Attachment 9
Mitigation Plans

Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

I-5 to Medina: Bridge Replacement and HOV Project

Initial Aquatic Mitigation Report
I-5 to Medina: Bridge Replacement and HOV Project

Prepared for

Washington State Department of Transportation
Urban Corridors Office

and

Federal Highway Administration

October 2009

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Washington State Department of Transportation

SR 520 Bridge Replacement and HOV Program

I-5 to Medina: Bridge Replacement and HOV Project

Initial Aquatic Mitigation Report

I-5 to Medina: Bridge Replacement and HOV Project

October 2009

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TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

TABLE OF CONTENTS

ACRONYMS

BMP	best management practice
cfs	cubic feet per second
DDD	**Dichlorodiphenyldichloroethane**
DO	dissolved oxygen
EIS	Environmental Impact Statement
ESA	Endangered Species Act
GIS	geographic information system
HCT	high-capacity transit
HOV	high-occupancy vehicle
HPA	Hydraulic Project Approval
LWD	large woody debris
LWSC	Lake Washington Ship Canal
m	meter
mg/L	milligrams per liter
n.d.	no date
NMFS	National Marine Fisheries Service
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGIS	pollution-generating impervious surface
RM	River Mile
SPU	Seattle Public Utilities
SR	State Route
TCDD	**2,3,7,8-Tetrachlorodibenzodioxin** (dioxin)

USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

1. EXECUTIVE SUMMARY

This document documents the development and results of a screening process for aquatic mitigation opportunities to offset impacts on aquatic species and habitat associated with the construction and operation of the I-5 to Medina: Bridge Replacement and HOV Project. The Washington State Department of Transportation (WSDOT) will replace the existing State Route (SR) 520 bridges, approaches, and portions of the highway leading to the bridges, which will result in additional inwater and overwater structures, and impacts to the aquatic and riparian resources of Lake Washington and the Lake Washington Ship Canal. The goal of the Initial Aquatic Mitigation Plan is to define a mitigation screening framework that will facilitate future efforts to functionally link project impacts to potential mitigation benefits, benefits based on how each impact or mitigation action would affect habitat functions that support key juvenile salmonid life functions of migration, rearing, refugia and feeding.

The screening exercise consisted of a three-part process that pared all the potential parcels within the geographic study area (a large portion of the Lake Washington Basin) down to a list of 30 sites, which offer the best opportunities to achieve the project mitigation goals. The initial screen used straightforward pass/fail criteria to remove both high-risk sites and those sites deemed insufficient in providing substantial functional uplift from a list of thousands of parcels. The remaining 208 candidate sites were then sorted into four functional groups, based on the relationship between basin geography and salmonid life history functions they provide. After sorting, additional evaluation criteria, including an evaluation of existing site condition and potential functional uplift (where information was available) and site consistency with existing restoration plans, were then considered to facilitate advancement of a subset of high value or potential uplift sites (30 sites total) for more detailed analysis in the future. The overall screening and evaluation process reduces the number of potential mitigation sites to a manageable number while still advancing those sites best suited to provide a wide array of aquatic mitigation options that will meet the specific compensatory mitigation needs of the project. The aquatic mitigation team advanced only those individual sites that when combined with other identified sites, could provide the types and quantity of aquatic mitigation to adequately compensate for the project's estimated effects on fish and aquatic habitat. This effort resulted in an interim list of top candidate sites for each of the four functional groups; Lake Washington, Lake Washington Ship Canal, Marine, and Riverine. These sites are not ranked, as the final ranking of sites will require input from resource agencies and further evaluation with more detailed data sources, including field reconnaissance.

Although an exact quantitative accounting of project effects and functional uplift from mitigation opportunities is beyond the scope of this document. As the mitigation planning effort proceeds, future detailed analysis will establish and document a quantitative basis for the appropriateness and sufficiency of the mitigation plan to replace lost or impaired habitat functions resulting from the project. An example of such a quantitative approach might involve the incorporation of salmonid population effects metrics, salmonid habitat metrics, or a combination of these metrics to develop a common denominator for mitigation planning.

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2. PURPOSE

The Washington State Department of Transportation (WSDOT) is proposing to construct the I-5 to Medina: Bridge Replacement and HOV Project to replace the existing State Route (SR) 520 bridges, approaches, and portions of the highway leading to the bridges. The study area for this project (see Figure 1) contains important aquatic and riparian resources that are essential to the health and sustainability of the natural ecosystem. Project construction would result in both temporary and permanent effects on these aquatic and fisheries resources. Federal, state, and local regulations, as well as WSDOT policy, require that WSDOT provide mitigation for these effects to aquatic and fisheries resources.

The Initial Aquatic Mitigation Report is part of a three-document set that identifies aquatic mitigation appropriate to the project's effects and supports the permitting process. This report, in conjunction with the Initial Wetland Mitigation Report, list potential mitigation opportunities to offset impacts to aquatic resources. The Initial Aquatic Mitigation Report provides preliminary information about mitigation planning concurrently with publication of the I-5 to Medina: Bridge Replacement and HOV Project Environmental Impact Statement (EIS). The report also identifies a pool of pre-qualified candidate mitigation sites from which to develop a specific conceptual mitigation plan as the project elements and effects become more clearly defined.

The information in this report presents an early approximation of project effects representing the range of alternatives under consideration. This early approximation provides preliminary guidance about the nature and extent of needed mitigation. This approach accelerates the development of specific mitigation components and may be used to identify and implement early mitigation actions. The remaining two documents in the set (the Conceptual Aquatic Mitigation Plan and the Final Conceptual Aquatic Mitigation Plan) further refine the site selection and develop and refine site-specific aquatic mitigation concepts. These documents also serve as supplements to the permit applications for Sections 401 and 404 of the Clean Water Act, the Hydraulic Project Approval (HPA), and local Critical Areas Ordinances.

The project team is currently evaluating several design options (for more information on these options, see WSDOT 2009). The extent and magnitude of the project's effects would vary depending upon the alternative chosen. Currently, only the 6-Lane Alternative has been developed sufficiently to quantify effects to aquatic resources. Additional analysis will occur as the mitigation team concludes its process.

The following sections of the Initial Aquatic Mitigation Report summarize the proposed project's effects on aquatic and fisheries resources, the mitigation needs, and the preliminary results of screening and selecting candidate mitigation sites to compensate for the project's effects on aquatic and fisheries resources. WSDOT and consultant biologists (the mitigation team) developed a mitigation site selection process to be adapted and applied through collaboration with regulatory agencies. The purposes of the site selection process are the following:

- Document decisions in the selection process.
- Quickly eliminate unsuitable or higher-risk sites.

- Develop a list of suitable sites with lower risk.
- Identify appropriate and viable site(s) for WSDOT project delivery.
- Manage the level of effort by following an efficient process.
- Adapt to changing project and regulatory requirements.

The goal of selection process is to develop a list of potential mitigation sites that would compensate for the project's effects on aquatic and fisheries resources. The list is intended to be a living document, growing and changing as the project evolves and more information is collected and analyzed. Ultimately, a short list of the best sites will be provided to WSDOT for potential project implementation and/or site acquisition.

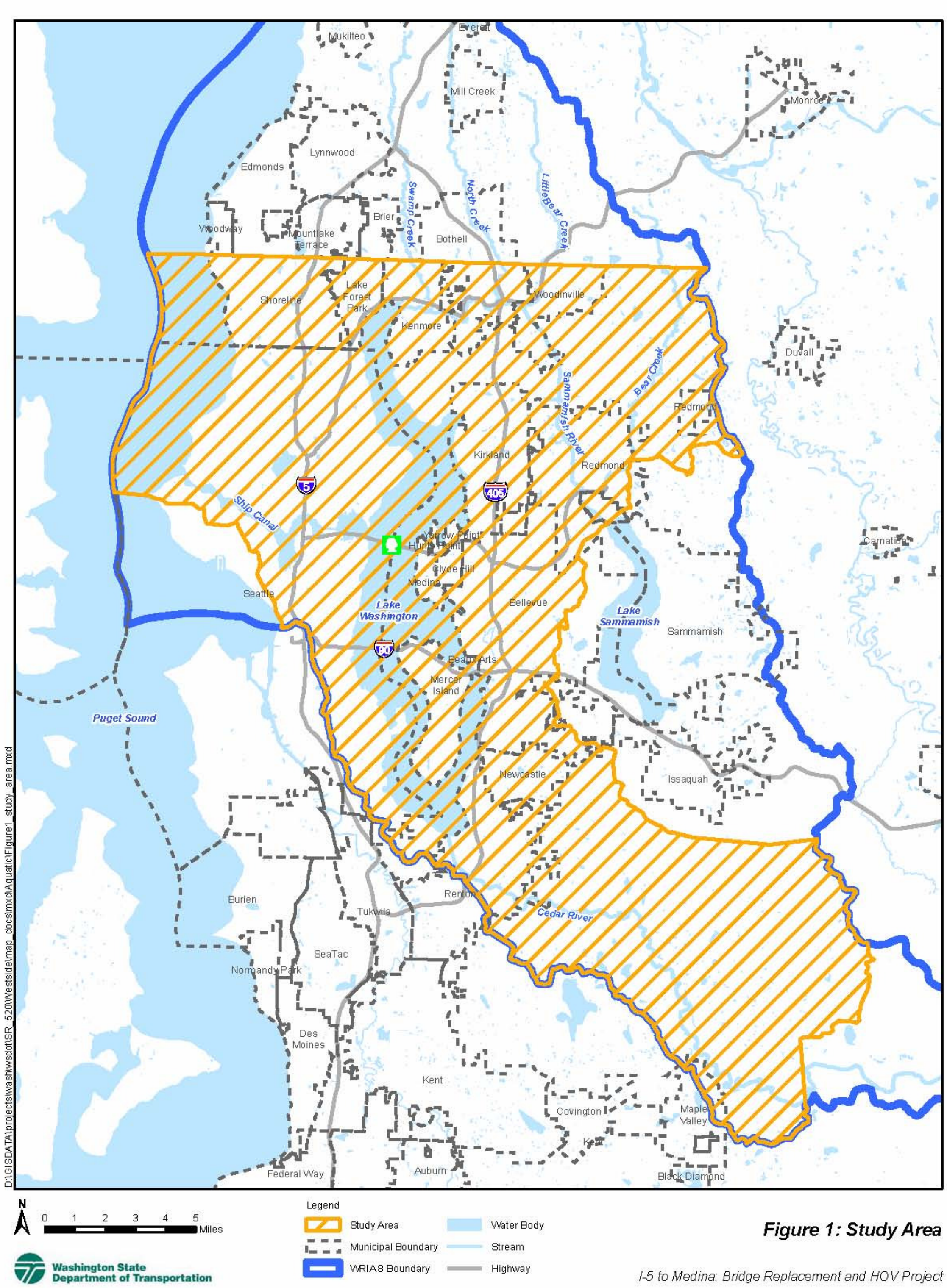

Figure 1. Study Area

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3. PROJECT DESCRIPTION

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

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

Improvements to the western portion of the SR 520 corridor—known as the I-5 to Medina: Bridge Replacement and HOV Project (the *I-5 to Medina Project*)—are being evaluated in a Supplemental Draft EIS (SDEIS). Project limits for this project extend from I-5 in Seattle to 92nd Avenue NE in Yarrow Point, where it transitions into the Medina to SR 202: Eastside Transit and HOV Project (the *Medina to SR 202 Project*). Exhibit 1 shows the project vicinity.

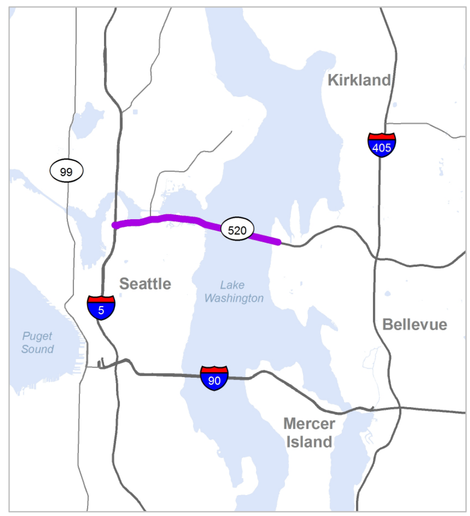


Exhibit 1. **Project Vicinity Map**

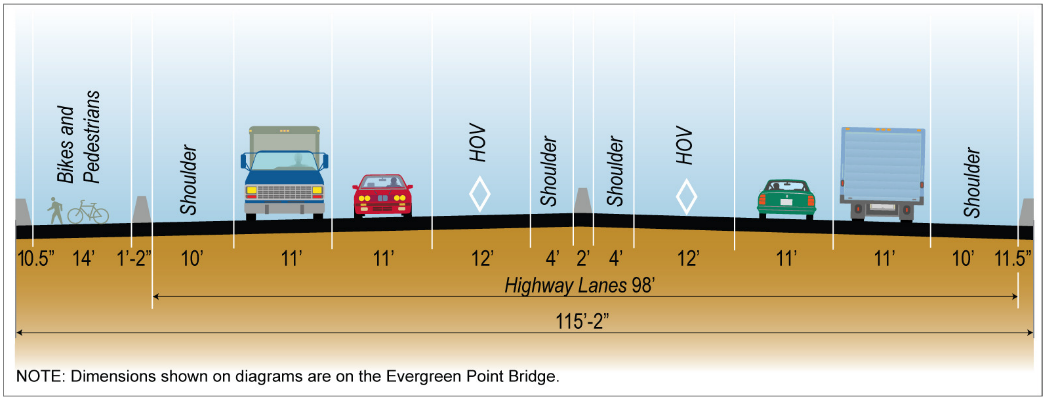
For this project, a mediation group convened at the direction of the state legislature after the publication of the Draft EIS in 2006 to evaluate the corridor alignment for SR 520 through Seattle. The mediation group identified three 6-lane design options for SR 520 between I-5 and the floating span of the Evergreen Point Bridge; these options were documented in a Project Impact Plan (WSDOT 2008). The SDEIS evaluates the following two alternatives and the three design options:

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

The 6-Lane Alternative is summarized below. More detailed information on the three design options is provided in the Description of Alternatives Discipline Report (WSDOT 2009).

3.1 6-LANE ALTERNATIVE

The 6-Lane Alternative would complete the regional HOV connection (3+ HOV occupancy) across SR 520. This alternative would include six lanes (two 11-foot-wide outer general-purpose lanes and one 12-foot-wide inside HOV lane in each direction), with 4-foot-wide inside and 10-foot-wide outside shoulders (Exhibit 2 depicts a cross section of the 6-Lane Alternative). The proposed width of the roadway would be narrower than the one described in the Draft EIS and reflects public comment from local communities.



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

Exhibit 2. **6-Lane Alternative Cross Section**

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

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

3.1.1 Floating Bridge

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

A single row of 21 75-foot-wide by 360-foot-long longitudinal pontoons would support the floating bridge. One 240-foot-long by 75-foot-wide cross pontoon at each end of the bridge would be set perpendicularly to the longitudinal pontoons. The longitudinal pontoons would be bolstered by 54 smaller supplemental stability pontoons on each side for stability and buoyancy. The longitudinal pontoons would not be sized to carry future high-capacity transit (HCT), but would be equipped with connections for additional supplemental stability pontoons to support HCT in the future. The floating pontoons for the new bridge would be anchored to the lake bottom to hold the bridge in place.

