW priority wildlife habitats occur in the project area?

As described in the *Ecosystems Discipline Report*, WDFW priority habitats within the project area include urban natural open space, riparian areas, and wetlands habitat types (WDFW 2004). Urban natural open spaces are described under Parks and Other Protected Areas in Exhibit 53 of the *Ecosystems Discipline Report*. The occurrence of riparian areas and wetlands for the 6-Lane Alternative options is described in the *Wetlands* and *Fish Resources* sections of this memorandum.

Potential Effects of the Project on Wildlife and Wildlife Habitat

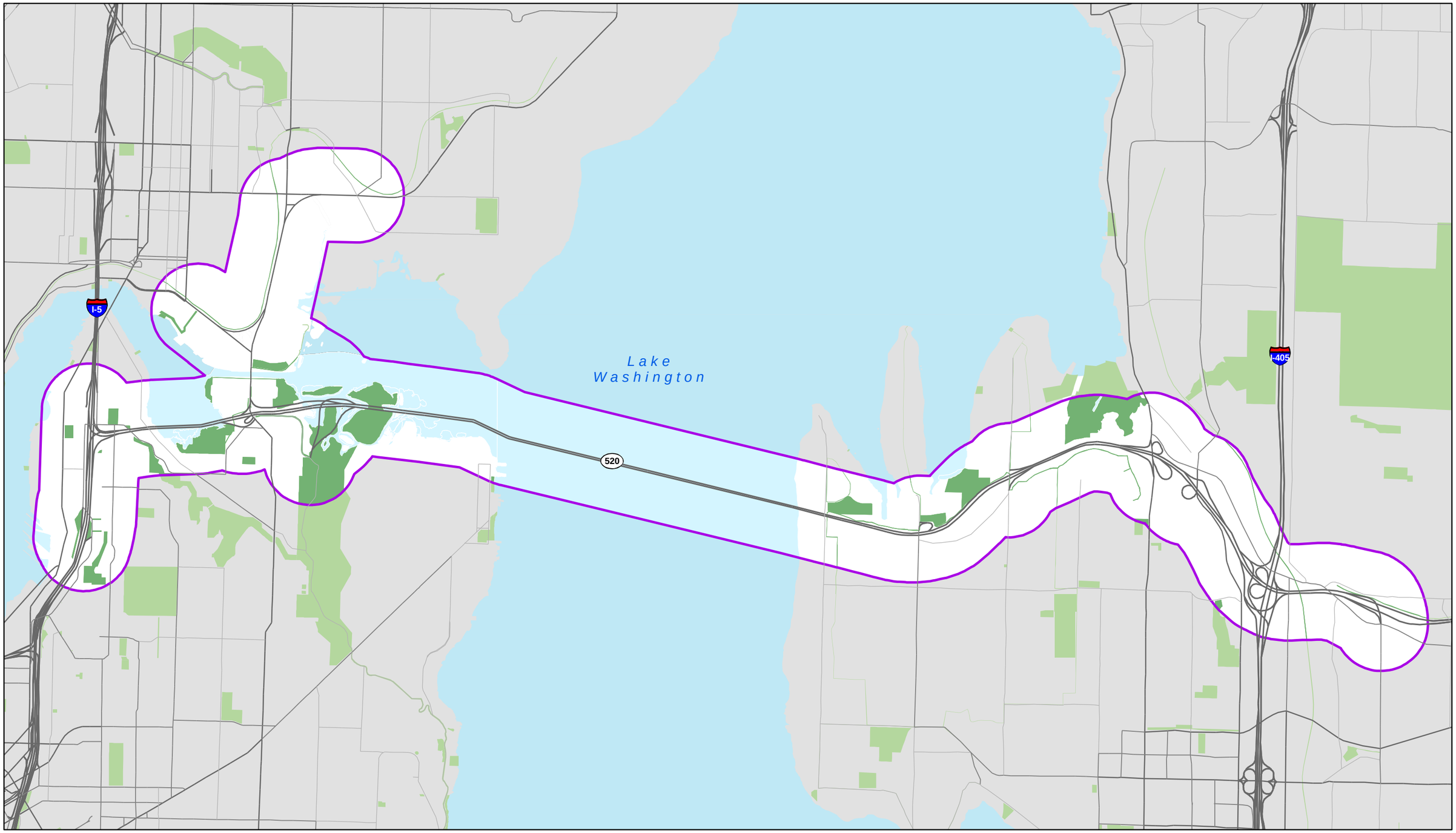
What methods were used to evaluate the potential effects on wildlife and habitat?

Methods for evaluating potential effects on wildlife and habitat are the same as described in the *Ecosystems Discipline Report*.

How would the 6-Lane Alternative options permanently affect habitat and associated wildlife species?