Near the east approach bridge, the roadway would be widened to accommodate transit ramps to the Evergreen Point Road transit stop.

3.1.2 Bridge Maintenance Facility

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

3.1.3 Eastside Transition Area

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

3.1.4 Seattle

3.1.4.1 Elements Common to the 6-Lane Alternative Options

SR 520 would connect to I-5 in a configuration similar to the way it connects today. Improvements to this interchange would include a new reversible HOV ramp connecting the new SR 520 HOV lanes to existing I-5 reversible express lanes. WSDOT would replace the Portage Bay Bridge and the Evergreen Point Bridge (including the west approach and floating span), as well as the existing local street bridges across SR 520. New stormwater facilities would be constructed for the project to provide stormwater retention and basic treatment, as well as enhanced treatment where feasible. The project would include landscaped lids across SR 520 at I-5, 10th Avenue East and Delmar Drive East, and in the Montlake area to help reconnect the communities on either side of the roadway. The project would also remove the Montlake freeway transit station.

The most substantial differences among the three options are the interchange configurations in the Montlake and University of Washington areas.

3.1.5 Options

The most substantial differences among the three options are the interchange configurations in the Montlake and University of Washington areas.

Option A

Option A would include a new Portage Bay Bridge, which would include a total of seven lanes (four general-purpose lanes, two HOV lanes, and a westbound auxiliary lane). WSDOT would replace the interchange at Montlake Boulevard NE with a new interchange in a similar configuration. The Lake Washington Boulevard ramps and the median freeway transit stop near Montlake Boulevard East would be removed, and a new bascule bridge (i.e., drawbridge) would be added to Montlake Boulevard NE, parallel to the existing Montlake Bridge. SR 520 would maintain a low profile through the Washington Park Arboretum and flatten out east of Foster Island, before rising to the west highrise of the Evergreen Point Bridge. This option would include quieter pavement and might also include noise walls, depending on neighborhood interest.

Suboptions for Option A would include adding eastbound and westbound off-ramp to Lake Washington Boulevard, adding an eastbound direct access on-ramp for transit from Montlake Boulevard East, and a constant slope profile from 24th Avenue East to the west highrise, with no Foster Island Land Bridge.

Option K

Option K would also replace the Portage Bay Bridge, but the new bridge would include four general-purpose lanes and two HOV lanes with no westbound auxiliary lane. In the Montlake area, Option K would remove the existing Montlake Boulevard East interchange and the Lake Washington Boulevard ramps and replace their functions with a depressed, single-point urban interchange (SPUI) at the Montlake shoreline. Two HOV direct-access ramps would service the new interchange, and a tunnel under the Montlake Cut would move traffic from the new interchange north to the intersection of Montlake Boulevard NE and NE Pacific Street. SR 520 would maintain a low profile through Union Bay and would make landfall at Foster Island and remain flat before rising to the west transition span of the Evergreen Point Bridge. A land bridge would be constructed over SR 520 at Foster Island. Citizen recommendations made during the mediation process defined this option to include only quieter pavement for noise mitigation, rather than the sound walls that were included in the 2006 Draft EIS. Because quieter pavement is not recognized by the Federal Highway Administration (FHWA) as an acceptable form of noise mitigation in Washington state, sound walls could be included in Option K. The decision to build sound walls depends on neighborhood interest, the findings of this Noise Discipline Report, and WSDOT's reasonability and feasibility determinations.

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

Option L

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

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

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4. AQUATIC HABITAT BASELINE CONDITIONS

The project is located in the Lake Washington watershed, which comprises 13 major drainage sub-basins and numerous smaller drainages, totaling about 656 miles (1,050 kilometers) of streams, two major lakes, and numerous smaller lakes. Lake Washington and its major drainages (Issaquah Creek, the Sammamish River, and the Cedar River) are located in the Cedar-Sammamish Watershed Basin, or Water Resource Inventory Area (WRIA) 8.

The majority of the watershed is highly developed, with 63 percent of the watershed fully developed; WRIA 8 has the highest human population of any WRIA in Washington State (NMFS 2008a). Lake Washington is the second largest natural lake in Washington with 80 miles (128 kilometers) of shoreline. The lake is approximately 20 miles long (32 kilometers) with a mean width of approximately 1.5 miles (2.4 kilometers), has a circumference of 50 miles (80 kilometers), covers 22,138 surface acres (8,960 hectares), and has a mean depth of approximately 100 feet (30 meters) and a maximum depth of approximately 200 feet (60 meters) (Jones and Stokes 2005).

4.1 LAKE WASHINGTON HYDROLOGY

The Lake Washington watershed has been dramatically altered from its pre-settlement conditions primarily due to urban development and removal of the surrounding forest, as well as the lowering of the lake elevation and rerouting of the outlet through the Ship Canal. As a result, the Cedar River is now the major source of fresh water to Lake Washington, providing about 50 percent (663 cubic feet per second [cfs]) of the mean annual flow entering the lake (NMFS 2008). The Cedar River drainage area is approximately 184 square miles (476 square kilometers), which represents about 30 percent of the Lake Washington watershed area.

The Lake Sammamish basin is also a substantial fresh water source, providing about 25 percent (307 cfs) of the mean fresh water flow into Lake Washington. The Sammamish sub-basin has a drainage area of about 240 square miles (622 square kilometers) and represents about 40 percent of the Lake Washington basin. Tributaries to the Sammamish River include Swamp, North, Bear, and Little Bear creeks, as well as the surface waters of Lake Sammamish. Hydrology in the Lake Sammamish sub-basin is generally affected by the same factors that affect Lake Washington.

The remainder of fresh water flow into Lake Washington originates from a variety of small creeks located primarily along the northern and eastern shores. These smaller tributaries and sub-basins in the Lake Washington system include Thornton, McAleer, Forbes, Juanita, Kelsey, Coal, and May creeks, and Mercer Slough. Within Lake Washington, the natural hydrologic cycle has been altered. Historically, lake elevations peaked in winter and declined in summer. Present operation of the locks produces peak elevations throughout most of the summer.

The U.S. Army Corps of Engineers (USACE) is mandated by Congress (Public Law 74-409, August 30, 1935) to maintain the level of Lake Washington between 20 and 22 feet (USACE datum) as measured at the locks. USACE operates this facility to systematically manage the water level in Lake Washington over four distinct management periods, using various forecasts of water availability and use. The four management periods are as follows:

- Spring refill – lake level increases between February 15 and May 1 to 22 feet (USACE datum).
- Summer conservation – lake level maintained at about 22 feet for as long as possible, with involuntary drawdown typically beginning in late June or early July.
- Fall drawdown – lake level decreasing to about 20 feet from the onset of the fall rains until December 1.
- Winter holding – lake level maintained at 20 feet between December 1 and February 15.

Operation of the locks and other habitat changes throughout the Lake Washington basin, have substantially altered the frequency and magnitude of flood events in Lake Washington and its tributary rivers and streams. Historically, Lake Washington's surface elevation was nearly 9 feet (2.7 meters [m]) higher than it is today, and the seasonal fluctuations further increased that elevation by an additional 7 feet (2.1 m) annually (Williams 2000). In 1903, the average lake elevation was recorded at approximately 32 feet (9.8 m) (USACE datum) (NMFS 2008).

4.2 LAKE WASHINGTON SHORELINE HABITAT

Lowering the lake elevation after completion of the Ship Canal transformed about 1,334 acres (540 hectares) of shallow water habitat into upland areas, reducing the lake surface area by 7 percent and decreasing the shoreline length by about 13 percent (10.5 miles or 16.9 kilometers) (Chrzastowski 1981). The most extensive changes occurred in the sloughs, tributary delta areas, and shallow portions of the lake. The area of fresh water marshes decreased about 93 percent, from about 1,136 acres (460 hectares) to about 74 acres (30 hectares) (Chrzastowski 1981). Essentially all of the existing wetlands and riparian zone habitat developed after the lake elevation was lowered. Currently, this habitat occurs primarily in Union Bay, Portage Bay, Juanita Bay, and Mercer Slough (Dillon et al. 2000).

Lake level regulation by USACE has eliminated the seasonal inundation of the shoreline that historically shaped the structure of the riparian vegetation community. This, together with urban development, has replaced much of the hardstem bulrush- and willow-dominated community with developed shorelines and landscaped yards. The current lake level regulation affects the growth of many species of native terrestrial and emergent vegetation. This lake level regulation indirectly buffers the shorelines from potential winter storm wave effects. The loss of natural shoreline has also reduced the historic complex shoreline features such as overhanging and emergent vegetation, woody debris (especially fallen trees with branches and/or rootwads intact), and gravel/cobble beaches. The loss of native shoreline vegetation and wetlands has reduced the input of terrestrial detritus and insects to support the aquatic food web.

These natural shoreline features have been largely replaced with armored banks, piers, and floats, and limited riparian vegetation. A survey of 1991 aerial photos estimated that 4 percent of the shallow water habitat within 100 feet (30.5 m) of the shore was covered by residential piers (ignoring coverage by commercial structures and vessels) (USFWS 2008). Later studies report about 2,700 docks in Lake Washington and armoring of approximately 71 percent to 81 percent of the shoreline (Warner and Fresh 1999; City of Seattle 2000; Toft 2001).

An even greater density of docks and shoreline modifications occur throughout the Ship Canal, Portage Bay, and Lake Union (City of Seattle 1999; Weitkamp and Ruggerone 2000). Areas that have some amount of undeveloped shoreline include Gas Works Park, the area south of SR 520 (in Lake Union and Portage Bay), and a protected cove west of Navy Pier at the south end of Lake Union. Vegetation within these areas is limited, with the area south of SR 520 possessing the highest abundance of natural riparian vegetation, consisting primarily of cattails (*Typha* spp.) and small trees (Weitkamp and Ruggerone 2000). The loss of complex habitat features (i.e., woody debris, overhanging riparian and emergent vegetation) and shallow water habitat in Lake Washington has reduced the availability of prey refuge habitat and forage for juvenile salmonids. Dense growths of introduced Eurasian milfoil and other aquatic macrophytes effectively isolate much of the more natural shoreline from the deeper portions of the aquatic habitat.

Portage Bay is lined by University of Washington facilities, commercial facilities, and houseboats. The southeastern portion of Portage Bay has an area of fresh water marsh habitat and naturally sloped shoreline, while the remainder of the shoreline is developed, with little natural riparian vegetation. The Montlake Cut is a concrete-banked canal that connects Portage Bay to Union Bay, which extends eastward to Webster Point and the main body of Lake Washington.

Prior to construction of the Ship Canal, Union Bay consisted of open water and natural shorelines extending north to 45th Street. The lowered lake levels resulting from the Ship Canal construction produced extensive marsh areas around Union Bay, with substantial portions of this marsh habitat subsequently filled, leaving only the fringe marsh on the southern end (Jones and Jones 1975). The south side of the bay is bordered by the Arboretum, with a network of smaller embayments and canals, and extensive marsh habitats. The north side of Union Bay contains a marshy area owned by the University of Washington; the area was previously filled with landfill material. Numerous private residences with landscaped waterfronts and dock facilities dominate the remainder of the shoreline.

Development and urbanization have also altered base flow in many of the tributary systems (Horner and May 1998). Increases in impervious and semi-impervious surfaces add to runoff during storm events and reduce infiltration and groundwater discharge into streams and rivers. A substantial amount of surface water and groundwater is also diverted into the City of Seattle and King County wastewater treatment systems and is eventually discharged to Puget Sound.

Although the frequency and magnitude of flooding in the lake and the lower reaches of tributary streams have declined due to the operation of the locks, flooding has generally increased in the upstream reaches of tributary rivers and streams. This change is largely because of the extensive development that has occurred within the basin over the last several decades (Moscrip and Montgomery 1997).

No measurable changes in shoreline habitat condition are expected to occur in the near future, although gradual changes (both positive and negative) are likely to occur. Therefore, the existing degraded habitat in the study area and the greater Lake Washington watershed is expected to continue to affect ESA listed Chinook salmon and other salmonid species in the watershed for the foreseeable future.

4.3 LAKE WASHINGTON WATER AND SEDIMENT QUALITY

The water quality and sediment quality in the Lake Washington basin are degraded as a result of a variety of current and historic point and non-point pollution sources.

4.3.1 Pollution

Historically, Lake Washington, Lake Union, and the Ship Canal were the receiving waters for municipal sewage, with numerous shoreline area outfalls that discharged untreated or only partially treated sewage directly into these waterways. Cleanup efforts in the 1960s and 1970s included expanding the area wastewater treatment facilities and eliminating most untreated effluent discharges into Lake Washington. However, some untreated discharges occasionally still enter these waterways through discharge from combined sewer overflows during periods of high precipitation.

In addition to point source pollution, a variety of non-point sources continue to contribute to the degradation of water and sediment quality. Non-point sources include stormwater and subsurface runoff containing pollutants from road runoff, failing septic systems, underground petroleum storage tanks, gravel pits/quarries, landfills and solid waste management facilities, sites with improper hazardous waste storage, and commercial and residential sites treated with fertilizers and pesticides.

Historical industrial uses in the basin, such as those around Lake Union and southern Lake Washington, Newcastle, Kirkland, and Kenmore, have contaminated sediments with persistent toxins; these toxins include polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and heavy metals (King County 1995). The expanding urbanization in the basin has also increased sediment input into the Lake Washington system water bodies.

4.3.2 Aquatic Vegetation

Along with these physical changes to the basin, substantial biological changes have occurred. Non-native plant species have been introduced into Lake Washington, and years of sewage discharge into the lake increased phosphorus concentration and subsequently led to extensive eutrophication. Blue-green algae dominated the phytoplankton community and suppressed production of zooplankton, reducing the available prey for salmonids and other species. However, water quality improved dramatically in the mid 1960s as sewage was diverted from Lake Washington to Puget Sound, and the dominance by blue-green algae subsided and zooplankton populations rebounded.

Despite reversing the eutrophication trend in the lake, the introduction of Eurasian milfoil to Lake Washington in the 1970s caused additional localized aquatic habitat and water quality problems. Milfoil and other aquatic vegetation dominate much of the shallow shoreline habitat of Lake Washington, Lake Sammamish, Lake Union, Portage Bay, and the Ship Canal. Dense communities of aquatic vegetation, or floating mats of detached plants, can adversely affect localized water quality conditions. Dense communities can reduce dissolved oxygen (DO) to below 5 ppm (parts per million), and the decomposition of dead plant material increases the biological oxygen demand, further reducing DO and pH (WDNR 1999). Under extreme conditions, these situations can become anoxic.

4.3.3 Water Quality

In addition to the substantial water column habitat modification caused by aquatic vegetation, excessive accumulation and decomposition of organic material has transformed areas of natural sand or gravel substrate to fine muck and mud. Substantial shoreline areas of Lake Washington, the Ship Canal, and the project action area have soft substrate, with substantial accumulations of organic material from the decomposition of milfoil and other macrophytes. The dense vegetation also reduces the currents and wave energy in these areas, which encourages the accumulation of fine sediment material. As microorganisms in the sediment break down the organic material, they consume much of the oxygen in the lower part of the lake. By the end of summer, concentrations of DO in the hypolimnion can approach 0.0 milligrams per liter (mg/L). Despite these effects in some shallow nearshore habitats, mean hypolimnetic DO levels recorded at long-term monitoring sites in the lake between 1993 and 2001 ranged from 7.7 to 8.9 milligrams per liter (mg/L) (King County 2003). However, it should be noted that water depths in the hypolimnion extend well below the photic zone, to more than 200 feet. Also, the portions of the hypolimnion closer to the shoreline, which show the lowest DO concentrations, are support outmigrating and rearing juvenile salmonids to a greater degree than do deep water habitats.

Salt water intrusion occurs in the Ship Canal above the locks, but very little of the deeper, heavier salt water mixes with the lighter fresh water surface layer. Consequently, this area lacks the diversity of habitats and brackish water refuges characteristic of most other (unaltered) river estuaries. Usually this salt water intrusion extends to the east end of Lake Union but can extend as far as the University Bridge in an extremely dry summer. The extent of this intrusion into the Ship Canal and into Lake Union is primarily controlled by outflow at the locks and the frequency of large and small lock operations.

Historical data indicate that reduced water column mixing due to the salt water layer likely produced year-round anaerobic conditions in the deeper areas of Lake Union and the Ship Canal (Shared Strategy 2007). The lack of mixing, along with a significant oxygen sediment demand, can reduce dissolved oxygen levels to less than 1 mg/L, and could prevent fish from using the water column below 10-m depth. This condition was likely more severe before about 1966, when a salt water barrier was constructed at the locks, thereby improving water quality conditions upstream. Water quality in Lake Union has also improved since the 1960s, from the reduction in direct discharges of raw sewage and the closing of the gas plant, along with the upland cleanup activities at the gas plant and other industrial sites. However, Lake Union still experiences periods of anaerobic conditions that typically begin in June and can last until October (Shared Strategy 2007).

The thermal stratification of Lake Washington and Lake Union can produce surface temperatures in excess of 68° F (20° C) for extended periods during the summer. In addition, there is a long-term trend of increasing summer and early fall water temperatures (Goetz et al. 2006; Newell and Quinn 2005; Quinn et al. 2002; King County 2007). From 1932 to 2000, there was a significant increase in mean August water temperature from about 66° F to 70° F (19° to 21° C) at a depth of 15 feet (Shared Strategy 2007). If this trend continues, surface water temperatures could exceed the lethal threshold for returning adult salmon in some years.

Although raw sewage can no longer be discharged directly into the action area waters, untreated, contaminated discharges occasionally enter these waterways during periods of high precipitation through discharge from combined sewer overflows (NMFS 2008b). For example, a recent incident resulted in the accidental discharge of an estimated 6.4 million gallons of sewage into Ravenna Creek, which discharges into Union Bay (King County 2008).

The Ship Canal and Lake Union are listed on the Ecology 303(d) list of impaired water bodies for exceeding water quality criteria for total phosphorous, lead, fecal coliform, and aldrin (Ecology 2008). In addition, portions of Lake Washington are listed on the 303(d) list for exceeding water quality criteria for fecal coliform, as well as the tissue quality criteria for 2,3,7,8 TCDD (dioxin), PCBs, total chlordane, 4,4' DDD (metabolite of DDT) and 4, 4' DDE (breakdown product of DDT) in various fish species (Ecology 2008). Therefore, the overall water quality conditions in the action area are degraded compared to historical conditions.

4.4 FISH AND FISH PREDATORS IN LAKE WASHINGTON AND THE SHIP CANAL

The Lake Washington watershed supports a diverse group of fish species, including several species of native salmon and trout such as Chinook, coho, and sockeye salmon and steelhead trout. Cutthroat trout are also present in many of the tributaries and the lake. Rainbow trout were commonly planted in Lake Washington in the past and are still present in the lake. Several observers have reported sightings of individual bull trout in the watershed, but there is no evidence of a reproductive population occurring within Lake Washington or the lake's tributaries. There is a substantial reproducing population of bull trout in the Chester Morse Reservoir within the upper Cedar River watershed, but this population is isolated from the rest of the watershed by Chester Morse Dam. Some bull trout observed in the Ship Canal and Lake Washington may have been entrained from this upper Cedar River population and moved downstream, thus becoming isolated from their original population. Bull trout produced in other watersheds may occasionally migrate into the Ship Canal and Lake Washington, or prey on juvenile salmon downstream from the Ballard Locks. Fish species in the Ship Canal are the same as those in Lake Washington except that because no deep-water habitat is present, the species that require this habitat type are rarely likely to occur in the Ship Canal. In addition, the shoreline and shallow-water areas of Portage Bay and Union Bay provide habitat primarily for those species that prefer shallow-water habitats with abundant aquatic vegetation. Many introduced species such as carp, smallmouth bass, and yellow perch use the shallow areas within this highly altered habitat.

Predation of salmonids by native and non-native predatory fishes is a substantial source of mortality in Lake Washington and the Ship Canal (Fayram and Sibley 2000; Warner and Fresh 1998; Kahler et al. 2000). Fayram and Sibley (2000) and Tabor et al. (2004, 2006) demonstrated that bass may be a risk factor for juvenile salmonid survival in Lake Washington. Celedonia et al. (2008a, b) found that larger bass tend to be present near shoreline structures and bridge piers, including areas where young salmon are likely to migrate and rear. Therefore, juvenile Chinook and steelhead may be more vulnerable to predation as they migrate through Lake Washington to marine waters, as well as through the relatively confined Ship Canal. The highly modified habitat throughout the Ship Canal and the locks may also contribute to an increased predation potential by reducing refuge habitat.

The primary fresh water predators of salmonids in the lakes and waterways in the Lake Washington basin include native and non-native species. Substantial non-native predator fish include yellow perch (*Perca flavescens*), smallmouth bass (*Micropterus dolomieui*), and largemouth bass (*Micropterus* *salmoides*). Predominant native fish predators include cutthroat trout (*O. clarki clarki*), northern pikeminnow (*Ptychocheilus oregonensis*), and prickly sculpin (*Cottus asper*). However, sampling in February and June of 1995 and 1997 found only 15 juvenile Chinook salmon in the stomachs of 1,875 predators (prickly sculpin, smallmouth and largemouth bass, and cutthroat trout) examined, with most of the predation by prickly sculpin (Tabor et al. 2004). These data suggest the predation of less than 10 percent of the Chinook salmon entering the lake from the Cedar River.

Smallmouth bass overlap with juvenile Chinook salmon in Lake Washington in May and June, when both occur in shoreline areas. However, predation rates are also affected by physical conditions. For example, smallmouth bass do not feed as actively in low water temperatures in areas typically occupied by Chinook, as they do above 68ºF (20ºC) (Wydoski and Whitney 2003). Chinook also avoid overhead cover, docks and piers, and the coarse substrate habitat areas preferred by smallmouth bass (Tabor et. al 2004a; Gayaldo and Nelson 2006; Tabor et al. 2006; Celedonia et al. 2008a, b).

Tabor et al. (2006) concluded that under existing conditions, predation by smallmouth and largemouth bass has relatively minor effect on Chinook salmon and other salmonid populations in the Lake Washington system. However, predation appears to be greater in the Ship Canal than in the lake. Tabor et al. (2000) estimated populations of about 3,400 smallmouth and 2,500 largemouth bass in the Ship Canal, with approximately 60 percent of the population occurring at the east end at Portage Bay. They also observed that smallmouth bass consume almost twice as many Chinook salmon smolts per fish as largemouth bass (500 smolts versus 280 smolts, respectively). This consumption occurs primarily during the Chinook salmon outmigration period (mid-May to the end of July) when salmon smolts represented 50 percent to 70 percent of the diet of smallmouth bass (Tabor et al. 2000). An additional study estimated the overall consumption of salmonids in the Ship Canal at between 36,000 and 46,000 juvenile salmon, corresponding to mortality estimates ranging from 0.5 percent to 0.6 percent (Tabor et al. 2006).

While there has been an obvious increase in the number of non-native predators in the lake, changes in the number of native predators have been less apparent. However, there is some anecdotal evidence that the number of cutthroat trout has increased considerably over time (Nowak 2000). In addition, Brocksmith (1999) concluded that the northern pikeminnow population increased by 11 percent to 38 percent between 1972 and 1997, as did the number of large northern pikeminnow. The greater number, and the larger size, of these predators suggest an overall increase in predation mortality of anadromous juvenile salmonids. The incidence of fresh water predation by fish in Lake Washington and the Ship Canal may also be increasing due to the increasing water temperatures (Schindler 2000).

In addition to fresh water predation, the relatively confined marine habitat area below the locks may also result in additional predation mortality for salmonid smolts. Footen (2000) found that the most abundant predators near the locks were sea-run cutthroat trout (*Salmo clarki clarki*) and staghorn sculpin (*Leptocottus armatus*), while farther away the key predators were staghorn sculpin and resident Chinook salmon (blackmouth). Another important predator in the area was bull trout. Chinook salmon smolts made up 12 percent of the cutthroat trout diet, while 34 percent was other species smolts, mostly chum. Bull trout diet consisted of 27 percent Chinook and 12 percent other salmonids. Fifty percent of the sculpin diet was Chinook salmon, but this estimate was based on only one sample. The primary known avian and mammalian predators on juvenile salmon and steelhead are glaucous-winged gulls (*Larus* *glaucescens* and others), harbor seals (*Phoca vitulina*), and California sea lions (*Zalophus californianus*).

5. POTENTIAL EFFECTS TO AQUATIC RESOURCES AND MITIGATION FRAMEWORK

5.1 POTENTIAL EFFECTS TO AQUATIC RESOURCES

Construction and operation of the project would affect Lake Washington as well as portions of the Lake Washington Ship Canal. These effects would be primarily related to the alteration or displacement of aquatic habitat due to either the placement of project-related structures (piles, columns) or to shading from overwater structures. These changes would affect shoreline/riparian habitat as well as deeper open water habitat.

The project has the potential to affect fish and aquatic habitat in Portage Bay, Montlake Cut, Union Bay, Lake Washington, and tributary streams on the east side of Lake Washington. To build the replacement bridges and other project-related facilities, some construction would take place outside of the footprint of the existing infrastructure, but generally within the permanent right of way. To safely construct any of the proposed design options or their suboptions, WSDOT would build construction work bridges along both sides of the existing bridge structures, except where construction activities could be safely conducted from barges or existing roadways. In addition, detour bridges would be constructed in some areas to allow simultaneous vehicular traffic and construction activity in the project corridor. A portion of the work area (which includes the work bridges/detour bridges and proposed finger piers that would extend from the work bridge to the individual support columns) would be located within the footprint of the proposed 6-Lane Alternative. In other cases, the construction limits would extend beyond the area affected by the permanent structure. This would increase the amount of aquatic habitat affected by the structures for a period of time (several years). After construction of SR 520 was complete, some aquatic habitat areas affected by construction, particularly riparian and shoreline habitats, would be restored and replanted with appropriate riparian vegetation.

Project effects on aquatic resources in the project area would be both permanent and temporary. For fish resources, the amount of aquatic habitat lost would be primarily due to in-water support structures of the elevated or floating bridge structures. The proposed project would place new structures and/or maintain existing structures within the shoreline and open-water habitats that support various fish species throughout much of the Seattle study area. New structures would be built and existing structures would be removed from these habitat areas in Portage Bay, Union Bay, and open-water areas adjacent to the western shoreline of Lake Washington.

Table 1 shows the permanent effect that could result from installing bridge columns. In addition to changes in bridge height, the project could also affect fish resources due to increased shading from the wider overwater bridge structures. For example, under all options, the floating portion of the Evergreen Point Bridge would be equal, at approximately twice the width of the existing bridge. In Portage Bay, the proposed replacement bridge would be approximately 2,690 feet long and have a minimum width of approximately 115 feet; it would be least 40 feet wider than the existing bridge. The new West Approach to the Evergreen Point Bridge would be approximately 57 feet wider than the existing roadway. For Options A and L, the new bascule bridge over the Montlake Cut would be approximately 60 feet wide, similar to the existing bridge.

While the shaded aquatic habitat would continue to function, the reduced light levels could affect aquatic plant growth and therefore the quality of the habitat for fish. Most of the proposed bridge structures would be similar or higher than the existing bridge structures. The higher sections would somewhat offset the potential effects of the wider structures, while the shading effects would likely be substantially greater for sections that remain at about the same height as the existing structures. In addition, the shading could also have a positive effect of fish habitat by decreasing the growth of invasive milfoil in the shallow nearshore areas. Table 2 lists the amount of overwater structure for each option, while Table 3 lists temporary effects from overwater shading due to construction of temporary work and detour bridges.

Table 1. Estimated Number of Concrete Columns and Resulting Permanent Habitat Effect

Alternative	Portage Bay	West Approach	East Approach	Total
Existing (Baseline) Conditions	119 (1,890 sq/ft)	404 (6,590 sq/ft) [a]	14 (350 sq/ft) [a]	**537 (8,830 sq/ft)**
Option A	47 (18,020 sq/ft) [a]	187 (5,290 sq/ft)	4 (450 sq/ft)	**238 (23,760 sq/ft)**
Option A and Suboptions	47 (18,020 sq/ft) [a]	214 (6,050 sq/ft)	4 (450 sq/ft)	**265 (24,520 sq/ft)**
Option K	42 (17,850 sq/ft) [a]	928[b] (97,890 sq/ft)[c]	4 (450 sq/ft)	**974 (116,190 sq/ft)**
Option K and Suboptions	48 (18,160 sq/ft) [a]	928[b] (97,890 sq/ft)[c]	4 (450 sq/ft)	**980 (116,500 sq/ft)**
Option L	48 (18,160 sq/ft) [a]	185 (9,150 sq/ft)	4 (450 sq/ft)	**237 (27,760 sq/ft)**
Option L and Suboptions	48 (18,160 sq/ft) [a]	185 (9,150 sq/ft)	4 (450 sq/ft)	**237 (27,760 sq/ft)**

[a] Area includes footings or shaft caps at the mud line supporting the columns.
[b] Columns range from 2 to 7 feet in diameter, while columns for the other options range from 6 to 10 feet.
[c] Area includes the entire in-water fill of the submerged roadway entering the single-point urban interchange. .

Table 2. Total Area (acres) of Overwater Structure that Would Cause Shading Effects

Option	Floating Bridge	East Approach Area	Portage Bay Area	West Approach Area	Montlake Area	Total
Existing (Baseline) Conditions	10.8	0.8	3.1	11.1	0.2	26.4
Option A[a]	29.5	1.8	3.6	9.6	0.2	44.0[b]
Suboptions[a]	29.5	1.8	3.6	11.2	0.2	45.6[b]
Option K[a]	29.5	1.8	2.1	10.3	0	43.0[c]
Suboptions[a]	29.5	1.8	2.1	10.3	0	43.0[c]
Option L[a]	29.5	1.8	2.3	11.1	1.5	45.5[d]
Suboptions[a]	29.5	1.8	2.3	11.1	1.4	45.4[d]

[a] Acreages represent new overwater structure area where no existing overwater structures occur (does not include areas where new overwater structure overlaps with existing overwater structure).

[b] Includes 2.8 acres (6 percent) of additional shading of aquatic bed wetlands within open water.

[c] Includes approximately 3.5 acres (7 percent) of additional shading effects on aquatic bed wetlands within open water.

[d] Includes approximately 3.8 acres (8 percent) of additional shading effects on aquatic bed wetlands within open water.