As with the original 6-Lane Alternative, the 6-Lane Alternative options have the potential to permanently affect habitat and/or wildlife through four primary mechanisms or pathways:

1. Effects to vegetation from direct removal, shading, and changes in hydrology
2. Water quality and quantity effects from changes in stormwater
3. Noise disturbance from increased noise levels in the highway vicinity
4. Changes in obstructions to animal movement



Open Water

Parks and Other Protected Areas

Project Area (within 1/4 mile)

Urban Matrix

N

0 2,500 5,000 Feet

Exhibit 20. **Existing Cover Types in the Project Area**

SR 520 Bridge Replacement and HOV Project

The likelihood and anticipated magnitude of these potential effects are described below for each of the 6-Lane Alternative options. As with the original 6-Lane Alternative, effects of the 6-Lane Alternative options from wildlife habitat fragmentation would be negligible because the area is already fragmented by the existing roadway. Detailed information on wetland effects are described in the *Wetlands* section. Effects on fish resources are described in the *Fish Resources* section.

Seattle

What are the effects of vegetation removal and shading on wildlife?

As with original 6-Lane Alternative, the 6-Lane Alternative options would include removal of vegetation and consequent elimination of habitat where the roadway is on the ground and shading of vegetation where the roadway (and bridges and approaches) would be elevated, such as in Portage Bay and through the Arboretum .

Construction of the elevated roadway would also include some removal of vegetation for placement of columns to support the roadway. In densely shaded areas under the bridge structures, vegetation cover and composition could decrease, thereby reducing habitat for wildlife. These effects are expected to be minor relative to those effects caused by bridge structures because wildlife may avoid the shaded areas due to noise and other disturbances. The sections below describe differences in vegetation removal and shading between the Seattle project area options. Effects on wildlife from obstructions and barriers are described in later sections of this report.

6 Lanes with Pacific Street Interchange Option

Exhibit 21 shows cover types that would be affected by the 6 Lanes with Pacific Street Interchange option. Compared to the original 6-Lane Alternative, this option would remove approximately 2.3 fewer acres of vegetation (trees, grasses, and shrubs) in the Urban Matrix cover type, and approximately 1.9 fewer acres of vegetation in the Parks and other Protected Areas cover type (Exhibit 22). However, this option would cause more shading effects on trees, shrubs, grasses, and wetlands within the Urban Matrix cover type than the original 6-Lane Alternative. Note that actual shading effects on individual areas would depend on roadway height, the width of the gaps between bridge structures, and existing vegetation cover.

Second Montlake Bridge Option

The cover types that would be affected by the Second Montlake Bridge option are shown in Exhibit 23. Total effects on vegetation from the Second Montlake Bridge option would be approximately 0.3 acre less than the original 6-Lane Alternative. This option would remove approximately 2.1 acres less vegetation than the original 6-Lane Alternative (Exhibits 22 and 24), and vegetation removal in Parks would be approximately 1.5 acres less under the Second Montlake Bridge option.

How would changes in water quality and quantity affect wildlife?

As with the original 6-Lane Alternative, each of the 6-Lane Alternative options would include implementation of stormwater detention and treatment facilities and water quality BMPs to treat and remove pollutants. Stormwater discharges would comply with federal and state water quality regulations.

6 Lanes with Pacific Street Interchange Option

As previously discussed in the *Fish Resources* section of this report and the *Addendum to Water Resources Discipline Report*, the amount of stormwater discharged to the eastern part of the Portage Bay basin and to the western portion of the Union Bay basin would be reduced. In addition, some of the stormwater that currently falls on impervious surface in the Montlake Boulevard area north of the proposed Pacific Street interchange would be treated and discharged primarily to University Slough. A slight improvement in Union Bay water quality would occur with this treatment of currently untreated stormwater. This slight improvement in water quality relative to existing conditions is expected to have a minimal effect on wildlife.

Second Montlake Bridge Option

The effects of water quality and quantity on wildlife would be the same as under the original 6-Lane Alternative.

What types of wildlife disturbances, barriers, and obstructions would occur as a result of the options?

In general, noise levels and consequent disturbance to wildlife under the 6-Lane Alternative options would be very similar to the original 6-Lane Alternative. Some difference in disturbance levels and barriers/obstructions would occur at specific locations under some options, as described in the following paragraphs.

Lake Washington

520

Park Within 1/4 mile of Project Area

6 Lanes with Pacific Street Interchange Option Footprint

Cover Types Effects

Parks and Other Protected Areas

Temporary shading of existing vegetation

Permanent shading of existing vegetation

Permanent removal of existing vegetation

*Permanent removal of existing vegetation would occur in areas where the roadway or associated facility is at-grade. Shading effects would occur where the roadway or associated facility is elevated.

Open Water

Temporary shading

Permanent shading

Urban Matrix

Temporary shading of existing vegetation

Permanent shading of existing vegetation

*Permanent removal of existing vegetation within Urban Matrix would also occur within the permanent footprint area. These areas are not assigned a color but can be inferred from the aerial photo.

NOTES: Pile driving would occur in all elevated roadway areas.

Source: City of Seattle (2003) GIS Data (aerial photo and parks); Parametrix (2004) CAD data (footprint boundary). Horizontal datum for all layers is NAD83(91), vertical datum for layers is NAVD88.

N

0 250 500 1,000 Feet

Exhibit 21. **Effects of 6 Lanes with Pacific Street Interchange Option on Cover Types in the Seattle Project Area**
SR 520 Bridge Replacement and HOV Project