Table 3. Approximate Acres of Shading from Temporary Detour and Work Bridge Structures

Location	Portage Bay[a]	West Approach[a]	East Approach[b]	Total
Option A	3.2	8.7	1.5	13.4
Option A and Suboptions	3.2	8.7	1.5	13.4
Option K	3.2	9.1	1.5	10.6
Option K and Suboptions	3.2	9.1	1.5	10.6
Option L	3.2	7.5	1.5	12.2
Option L and Suboptions	3.2	7.5	1.5	12.2

[a] Acreages do not include overlap with the proposed permanently shaded bridge structure.
[b] Includes 0.8 acre of work bridges and 0.7 acre of falsework.

Shading over shallow nearshore habitats may likely have greater potential effects to aquatic plants and organisms than shading in the deeper open lake environment, due to a reduction in the photosynthetic potential of primary producers that inhabit the littoral zone. Nearshore areas generally provide areas of greater habitat complexity to support a diverse biological community. Therefore, increased shading in these areas would have a greater potential to affect the growth and behavior of a variety of plant and animal species. However, shading would also reduce the densities of invasive aquatic vegetation, which could result in slight improvements to water quality conditions and habitat use.

As noted previously, the amount of shading generated from a new overwater structure (e.g., bridge deck) depends both on the width of the structure as well as the height of the structure over the water. For example, in Portage Bay, the proposed bridge height (approximately 48 feet) would likely be sufficiently high to allow natural vegetation to grow underneath, based on the fact that mature trees (40 to 80 feet high) currently grow within the shadow of the existing Portage Bay Bridge. Although the western half of the proposed bridge would be slightly lower than the existing structure, the eastern half of the proposed bridge would be approximately 8 feet higher than the existing bridge and typically between 13 and 16 feet above the water. The comparison of bridge heights to existing locations would vary by option and bridge location (Table 4).

In addition to permanent impacts from inwater and overwater bridge structures, some design options would also result in impacts to the shoreline of Lake Washington. For example, the Alternative K roadway would be lower than the other options at the eastern shoreline of the Washington Park Arboretum. The roadway would actually be below the high water elevation of the lake and would result in fill of approximately 90,500 square feet (2.1 acres) of shallow-water habitat. This would require some excavation along the Washington Park Arboretum shoreline and the construction of retaining walls extending out into the water.

Table 4. Approximate Height (feet) from the High Water Level to the Underside of Bridge Structures[a]

Location	Existing (Baseline) Conditions	Option A	Option K	Option L
Portage Bay				
West shoreline	50	48	48	48
Mid-point	10	16	16	16
East shoreline	8	13	13	13
Montlake				
Montlake Cut	35-46	35-46	0[b]	43-57
Union Bay				
West Arboretum shoreline	2.5	17	<0[c]	8[e]
West Foster Island shoreline	6	25	<0[c]	13[e]
West Approach				
East Foster Island shoreline	4	23	<1	15[e]
Mid-point [c]	4	8	5	19[e]
West Highrise	44	50	50	47[e]
East Approach				
East Highrise	55-64	70	70	70

[a] Bridge heights were estimated from elevation information at each bridge pier location, which varies between options.
[b] Option K will tunnel under the Montlake Cut.
[c] The proposed roadway would occur below the high water elevation in the nearshore area of the Arboretum by several feet.
[d] About 1,400 feet east of Foster Island, midway between the island and West Highrise.
[e] Suboption A has a similar profile as Option L in this area.

The project would require substantial in-water pile-driving activities to construct work bridges in shallow water areas that cannot be accessed by barge. The underwater sound levels generated during pile-driving activities could disturb or alter the natural behavior and habitat of fish and other aquatic species and, in some instances, cause injury or mortality. The type and magnitude of effects on fish and other aquatic species depend on a wide range of factors including the type and size (diameter) of pile, type of pile-driving hammer, pile-driving duration, sound attenuation method, size, and number of surface waves, depth of the site, sound minimization best management practices (BMPs) employed, geologic conditions that govern the penetration rate of the pile, and the required penetration depth.

It is anticipated that at least some of the pile-driving activities can be accomplished using a vibratory hammer to minimize in-water sound levels. However, some impact pile driving (proofing) would be needed to achieve adequate load-bearing capacity for the piles. After the construction is completed, these piles would be removed with a vibratory hammer. Table 5 lists the number of temporary piles that would be required and the corresponding mudline habitat areas temporarily affected.

Site-specific evaluations are planned for this project to assess the sound levels generated by pile-driving in Portage Bay, Union Bay, and Lake Washington and to identify appropriate BMPs to minimize the potential effects of pile-driving on fish and other aquatic species. Specific in-water construction periods would also be established through the project permitting process to minimize potential effects of pile-driving and other in-water construction activities on salmonid species.

Table 5. Estimated Number of Support Piles and Lakebed Occupied for Temporary Detour and Construction Work Bridges

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

[a] Area calculations based on 24-inch piles.
[b] Includes piles for the work bridges and falsework structures.

5.1.1 Turbidity

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

5.1.2 Anchoring

Increased turbidity can alter the behavior of aquatic species, impair their ability to capture prey, and in severe cases cause physical injuries such as gill abrasion in fish. However, the relatively calm, protected, waters in Portage Bay have very little current, and are unlikely to cause the substantial dispersion of any suspended sediment that might occur from construction activities, thereby limiting the overall potential to affect aquatic species or habitat conditions. The substantial anchoring depths (two-thirds of the anchors will be in water depths of at least 180 feet) would also likely limit potential effects because fewer species typically occur in the deeper areas of the lake. The implementation of appropriate BMPs would also likely minimize the potential effects of any turbidity resulting from construction activities.

5.1.3 Water Quality

Other potential short-term construction effects could include spills of hazardous materials (e.g., oil and gasoline), chemical contaminants, or other materials. All pollutants would be handled in a manner that would not contaminate surface water in the study area. No maintenance or fueling of construction equipment, vehicles, or vessels would be allowed within 200 feet of the area waterways to reduce the risk of spills of petroleum and hydraulic fluids in sensitive areas. Materials that modify pH, such as cement, cement grindings, and cement saw cutting, would be managed or isolated to minimize the spread of these materials by surface water runoff or by other means. The contractor would be required to submit a spill prevention and control plan before beginning work.

5.1.4 Stormwater

Stormwater that runs off SR 520 within the study area is currently not treated before it is discharged into Lake Washington, Lake Union, and Portage Bay. Under the proposed options and sub-options, all stormwater from new and replaced impervious surfaces would be treated for water quality before being discharged into these water bodies. In addition, although compliance with water quality regulations in accordance with WSDOT's *Highway Runoff Manual* (WSDOT 2008b) would be met by providing basic stormwater treatment, WSDOT would provide enhanced stormwater treatment at multiple facilities under all options and their sub-options, where feasible and practical. This action would further improve the water quality of stormwater runoff prior to discharge.

Under all options, the proposed project would treat 100 percent of runoff from post-project pollution generating impervious surfaces (PGIS). This would reduce the discharge concentrations of total suspended solids, and total and dissolved zinc and copper for all options. More importantly, all proposed project options would reduce the total loading of these substances discharged into the receiving environment (Lake Washington and the Ship Canal), including reductions in both dissolved copper and dissolved zinc loading. In addition, the current floating bridge drainage system is leaching high levels of zinc, but the WSDOT (2005) stormwater monitoring report suggests that dissolved zinc may decrease dramatically in some areas of Lake Washington since the drainage system of the new floating bridge would use materials constructed of alternative materials. Overall, all stormwater discharges would comply with Clean Water Acts standards and would meet state water quality standards for the protection of aquatic life.

5.2 MITIGATION FRAMEWORK

Preliminary effects on aquatic ecological habitat were calculated by overlaying the proposed design onto the project base maps of aquatic features. Physically affected habitat areas were determined as the area of intersection of the two sets. Effects were calculated based on the project action that causes the effect, and were broken down by the type of ecological stressors that the project action will affect. This impact analysis presents only the direct impacts of the various design options and does not take into account the removal of existing bridge or roadway structures that would likely offset some of the construction and operational impacts of the project. For example, while all options include the construction of new bridge columns and decking, the existing bridge columns and decking will also be removed, reducing overall (net) impacts to aquatic resources.

The types and magnitude of these effects guided the mitigation team in formulating the types of mitigation activities that would serve to offset the temporary and permanent effects of project construction and operation. Unlike the regulatory process for wetland mitigation, no prescribed mitigation ratios exist for the majority of the effects to aquatic habitat. In addition, many of the potential effects to fish and other aquatic species would be indirect, and resulting from effects to organism behavior patterns or effects to fish predators or prey resources. For example, partial shading effects from the new bridge structures could alter juvenile salmon migration patterns or timing, or influence the distribution of salmonid predators within the study area. These effects could ultimately affect the number of juvenile salmon completing successful outmigration to marine waters.

Effects on individual fish, or populations of fish, resulting from habitat alterations are generally mitigated by increasing the quality and quantity of habitat for the species of interest, either at the site of the effect or at an offsite location that would provide similar benefit to the species/populations of interest. Therefore, the team analyzed habitat creation or improvement projects within WRIA 8 to address the project's mitigation needs.

The goal of the mitigation screening and ranking process was to select a suite of sites (land parcels) where the restoration combined uplift in aquatic functions and values would be of a sufficient magnitude to offset the project's effects on key salmonid habitat functions. Salmon, in particular Chinook salmon, were chosen as key indicator species because these species are the most studied species in the watershed and the most comprehensive data set linking habitat variables in the watershed was collected for salmonids (City of Seattle 2008; King County 2005). The key salmonid life history functions that would be affected are directly related to the life history phases of the affected fish. These functions are refugia, rearing areas, foraging areas, and migratory corridors that are important for juvenile salmonid survival in littoral, nearshore, or lotic areas of the Lake Washington basin. The mitigation screening approach was designed to link affected habitat features and ecological functions with potential enhancements of such features that support the key life history functions of salmonids in the Lake Washington basin.

To screen or sort potential mitigation sites, it is necessary to consider which habitat elements are the most important within WRIA 8, and the relationship between these elements and the key life history functions they support. Project effects can then be calculated based on their influence on these habitat elements, as can the benefit of enhancing these elements with mitigation activities. Since there is currently no prescription for aquatic effects, the mitigation team needs to find a common denominator to quantify the project effects versus project mitigation needs. There needs to be a common currency and link between mitigation actions and project effects, and a possible solution may be to use salmonid population effects metrics combined with salmonid habitat metrics. A key step that will be examined in greater detail in the Conceptual Aquatic Mitigation Plan is the incorporation of salmonid population effects metrics, salmonid habitat metrics, or a combination of these metrics to develop a common denominator for mitigation planning and ultimately documenting the sufficiency and appropriateness of WSDOT's proposed mitigation actions.

High quality habitat for juvenile salmonids in Lake Washington and Lake Union is characterized by fine-grained substrates, shallow gradients, overhead cover, unarmored banks, and no barriers to migration (Tabor and Piaskowski 2002; City of Seattle 2001). High quality habitats in Lake Union and the Ship Canal are similar to those in Lake Washington, but include limited barriers to migration (City of Seattle 2001). Favorable habitat in Puget Sound is similar to that in fresh water areas, but also includes eelgrass beds, marine riparian vegetation, and diverse substrate types (City of Seattle 2001). From a landscape ecology perspective, improving the spatial distribution of refuge, cover, and food, as well as connectivity between and among habitats is important in the Cedar/Sammamish rivers, Lake Washington, Lake Union/Ship Canal, and Puget Sound. The individual key juvenile salmonid life history functions (migration, feeding, and rearing/refugia) were used to assess project effects, as well as in screening potential mitigation sites. These functions are discussed below in greater detail.

5.2.1 Rearing and Refugia

Juvenile salmonids require habitat that provides refuge from predatory, physiological, and high-energy challenges. High-quality freshwater refuge habitat, limited in Lake Washington and the Ship Canal (Tabor and Piaskowski 2002; Weitkamp et al. 2000), consists of unarmored, shallow-gradient littoral zone with large woody debris (LWD) and overhanging vegetation (Tabor and Piaskowski 2002). Low-quality refuge habitat is prevalent in most Lake Washington shoreline areas due to shoreline development, lack of LWD, and the proliferation of exotic predatory fish species. Shoreline modifications that preclude shallow water habitat comprise most of the Lake Washington shoreline (Toft 2001; Toft et al. 2003a). In Lake Washington, pilings and riprap likely contribute to increased energy expenditure and risk of predation on juvenile salmonids by bass and northern pikeminnow (Celedonia et al. 2008 a, b). Riprap areas have been shown in other lakes to exhibit higher water velocities, depths, and steep slopes compared with unaltered habitats (Garland et al. 2002). Due to littoral zone activities and modifications, including dredging, filling, bulkheading, and construction, very little native vegetation remains on the Lake Washington shoreline (Weitkamp et al. 2000; Toft 2001; Toft et al. 2003a).

Refuge is limited in the Lake Washington basin near the fresh/salt water transition at the locks due to the limited natural habitat and sharp osmotic gradient. Juvenile salmonids exiting Lake Washington may seek tributary mouths as refuge habitats because overhead vegetative cover and the water from these tributaries provide refuge from higher salinities or temperatures (Seattle Parks and Recreation 2003). In nearshore marine areas and shallow nearshore areas, aquatic and marine riparian vegetation, LWD, and larger substrates are considered high quality refuge habitat (City of Seattle 2001). In Puget Sound, this habitat is limited due to the prevalence of bulkheads and overwater structures, and extensive filling, dredging, and grading in shoreline areas (Weitkamp et al. 2000; City of Seattle 2001).

5.2.2 Foraging

Juvenile salmon require habitat that provides and supports the production of ample prey resources, which includes unaltered shorelines with organic inputs and small substrates. Juvenile Chinook in Lake Washington prey on insects and pelagic invertebrates, namely chironomids and Daphnia spp. (Koehler 2002). Juvenile salmonids in Puget Sound feed on forage fish larvae and eggs as well as other pelagic, benthic, and epibenthic organisms from nearshore, intertidal, and eelgrass/kelp areas (Simenstad and Cordell 2000). Although existing literature generally concludes that lack prey resources are not a limiting factor for juvenile salmon (Kerwin 2001), inwater construction activities have the potential to temporarily affect foraging behavior, by decreasing primary productivity, or altered feeding behaviors due to changes in water clarity (sedimentation) or inwater noise and disturbance. Because the proposed project has the potential to temporarily affect the foraging ability of juvenile outmigrant salmonids, this life-history element was incorporated into the mitigation framework.

5.2.3 Migration

Lake habitat generally considered favorable for migration includes a gently sloping beach with no overwater structures to restrict light penetration of the water. Juvenile salmonids require habitat with few barriers to their seaward migration. Lake Washington lacks these barriers, but concern exists among biologists that overwater structures such as docks and piers may indirectly act as a barrier to alter migration patterns (Weitkamp et al. 2000). Juvenile salmon readily pass under small docks and narrow structures under which darkness is not complete, but some studies have indicated that under some conditions, large overwater structures with dark shadows can alter migration (Fresh et al. 2001). However, juvenile migration of salmonids is complex and influenced by a variety of factors. In a study of the effects of the existing SR 520 bridge, Celedonia et al. (2008a, pp. 97-98) observed no apparent holding behavior of juvenile Chinook at the existing bridge during year 1 of the study, while in another year minutes to hours of holding was observed for about half the fish (Celedonia et al. 2008a, p. ii). Some juveniles pass directly under the bridge without delay, while others spend up to two hours holding close to the bridge. Overall, these short delays are unlikely to result in detectable changes in survival of Chinook or other juvenile salmon as they migrate through Lake Washington and the Ship Canal.

In nearshore areas of the Duwamish estuary and Elliott Bay, several studies have shown that unlike Lake Washington's docks and piers, overwater structures in the Duwamish estuary and in Elliott Bay do not have a detrimental effect on juvenile salmonid migration patterns; however, this has been attributed to the difference in size and construction from similar structures along Lake Washington and Lake Union shorelines (Weitkamp et al. 2000). Some studies have shown that drastic changes in ambient underwater light environments may alter fish migration behavior (Nightingale and Simenstad 2001).

The migratory corridor is severely modified at the locks, as the fresh- to salt water transition occurs rather abruptly within the salt wedge and mixing zone near the locks. Options for fish passage include a fish ladder for large fish, a fish slide (primarily for smaller fish), and the water of the locks themselves. However, the locks remain problematic because of the high rate of injury, including scale loss (Seiler 1996).

6. SCREENING AND EVALUATION APPROACH

Effects to aquatic and wetland resources generally have different mitigation requirements and needs than do effects to wetland resources. Because the project is adjacent to the entrance of the Lake Washington Ship Canal, the project could affect fish from all naturally spawned anadromous populations located upstream of this location, including important populations of Endangered Species Act (ESA) listed Chinook salmon in the Cedar River and Sammamish River. Likewise, many species of juvenile salmon produced in WRIA 8 use the marine nearshore within and adjacent to Shilshole Bay. Based on the wide variety of interrelated physical, chemical, and biological effects to aquatic species and habitat that could occur from the construction and operation of the project, it is unlikely that all aquatic mitigation needs would be satisfied at a single site or within a single drainage basin. In addition, although achieving onsite aquatic mitigation is a primary goal of this process (such suitable sites would take priority) existing project constraints (the project is located in a heavily developed and near fully built out, urban environment) dictate the need to examine appropriate mitigation opportunities within offsite areas as well, in order to develop a range of sites that will provide the type and quantity of compensatory mitigation required to adequately offset the aquatic impacts of the project.

The current approach, described in this document, builds upon past SR 520 mitigation planning efforts. Previous mitigation planning efforts included preparation of an Initial Aquatic Habitat Mitigation Plan (WSDOT 2006), prepared simultaneously with the Draft SR 520 Bridge Replacement and HOV Project Environmental Impact Statement (Draft EIS). The 2006 report identified mitigation measures for potential aquatic habitat effects resulting from construction and operation of the SR 520 project. This version of the Initial Aquatic Habitat Mitigation Plan supersedes that effort, and seeks to assess sites for their suitability to offset the impacts from the current design options. This report incorporates resource agency input on the 2006 mitigation report, as well as feedback on the 2006 DEIS.

The following sections summarize the approach and rationale in conducting preliminary screenings and parings of candidate mitigate sites. The result of this process was a compiled list of preliminary candidate aquatic mitigation sites for the project. The general approach included the following elements: (a) reviewing previous project reports and public documents; (b) researching planning documents, databases, and photographs; (c) integrating available geographic information system (GIS) data sources that relate appropriate physical or biological data to specific geographic locations; and (d) stakeholder input.

To characterize and evaluate mitigation opportunities for the project, it was necessary to evaluate the potential of individual land parcels to offer mitigation opportunities likely to successfully achieve the project's mitigation goals. The offsite mitigation site selection process was divided into two steps: (1) an initial pass/fail screening for physical constraints and general mitigation suitability, including geographical boundaries; and (2) a more detailed sorting into various functional groups, with additional analysis parameters added for later analysis. These two steps, described in detail below, produced four separate lists of functional mitigation sites, which were then further pared down (see Section 6) to produce several unranked lists of preliminary preferred sites.

6.1 REVIEW OF EXISTING INFORMATION

Prior to conducting the mitigation screening and evaluation, the mitigation team used GIS information to prepare overlay data layers for analyzing and interpreting aerial photographs and for identifying and characterizing potential mitigation sites. Such characteristics included location, proximity, and connectivity to streams or riparian areas, potential wetland areas, and riverine deltas. County assessor tax parcel information was overlain onto an aerial photographic base map to estimate the size of potential mitigation sites.

Also, to assist the mitigation team with site selection, the team considered pertinent information on the land use, marine and fresh water shorelines, and rivers and streams within each functional group. Literature and available spatial data, including information on topography, land use, and water bodies, which were considered and utilized during the site selection process, included the following:

- King County GIS layers including critical areas, parcels, parks, trails, water system-related data, land use, and zoning (data acquired from King County 2008)
- King County Flood Hazard Management Plan (2006)
- Chinook Salmon Conservation Plan – WRIA 8 (King County 2005)
- Lake Washington/Cedar/Sammamish Watershed (WRIA 8) Near Term Action Agenda for Salmon Habitat Conservation (King County 2002)
- Puget Sound Nearshore Project Priorities (December 2007)
- Synthesis of Salmon Research and Monitoring – Investigations Conducted in the Western Lake Washington Basin, City of Seattle (December 2008)
- Seattle's Urban Blueprint for Habitat Protection and Restoration (City of Seattle 2001)
- Seattle Shoreline Park Inventory and Habitat Assessment (June 2003)
- Seattle Shoreline Alternative Mitigation Plan (Preliminary Plan) (May 2006)
- SR 520 Bridge Replacement and HOV Project Draft EIS, Appendix E (August 18, 2006)
- SalmonScape interactive Web site (WDFW 2009)

6.2 INITIAL SCREENING (PARE 1)

The mitigation team established initial screening criteria based on the geographical locations of potential mitigation sites and other factors related to the physical constraints of potential sites, such as available area and the current level of onsite development. The initial screening used four parameters to determine suitability of the site: parcel location, parcel classification, parcel size/shoreline length, and preliminary fatal flaw analysis (see Table 6). These parameters are described in detail below.

The initial screening, conducted as a GIS exercise, had only two outcomes: pass or fail. The results of the initial screening are presented in Appendix A, which lists all parcels that successfully advanced through the initial screening. In addition to the list of mitigation sites generated by the screening exercise, several local jurisdictions provided WSDOT with lists of potential mitigation sites within their jurisdictions. These sites were added to the initial list and subjected to the same screening process as other potential sites.

If sites were screened out during the initial screening, they were placed on a secondary list for consideration at a later time, as needed. In most cases, if any of the criteria were not met, the parcel was not carried forward for further consideration as a potential mitigation opportunity.

Table 6. Site Suitability Criteria

Parameter	Criteria
Parcel Location	A parcel must border the shoreline of following water bodies in Water Resource Inventory Area (WRIA) 8: • Lake Washington • Lake Union and Ship Canal • Marine shoreline of WRIA 8 between West Point and Carkeek Park • Lower Cedar River (River Mile [RM] 0.0 to RM 21.7) • North of Lake Washington tributaries (Swamp, North, and Little Bear Creeks) • Sammamish River and Bear Creek
Parcel Classification	A parcel (privately held or publicly owned) must be classified as vacant or unoccupied by the King County Assessor's Office.
Parcel Size/ Shoreline Length	A parcel must have a minimum shoreline length of 200 feet (or 500 feet for riverine sites) along a water body listed above.
Preliminary Fatal Flaw Analysis	A parcel must not contain onsite hazardous materials or sensitive cultural resources.

1. **Parcel location** – To successfully pass the initial screening, a parcel needed to border the shoreline of the specific water bodies listed in Table 6. The purpose of this criterion was to select one or more migration sites close to where project effects would occur in order to maximize onsite and within-basin mitigation opportunities. The geographic screening focused mitigation on those sites with the most potential to provide "in-kind" mitigation similar to the impacted habitat and providing maximum ecological benefit while meeting the mitigation requirements of the relevant resource agencies.

2. **Parcel classification** – To successfully pass the initial screen, a privately held or publicly owned parcel needed to be classified as vacant or unoccupied by the King County Assessor's Office (King County 2009). WSDOT established this criterion because vacant/unoccupied parcels generally offer better construction and maintenance access while providing fewer barriers to acquisition (e.g., land owner cooperation and/or parcel cost) compared with occupied parcels. In addition, vacant or

unoccupied parcels normally have a higher proportion of the parcel available as aquatic buffer due to the general lack of developed facilities or structures on the parcel.

3. **Parcel size/shoreline distance** – To successfully pass the initial screening, an individual parcel needed to have a minimum shoreline length of 200 feet immediately adjacent to a water body listed in Parameter 1 above. This criterion was based on the scale of the preliminary in-water effects and a site size that minimized the total number of sites required, thus establishing a scale of efficiency for mitigation construction, maintenance, and monitoring activities. The WSDOT project team chose 200 feet as a sufficient shoreline length to support mitigation activities that would provide substantial increases in the ecological functions associated with salmonid migration and rearing habitat on a suitable scale for acquisition, construction, and operational/monitoring efficiencies.

   An exception to this criterion was made for parcels adjacent to rivers or streams (riverine parcels). As a general rule, parcel sizes are generally smaller and development densities are higher in urban areas than in less developed suburban or rural areas. Because the large geographic extent of riverine parcels extends relatively far into unincorporated King County (e.g., the Cedar River and North Lake Washington tributaries), many more mitigation opportunities exist, and mitigation site development constraints are often greater for these rural parcels. Accordingly, WSDOT determined that the appropriate minimum size (shoreline length) for potential riverine parcels should be larger to reflect these differences. To successfully pass the initial screening, a riverine parcel needed to have a minimum shoreline length of 500 feet.

4. **Preliminary fatal flaw analysis** – A preliminary fatal flaw analysis was conducted for prospective mitigation sites to screen out those sites with conditions that would make successful mitigation construction difficult or impossible within time and budget constraints. For the purposes of the initial screening, the fatal flaw was the likelihood of encountering onsite hazardous materials or sensitive cultural resources.

The mitigation team provided a list of prospective parcels to WSDOT, then WSDOT compared the list against existing databases of potential hazardous materials and cultural resources sites. Any prospective mitigation parcel identified as having a high potential of containing hazardous materials or sensitive cultural resources was then screened out from further analysis. An exception to this standard was made for several parcels under these circumstances: although the results of the fatal flaw analysis indicated that hazardous materials could be associated with an individual parcel, the contamination was known to be primarily associated with the upland portions of the parcel, and mitigation activities would concentrate on the shoreline of the parcel. In these few cases (see Appendix A for a complete list of these parcels), the mitigation parcel was advanced through the initial screening.

6.3 MITIGATION SITE SORTING AND CLASSIFICATION

All parcels that passed the initial screening were carried forward to the next step of sorting and classifying the potential sites. The purpose of this secondary screening was to rank and compare potential mitigation sites for their suitability to meet specific mitigation needs of the project. The mitigation team assigned variable scores for the following factors:

1. Specific geographic area of the parcel
2. Specific mitigation types/opportunities available on the parcel
3. Exact length of shoreline available for mitigation
4. Overlap and concurrency with existing watershed or fish restoration/recovery plans

For the purposes of this screening, it was assumed that for a given aquatic species, the function of a discreet unit of aquatic habitat is inherently related to the location of the habitat within the larger watershed. For example, most juvenile salmonids utilize the shorelines of Lake Washington for outmigration and early growth (Kerwin 2001). In Lake Washington, Chinook salmon fry tend to use shallow shoreline areas after lake entry, while older Chinook fingerlings utilize deeper water (Fresh 2000; Tabor et al. 2004, 2006). Sockeye fry initially inhabit sandy, littoral habitats but move relatively quickly into deep, limnetic waters, while juvenile steelhead and juvenile coho may be found in both littoral and limnetic areas (R. Tabor *in* City of Seattle 2008). In locations within the project vicinity that provide several different habitat functions, such as nearshore areas of WRIA 8 Puget Sound, Chinook and coho smolts may spend up to several months rearing (feeding and growth) prior to their outmigration to deeper waters of Puget Sound or to the Pacific Ocean (Kerwin 2001; Toft 2001; Toft et al. 2003b; City of Seattle 2008).

Because various functional effect types would occur due to the project, and because the ultimate goal of the overall screening process is to be able to compare the suitability of sites to meet the mitigation goals and needs, all sites that passed the initial screening were grouped into one of four categories based on geography, which can be considered to be roughly equivalent to the specific aquatic function(s) provided by the various groups (Figure 2). This allowed comparison of sites that generally provide a similar ecological function and avoided a subjective weighting exercise that would be required to directly compare disparate mitigation sites and types (e.g., comparing sites that provide functions for fresh water outmigration to sites that support marine rearing). In addition, these four areas have varying spatial relationships to the specific construction and operational effects of the project.

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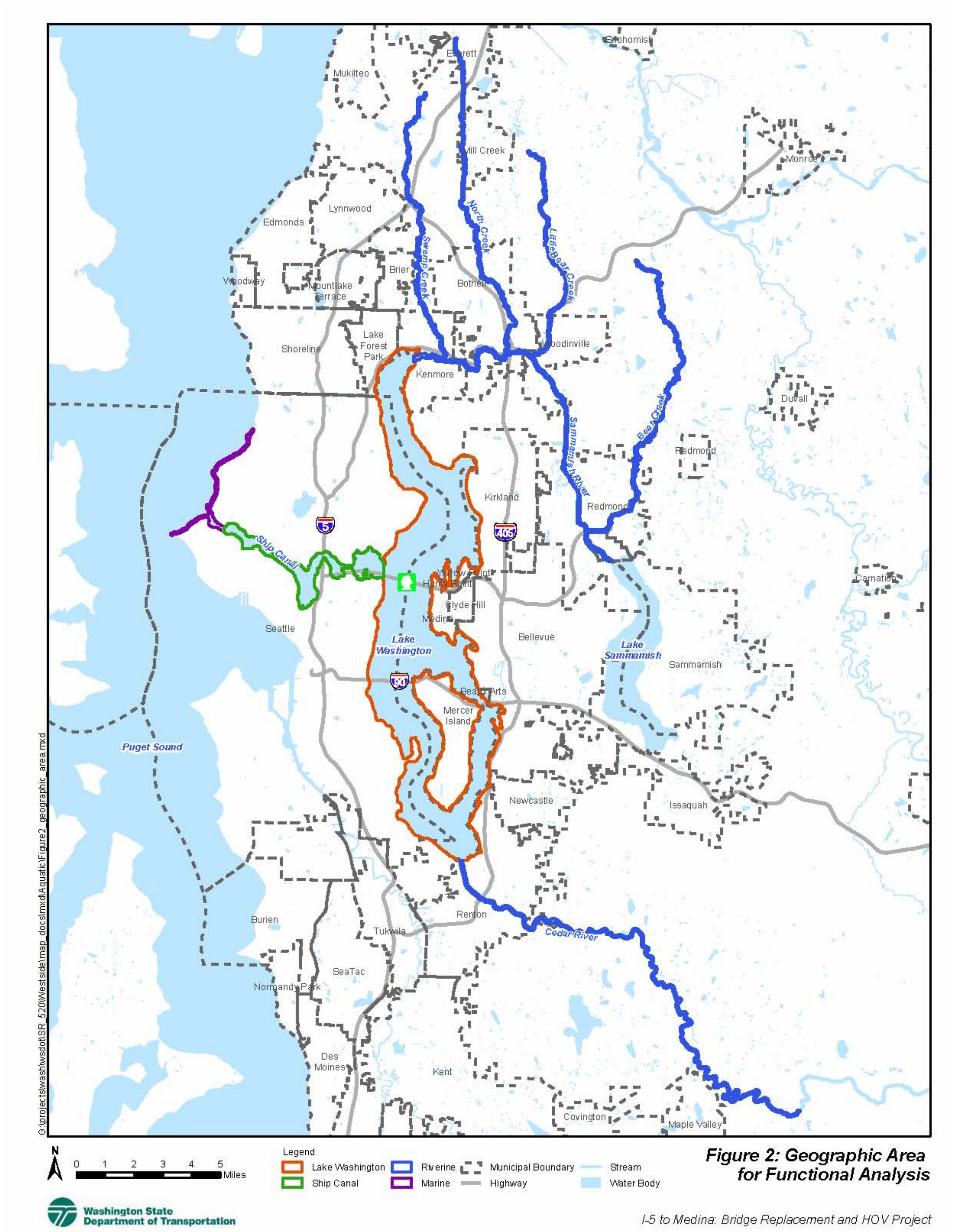

Figure 2. Geographic Area for Functional Analysis

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The mitigation team conducted a GIS analysis to assign the individual parcels to one of four functional/geographic groups, as follows:

Lake Washington Ship Canal (LWSC) – Sites located along Ship Canal between the east end of Union Bay and the Ballard Lock that primarily support outmigration of juvenile salmonids, and to a lesser extent, fresh water juvenile rearing.

Lake Washington – Sites located along the shoreline of Lake Washington that support both fresh water rearing and outmigration of juvenile salmonids.

Riverine – Sites located along the Cedar River, the Sammamish River (including Bear Creek), and the north Lake Washington tributaries that support spawning, fresh water rearing, and migration of juvenile salmonids.

Marine Shoreline – Sites located along the marine shoreline of WRIA 8 that support both marine rearing and migration of salmonids.

With the exception of prioritizing sites in the LWSC, no overall priority was assigned to the four functional/geographic groups. Because the LWSC has been identified by both the scientific literature (Kerwin 2001; City of Seattle 2008) and numerous regulatory agency staff as a primary limiting factor due to the extensive modification and degradation within this area , and because the effects from project construction and operation would directly affect this area, WSDOT has determined that the LWSC area has the greatest need for project mitigation.

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7. FUNCTIONAL GROUP ANALYSIS

Although the general grouping of mitigation sites by functional/geographic groups as described in Section 5 allowed comparison between related mitigation parcels, further analysis was required to prioritize individual sites within a given group.

The mitigation team identified and applied four key parameters to each list of geographic sites to define a group of sites best suited to serve the project's mitigation needs. The comparison of sites using these parameters was based on the characterization of several different elements. For example, the specific ecological setting of parcels within a given functional group may indicate that the parcel is better at supporting some of the key life history functions directly or indirectly affected by project actions compared with a parcel at some other location.

Also, the condition of the existing ecological function of each site (if known) can help determine the potential degree and magnitude of functional uplift that could be achieved at a given site. In addition, all other elements being equal, larger mitigation sites offer an opportunity to maximize efficiencies for mitigation construction, maintenance, and monitoring activities, and an overall greater chance of mitigation success; thus, the parcel size and shoreline length are important. Lastly, many mitigation sites or actions that have been previously evaluated and recommended in species recovery or watershed restoration plans, particularly those plans with a watershed or regional focus, are generally assumed to have a better chance of substantially adding to species or watershed recovery.

The purpose of the functional group analysis was to generally classify potential mitigation sites within each functional group for their suitability to meet the specific mitigation needs of the project. The following factors were considered in this process:

1. Specific geographic areas that are known to support key life history functions or stocks of salmonids of concern. eg. South Lake Washington

2. Status of known habitat factors that determine existing ecological condition of parcels. eg. Degree of shoreline armoring

3. Available parcel area for mitigation (both exact shoreline length and overall parcel size).

4. Overlap and concurrency with existing watershed or fish restoration/recovery plans such as the WRIA 8 Chinook Salmon Conservation Plan.

Although these factors were considered in the overall process, it is important to recognize that the relative contribution of local geography varies significantly between functional groups. Furthermore, as a practical matter, the availability of relevant GIS data pertaining to ecological condition varies by geographic area. Therefore, the number of the metrics used to conduct gross-level sorting of sites within functional groups varied among the groups. In some cases (LWSC Functional Group) all four of the metrics were available and suitable for evaluation purposes, so all were used. The end result of the process was a shorter list of appropriate mitigation sites that were judged to have the greatest suitability to achieve the mitigation goals. For each of the four functional groups, the evaluation criteria/factors considered are described in detail below.

7.1 LAKE WASHINGTON SHIP CANAL FUNCTIONAL GROUP

To provide an estimate of the amount of mitigation opportunity that exists within each site, the mitigation team used the estimated shoreline length of each parcel within the LWSC Functional Group to compare the parcels. For each parcel, the estimated linear feet of shoreline length was calculated using GIS. This information was generated using King County's GIS shoreline database as part of the initial screening. A higher priority was assigned to those parcels that have a longer shoreline, and thus greater potential mitigation opportunity.

Next, the parcels were reviewed for concurrency with watershed and species recovery plans, such as the WRIA 8 Chinook Recovery Plan (King County 2005), that identify site-specific projects that would benefit the overall health and viability of a particular species or watershed. Specific project mitigation opportunities that overlap with such recovery plans have a higher priority because they meet both the compensatory project mitigation requirements and support pre-identified wider-scale species or watershed recovery efforts. Plans and programs specific to WRIA 8 and the study area were reviewed. Where these projects overlapped with individual parcels that passed the initial screening, the parcels were identified as higher priority. Only projects that had not been completed or funded were included. The evaluation criteria for recovery plan consistency were applied as follows:

Higher Priority (A) – Parcels where published recovery plans identified site-specific habitat enhancement/shoreline projects.

Lower Priority (B) – Parcels where published recovery plans did not identify site-specific habitat enhancement/shoreline projects.

In addition to the information on parcel size and concurrency with existing restoration plans, the existing ecological condition of parcels in the LWSC was used for purposes of parcel comparison. This information is GIS-based and is derived from two primary GIS data sets. Detailed information on hardened structures was based on a GIS dataset titled "Inventory and Mapping of City of Seattle Shorelines along Lake Washington, the Ship Canal, and Shilshole Bay", created by Toft et al. (2003). This detailed dataset provides specific information on the location and distribution of docks, riprap, bulkheads, and unconfined shoreline reaches for the entirety of the geographic distribution of sites within this group.

To supplement these data, a dataset prepared by Washington State Department of Natural Resources (WDNR) was utilized. This dataset provides overwater structure locations for the length of the Lake Washington shoreline; however, it does not provide detail on other hardened structure types (riprap, bulkheads, etc.) as does the Toft et al. (2003) dataset. Using a combination of two GIS layers, the individual parcels were classified into three categories according to the amount of potential functional uplift that could be achieved based on existing site conditions. The classifications were applied as follows:

Higher Priority (A) – Sites where the LWSC shoreline has hardened via retained structures such as docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities: removal of the retained structures and restoration of the shoreline (e.g., regrading, placement of suitable substrate, enhancement or creation of riparian vegetation).

Medium Priority (B) – Sites where the LWSC shoreline is unretained (not confined by structures such as docks, bulkheads, riprap banks, etc.), but where shoreline enhancement or restoration is feasible due to the presence of degraded existing conditions, including the presence of landscaping. Mitigation activities would focus on installing natural vegetation, and may also involve some shoreline regrading or placement of beach substrate.

Lower Priority (C) – Sites where the LWSC shoreline is composed of unretained vegetated or beach habitat. At these locations, shoreline enhancement or restoration would likely not provide large increases in the ecological functions at the site.

Multiple parcels had a mix of retained and unretained features. Therefore, to aid in classification and subsequent site evaluation, WSDOT used the shoreline inventory data (Toft et al. 2003a) to estimate the amount (linear feet) of each shoreline subtype present along the shoreline of each parcel. Because the shoreline inventory data were not as precise or accurate as the King County shoreline database, there were discrepancies in the total parcel shoreline lengths between these two datasets. Therefore, for each parcel where the data were available, the relative percentage of each of the six shoreline types from Toft et al. (2003a) (Appendix B) was applied to the overall calculated shoreline length from the King County shoreline dataset to calculate the length of each shoreline type. The six shoreline types were: Rip-rap, Bulkhead (vertical), Bulkhead (sloping), Beach, Natural Vegetation, and Landscaped. These data are presented in Appendix B.

Lastly, the fourth comparison of parcels within the LWSC Functional Group was based on the parcel's exact location in relation to the proposed project's construction and operational effects. Resource agencies have indicated a preference to conduct on-site mitigation, defined as mitigation activities conducted as physically close to the corresponding effects as feasible and practicable. Because a portion of the LWSC Functional Group geographic area is located immediately within or adjacent to the area the project would affect, this evaluation criterion accounts for the benefits of conducting compensatory mitigation near the affected area. This classification criterion was applied as follows:

Higher Priority (A) – Sites located within or immediately adjacent (within 1/2-mile) of the SR 520 project corridor.

Lower Priority (B) – Sites located more than 1/2-mile from the SR 520 project corridor.

7.2 LAKE WASHINGTON FUNCTIONAL GROUP

For the Lake Washington Functional Group, the amount of mitigation opportunity existing at each parcel was evaluated by using shoreline length, as described above. In addition, the parcels within Lake Washington were reviewed for concurrency with watershed and species recovery plans, in a similar manner as discussed above for the LWSC Functional Group. The classifications areas are as follows:

Higher Priority (A) – Parcels where published recovery plans identify site-specific habitat enhancement/shoreline projects.

Lower Priority (B) – Parcels where published recovery plans did not identify site-specific habitat enhancement/shoreline projects.

Detailed information on hardened structures in Lake Washington was based on the same two GIS datasets used for the LWSC Functional Group. The classifications for the Lake Washington Functional Group are as follows:

Higher Priority (A) – Sites where the Lake Washington shoreline has hardened via retained structures such as docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities: (1) removal of the retained structures, and (2) restoration of the shoreline (e.g., regrading, placement of suitable substrate, and enhancement or creation of riparian vegetation).

Medium Priority (B) – Sites where the Lake Washington shoreline is unretained (not confined by structures such as docks, bulkheads, riprap banks, etc.) but where shoreline enhancement or restoration is feasible due to the presence of degraded existing conditions, including the presence of landscaping. Mitigation activities would focus on installing natural vegetation, and may also involve some shoreline regrading or placement of beach substrate.

Lower Priority (C) – Sites where the Lake Washington shoreline is composed of unretained vegetated or beach habitat. At these locations, shoreline enhancement or restoration would likely not provide large increases in the ecological functions at the site.

In addition to information on parcel size, concurrency with existing restoration plans, and information on the existing ecological condition of parcels along Lake Washington, specific geographic areas within Lake Washington were used to aid in the analysis. The analysis of Lake Washington parcel geographic location takes into account both the distance of the parcel from SR 520 and the parcel's location relative to specific locations in the lake that support ecological functions important for juvenile salmonids. This analysis prioritizes several specific areas that are known to support key life history functions or stocks of salmonids of concern within the lake. The parcels along Lake Washington were assigned one of three priorities, based on their geographic location.

Higher Priority – Sites located along the southwest and southeast shores of Lake Washington, between the south end of Mercer Island and the mouth of the Cedar River *or* sites located within or immediately adjacent (within 1/2-mile) of the SR 520 project corridor *or* sites located along the shore of Lake Washington within or adjacent (within 300 feet) to the mouth of a stream/river. Mitigation activities would include enhancement of the stream/lake interface zone (delta), which has been shown to provide key rearing and feeding opportunities for juvenile salmonids.

Medium Priority – Sites located along the north and northwest shore of Lake Washington, between a line extending west from Arrowhead Point and the mouth of the Sammamish River.

Lower Priority – All other sites within Lake Washington

7.3 RIVERINE FUNCTIONAL GROUP

Within the Riverine Functional Group, prioritization of specific geographic areas based on fish life histories is not as straightforward as for the previous functional groups due to the numerous salmonid life history stages supported by riverine habitat. In addition, no complete GIS-based shoreline inventory or habitat data for riverine environments are readily available, making a straightforward analysis of the existing ecological condition of individual parcels impossible. Because of the limitations in using those evaluation factors, the analysis of the Riverine Functional Group compares sites based solely on the other two evaluation factors, i.e., parcel size (exact shoreline length) and concurrency with existing restoration plans.

The parcels in the Riverine Functional Group were evaluated for the amount of mitigation opportunity existing at each parcel and for concurrency with watershed and species recovery plans, in a manner similar to that discussed above for other functional groups. The classification areas for recovery plan comparison are as follows:

Higher Priority (A) – Parcels where published recovery plans identify site-specific habitat enhancement/shoreline projects.

Lower Priority (B) – Parcels where published recovery plans do not identify site-specific habitat enhancement/shoreline projects.

7.4 MARINE SHORELINE FUNCTIONAL GROUP

As with the riverine sites, prioritization of specific geographic areas within the Marine Shoreline Functional Group, based on fish life histories, is not straightforward. However, unlike the riverine sites, a GIS-based shoreline inventory data is available for the Marine Shoreline Functional Group. The data from the Toft et al. 2003a shoreline survey, discussed above, extend to much of the shoreline area covered by this functional group. The parcels were evaluated for the amount of mitigation opportunity existing at each parcel and for concurrency with watershed and species recovery plans, in a manner similar to that discussed above for other functional groups. The classification areas for comparison of identified actions in recovery plans are as follows:

Higher Priority (A) – Parcels where published recovery plans identify site-specific habitat enhancement/shoreline projects.

Lower Priority (B) – Parcels where published recovery plans do not identify site-specific habitat enhancement/shoreline projects.

Detailed information on shoreline habitat in marine areas was based on the same two GIS datasets discussed for the Lake Washington Functional Group and the LWSC Functional Group. The classification areas are as follows:

Higher Priority (A) – Sites where the Marine shoreline has hardened via retained structures such as docks, bulkheads, riprap banks, etc. These sites offer two linked mitigation opportunities:

(1) removal of the retained structures, and (2) restoration of the shoreline (e.g., regrading, placement of suitable substrate, and enhancement or creation of riparian vegetation).

Medium Priority (B) – Sites where the Marine shoreline is unretained (not confined by structures such as docks, bulkheads, riprap banks, etc.) but where shoreline enhancement or restoration is feasible due to the presence of degraded existing conditions, including the presence of landscaping. Mitigation activities would focus on installing natural vegetation, and may also involve some shoreline regrading or placement of beach substrate.

Lower Priority (C) – Sites where the Marine shoreline is composed of unretained vegetated or beach habitat. At these locations, shoreline enhancement or restoration would likely not provide large increases in the ecological functions at the site.

7.5 FUNCTIONAL GROUP CLASSIFICATION AND RANKING (PARE 2)

To identify candidate mitigation sites for the project, the mitigation team used a hierarchical selection process based on the four functional groups in the project area. For each of the functional groups, the metrics discussed above were used as a gross-level screening to narrow the number of potential sites for each group. This second paring was semi-quantitative, as it is based both on numeric and non-numeric criteria, although numerical screening criteria were not used to order the individual sites. Rather, the short list of suitable sites was developed using a holistic watershed approach and applying best professional judgment from a number of technical specialists on the SR 520 project team.

Potential projects were defined as involving physical restoration, enhancement, or rehabilitation at specifically identified geographic sites within the four functional areas. In addition to lists of projects within each unique functional group, an additional list of mitigation opportunities was formulated. This latter group includes mitigation opportunities that are more programmatic in their nature, potentially including such activities as WSDOT funding of incentive programs and/or public education and outreach programs. Because these type of non-physical habitat restoration projects are currently not specifically defined, and do not contain a geographic element, they were not suited to the initial screening and evaluation discussed above.

7.6 LOCAL AGENCY INPUT

The mitigation team also incorporated sites provided by representatives from the City of Seattle Parks Department, Seattle Public Utilities, University of Washington, King County Water and Land Resources Division, and WRIA 8. Additional sites were added by biologists on the mitigation team with extensive experience in the project area through the SR 520 Bridge Replacement and HOV Project and other local projects.

8. FUNCTIONAL GROUP SITE CLASSIFICATION RESULTS

The mitigation team screened an initial list of potential aquatic mitigation sites that would compensate for the project's effects. This entire list (see Appendix B) of 208 candidate sites that passed the initial screening, broken down by functional group, will be maintained to provide flexibility moving forward with the screening process (additional sites can be added to the final list or moved up for consideration and more detailed analysis based on additional information or stakeholder input). The WSDOT mitigation team analyzed all sites on the list and generally prioritized the sites to generate a shorter list of sites that would offer the best mitigation opportunities (defined as the potential to achieve the project's mitigation goals with a relatively high chance of success) based on the criteria presented in Section 6. There were a total of 30 specific sites advanced for further consideration in the mitigation screening process, as well as several programmatic actions that could help meet the mitigation goals. These sites, all of which would support site-specific physical habitat improvement projects, are presented by functional group in Table 7, shown in Figures 3-1 through 3-4, and summarized as follows:

The Ship Canal Functional Group list includes seven potential mitigation sites located from Union Bay downstream to the Hiram Chittenden Locks.

The Lake Washington Functional Group list includes 12 potential mitigation sites located on the shores of Lake Washington, based on preliminary screening criteria.

The Marine Functional Group list includes four potential mitigation sites located in the marine environment downstream of the Hiram Chittenden Locks, based on preliminary screening criteria.

The Riverine Functional Group list includes seven potential mitigation sites, located on the Cedar River and its tributaries and the Sammamish River and its tributaries, based on preliminary screening criteria.

1194 **Table 7. Mitigation Sites Advanced for Further Screening**

Functional Group	Site Name	Parcel Number(s)
Ship Canal	University of Washington	1625049001
	Arboretum	4114600275, 4116100010, 2125049044
	Montlake Park	6788202280
	Hiram Chittendon Locks (upstream of locks)	1125039012, 0467000800
	Lake Union Vacant Industrial	088801605, 4088801610, 4088801615, 4088801620
	Aurora Bridge North	4088804415
	NOAA Montlake Lab	8805900001
Lake Washington	Seward Park	2324049007
	Magnuson Park	0225049061, 0225049001, 0225049062
	Gene Coulon Park	3344500775, 0523059010, 0523059003
	Newcastle Beach Park	1724059004, 1724059038
	Luther Burbank Park	0124049002, 0624059014, 0724059054
	WDNR Parcel	0723059105
	Beer Sheva Park	3524049013, 3524049102
	Pritchard Island Beach Park	6896300010
	Martha Washington Park	1102001300
	Rainer Beach Park	7129304755
	Meydenbauer Park	4389201295 (additional parcels to be acquired)
	Madrona Park	4114600995
Marine	Carkeek Park	2626039001
	Commodore Park – Wolf Creek	1025039047
	Hiram Chittendon Locks (downstream of locks)	1025039051
	Shilshole Marina	468000050

Functional Group	Site Name	Parcel Number(s)
Riverine	Lions Property	3323069074
	Rainbow Bend	7120400045 (5 parcels)
	Black River Pump Station	3779200090
	North Creek 228th Ave	27052900301300, 2705200302100
	Bear Creek	1125059098, 1225059261, 7202410180, 7202410190, 7202410260
	Squak Creek	1126049100, 1126049126, 1126049142
	Swamp Creek	4156700004, 4156700010, 4156700015, 4164100171, 9406500630

Detailed aerial photographs of each selected parcel are presented in Appendix D. These figures show the mitigation parcel with adjacent parcels and briefly summarize the baseline environmental conditions in relation to aquatic habitat, as well as the possible mitigation opportunities available at the site. In addition, the assumed direct benefit to fish resources is indicated, based on the life history phase(s) that the project would benefit. Six of these sites are also included in the wetland mitigation initial plan. These sites are as follows: University of Washington (2 sties in Wetland Plan), Montake Park, Arboretum (3 sites in Wetland Plan), Magnuson Park, Seward Park and Beer Sheva Park.

As discussed in Section 6.5, other non-project specific mitigation opportunities exist within WRIA 8. These programmatic opportunities include activities involving incentive achievement-oriented programs (e.g., indirect funding of habitat or water quality improvement projects or public outreach/educational activities). Various non-project specific mitigation opportunities were reviewed by the WSDOT mitigation team and the top such opportunities advanced for future consideration (Table 8).

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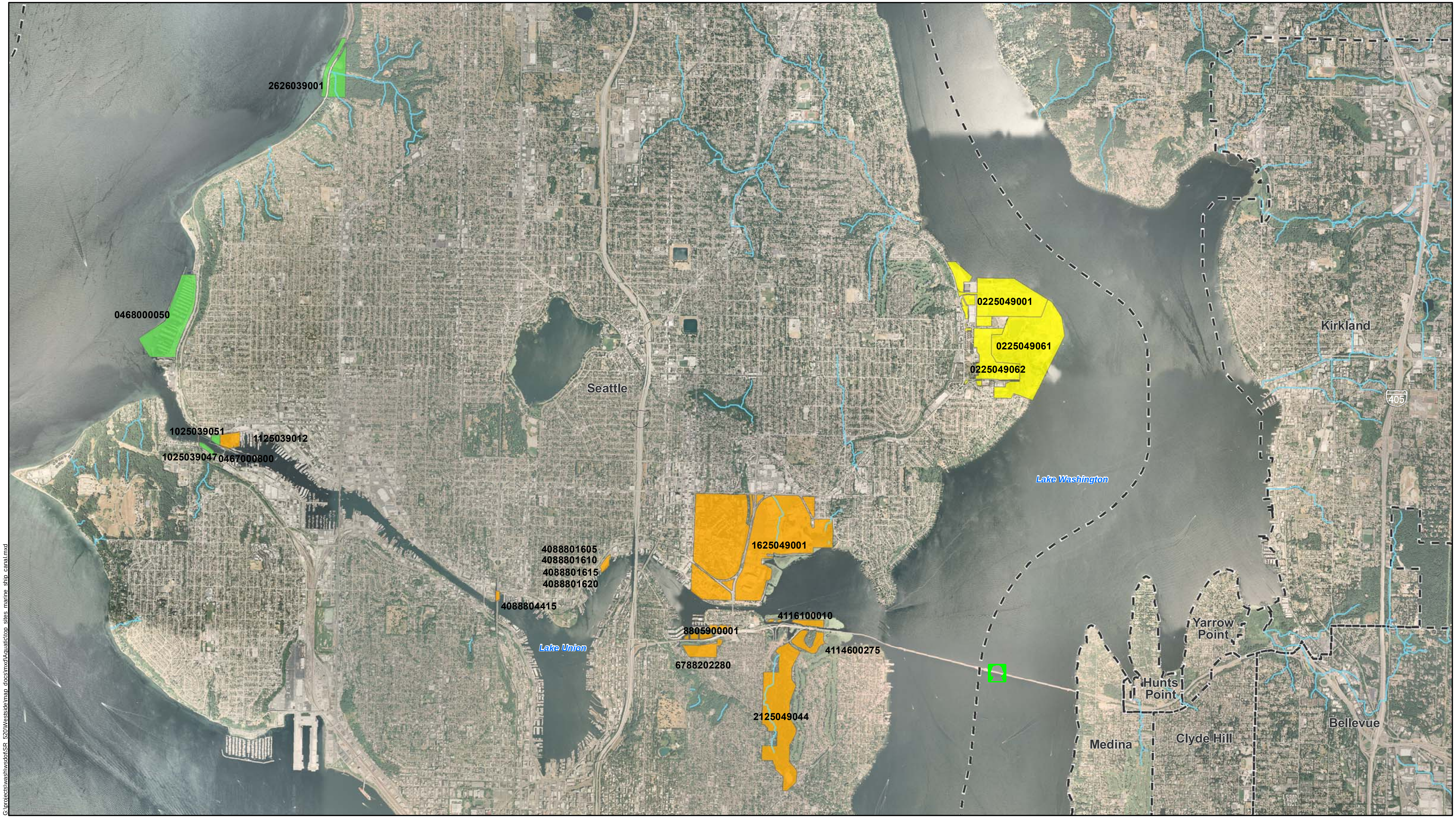
1212 **Table 8. Programmatic Mitigation Activities Advanced for Further Screening**

General Description	Examples	Primary Salmonid Life History Functions Addressed	Geographic Focus
Habitat-based incentive programs aimed at creating or restoring habitat functions that support salmonids on private property	Bulkhead/dock modification/removal, shoreline riparian planting, in-water debris removal, invasive species control	Migration refugia and rearing	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Habitat-based incentive programs aimed at minimizing effects from shoreline development or redevelopment activities on private property	Fish-friendly dock installations or retrofits, marina retrofits, redevelopment planning assistance, shoreline buffer preservation, Green Shorelines, programmatic hydraulic project approvals (HPAs)	Migration refugia and rearing	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Public education and outreach programs supporting minimization of shoreline and water quality effects and encouraging habitat restoration actions and activities	Environmental and outdoor education centers, Green Shorelines Programs, watershed stewards, displays at Issaquah Salmon Days or other community events	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Funding of ecological studies within WRIA 8 to better understand salmonid life histories; physical, biological, and chemical aquatic habitat needs; habitat limiting factors; and mitigation success	Salmonid research and studies on habitat utilization, predators, water temperature effects, flushing flows studies, migration routes and timing, spawning success, hatchery influences, mitigation effectiveness, etc.	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC
Improve water quality within WRIA 8 water bodies by reducing pollutant inputs into the system	Remove combined sewer overflows and illicit outfalls, reduce nutrient/pollutant input from lawns, improve/retrofit existing stormwater facilities	All	Water bodies within WRIA 8, with emphasis on Lake Washington and the LWSC



Legend

Candidate Site

- Lake Washington
- Ship Canal
- Marine
- Riverine
- Municipal Boundary
- Stream

Figure 3-1: Lake Wahington, Ship Canal, and Marine Potential Candidate Sites

Washington State Department of Transportation

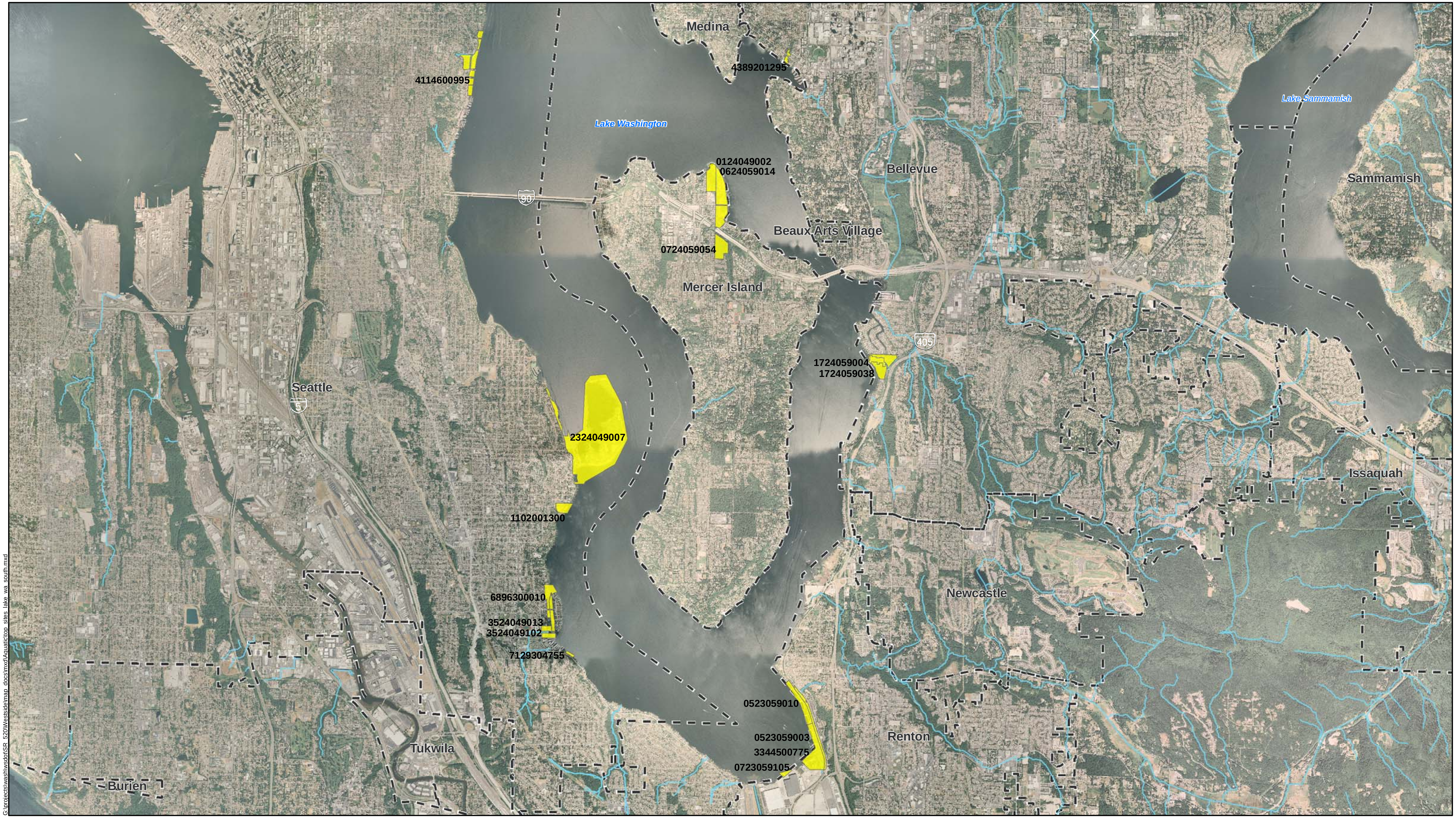
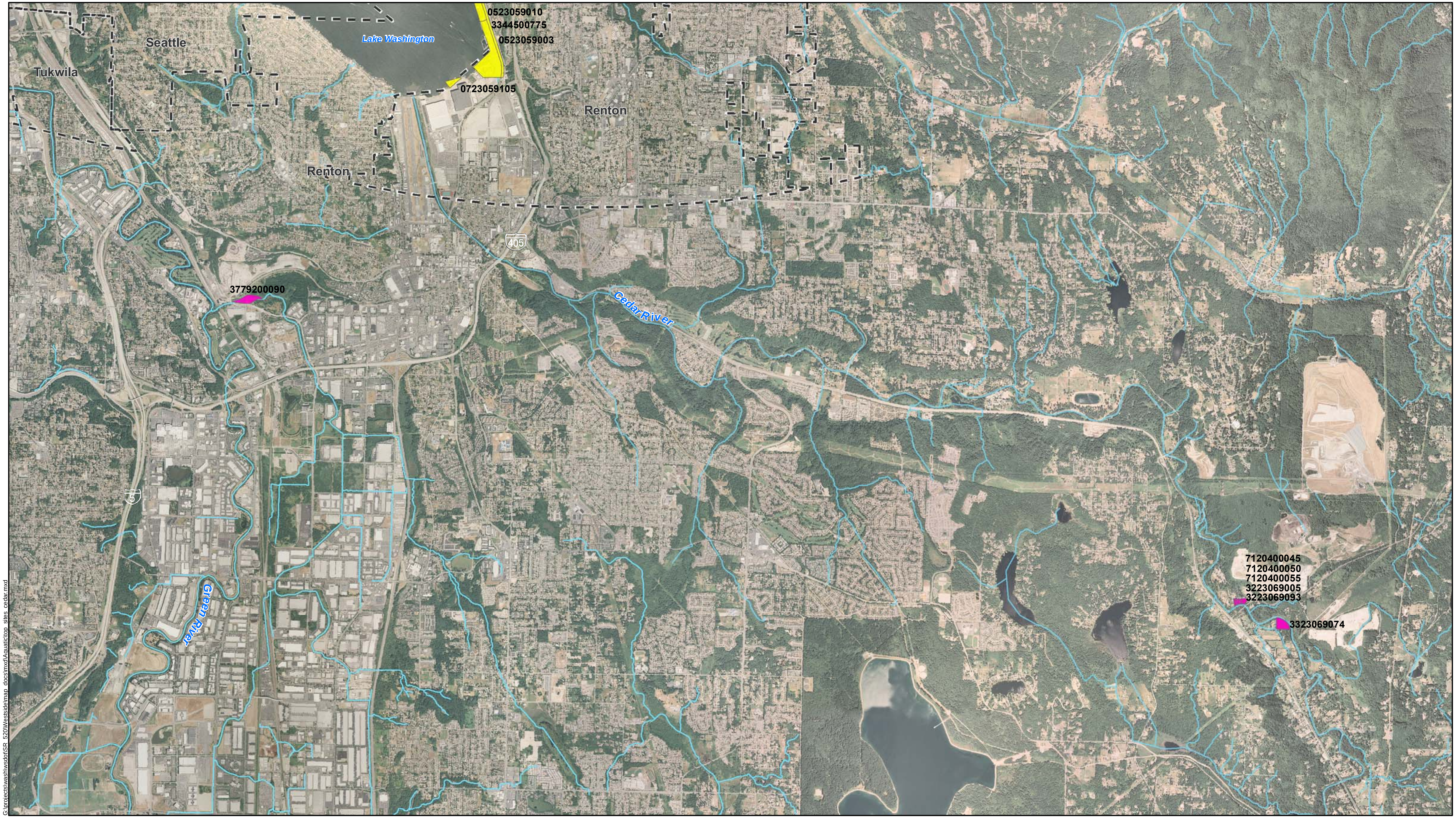


Figure 3-2: South Lake Washington Potential Candidate Sites

Washington State Department of Transportation

I-5 to Medina: Bridge Replacement and HOV Project



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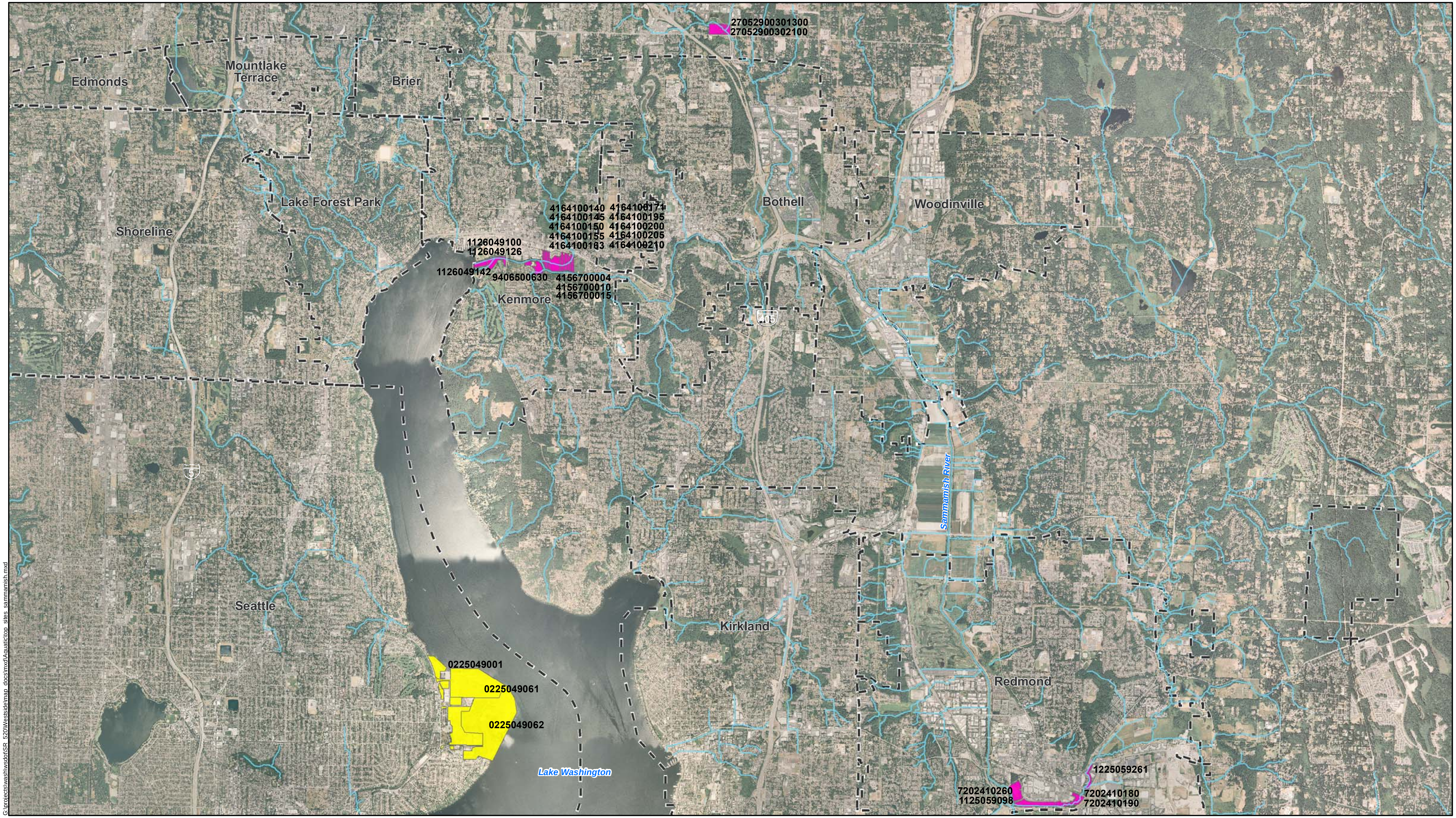
Candidate Site
- Lake Washington
- Ship Canal
- Marine
- Riverine
- Municipal Boundary
- Stream

Figure 3-3: Cedar River Potential Candidate Sites

Washington State Department of Transportation



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0 2,000 4,000 Feet

Legend

Candidate Site

- Lake Washington
- Ship Canal
- Marine
- Riverine
- Municipal Boundary
- Stream

Washington State Department of Transportation

Figure 3-4: Sammamish River and Tributaries Potential Candidate Sites

8.1 COMPENSATION FOR PROJECT IMPACTS

The combination of defined mitigation projects in a variety of aquatic shoreline locations in the Lake Washington basin that support multiple salmonid life history functions and wider-spread programmatic mitigation activities should provide adequate functional uplift to offset project effects. As discussed in Section 4, no prescribed aquatic habitat mitigation ratios exist for the majority of the project effect types. Therefore, this mitigation approach relies on the inherent relationship between the status of fish populations and the quality and quantity of fish habitat these populations utilize. Specifically, the mitigation screening utilized existing information on those ecological functions most important to juvenile salmonids in the SR 520 study area to assess potential effects and to target these functions for improvement by specific mitigation actions and activities.

Although an exact accounting of project effects to functional uplift from mitigation opportunities is beyond the scope of this document, the overall approach is suited to assessing effects and mitigation benefits based on how each project or mitigation action would affect habitat functions that support juvenile salmonid migration, rearing, refugia and feeding. Some of the potential restoration activities, such as increasing the amount of native overhanging vegetation at the shoreline, would address juvenile foraging by increasing detritus delivery to the substrate, thus increasing invertebrate production in the water as well as providing surface feeding opportunities to juvenile salmonids from insects that drop into littoral and nearshore shoreline waters. Also, the addition of overhanging vegetation would provide refuge from predators and provide localized areas of favorable light and temperature conditions. By removing bulkheads, riprap, and debris armoring, water depths and velocities would be decreased at the water's edge, providing safe refugia for juvenile salmonids in the restored habitat. Restoration of the selected site shorelines would establish a substantial length of high-quality edge habitat in the Lake Washington basin, which is important to juvenile salmon migration, and would provide increased connectivity from the Cedar and Sammamish rivers to Shilshole Bay (City of Seattle 2008; Seattle Parks and Recreation 2003).

As the mitigation planning effort proceeds, future analysis will establish and document a quantitative basis for the appropriateness and sufficiency of the mitigation plan to replace lost or impaired habitat functions resulting from the project. An example of such a quantitative approach might involve the incorporation of salmonid population effects metrics, salmonid habitat metrics, or a combination of these metrics to develop a common denominator for mitigation planning. A key step that will be examined in greater detail in the conceptual aquatic mitigation plan will be to document the sufficiency and appropriateness of WSDOT's proposed mitigation actions.

In addition, this approach allows the overlay of a broader landscape ecology perspective, which is important for prioritizing habitat restoration opportunities (Simenstad and Cordell 2000). For this initial screening effort, the broader perspective was useful for fitting existing conditions and potential habitat restoration opportunities into the overall habitat setting that littoral, riverine, and nearshore zones provide. Landscape perspective considerations included mitigation site locations in relation to known use areas (e.g., Cedar River), migration corridors, and locations relative to known rearing areas/tributary streams.

The methods and initial results from this planning and screening framework will be shared with resource agencies, stakeholders, and the Tribes as part of early agency coordination. Initial work completed to this point is intended to document the planning and screening framework to date. However, no firm decisions have been made regarding mitigation sites at this time. As a result of coordination with resource agencies and the Tribes, the mitigation team may modify this process, and potentially add or delete candidate sites.

9. SUMMARY AND NEXT STEPS

The screening exercise consisted of a three-part process that pared all the potential parcels within the geographic study area down to a list of 30 sites, which represent the best potential sites to achieve the project mitigation goals.

9.1 INITIAL SCREEN

During the initial screen, the mitigation team evaluated all sites (parcels) within the defined mitigation area. This list of several thousand parcels was narrowed down to 208 candidate sites, based on the parcel's ability to successfully pass through a set of four initial screening criteria (see Section 6 for criteria). All sites that failed the initial screening were removed from the list, and the remaining candidate sites continued to the site sorting and classification criteria. Because the overall list of all parcels undergoing the initial screen includes all parcels adjacent to the LWSC, Lake Washington, and the majority of parcels bordering the Cedar River, the Sammamish River, and the WRIA 8 shoreline, the list of screened parcels is too large to include in this report.

9.2 MITIGATION SITE SORTING AND CLASSIFICATION

The mitigation team sorted and classified all 208 candidate sites based on four functional groups that relate to the geography of the sites and the geographical relationship to key salmonid life history phases. Once the sites were sorted into their respective functional groups, a specific criterion was applied to each functional group (see Section 6 for criteria). These criteria were applied to allow more specific evaluation of site suitability in meeting the mitigation needs of the project. This classification was semi-quantitative, and rigid numerical screening criteria were not used to order the individual sites. Site descriptions of all of the sites sorted and classified in this step are provided in the Pare 1 List (Appendix A).

9.3 ADVANCEMENT OF TOP SITES FOR FURTHER SCREENING

The final step in the process was a gross ranking of all sites within each of the four functional groups (208 sites) to select the sites most amenable to mitigation activities that would meet defined functional goals, while providing efficiency of site design and construction. In addition, paring down the candidate list allowed WSDOT to arrive at a number of "good" sites small enough to facilitate more detailed site-specific investigations in the future. This paring utilized a holistic watershed approach, based on the classification factors, pertinent literature and data, local knowledge, and best professional judgment from a number of technical specialists on the SR 520 project team. A total of 30 preferred sites remained on the list after this step. Of these, 7 were located in the LWSC Functional Group, 12 were within the Lake Washington Functional Group, 7 within the Riverine Functional Group, and 4 within the Marine Functional Group (see Table 7). The geographic locations of these sites are displayed in Figures 3-1 through 3-4. Detailed site maps and description of baseline conditions and mitigation opportunities are presented in Appendix D.

9.4 ADVANCEMENT OF PROGRAMMATIC MITIGATION OPTIONS

An additional group of potential mitigation actions was also advanced for further consideration, involving mitigation opportunities that are more programmatic in nature, potentially including such activities as WSDOT funding of incentive programs and/or public education and outreach programs. Because these type of non-physical habitat restoration projects are currently not specifically defined, and do not contain a geographic element, they were not suited to the initial screening and evaluation, as previously mentioned. Although the programmatic mitigation programs and activities considered are an alternative or supplemental path to achieving aquatic mitigation, they would still require approval from the relevant regulatory agencies and local jurisdictions prior to implementation.

These programs and activities could supplement the specific, defined aquatic habitat restoration or creation projects advanced by producing habitat benefits across a larger landscape and/or modifying activities or behaviors that could degrade habitats in the futures. In addition, these actions may facilitate restoration enhancements in areas not otherwise available. By providing incentives, a number of these programmatic projects can compete for these incentives rather than relying on a specific physical mitigation site where negotiations may become complicated and/or the mitigation potential may be limited by that site's specific features (e.g., unsuccessful purchase negotiations for the specific mitigation sites advanced as described above).

9.5 NEXT STEPS

This planning and screening framework, the advanced programmatic activities and the interim list of top candidate sites for each functional group will be shared with resource agencies, stakeholders, and the Tribes as part of early agency coordination. It is important to note that this list is designed to evolve based on more detailed site analysis and further agency input, and no firm decisions have been made regarding mitigation sites at this time. The mitigation team may modify this process and potentially identify additional viable candidate sites as a result of coordination with resource agencies and the Tribes.

Also, because the project design effort is ongoing, the quantification and classification of project effects is also ongoing. The classification and characterization of project effects in relation to functional effects on aquatic habitats and species are currently evolving, and the final accounting of all project effects will aid the mitigation team in better defining the specific mitigation needs of the project. Changes and refinements in project design elements also have the potential to alter the list of top candidate sites.

Once a final draft list of top candidate sites has been finalized, additional analysis, including data analysis and site visits, will be required to better classify the potential of each parcel to have a reasonable probability of mitigation success. Further information to be analyzed includes data on site layout and condition (exact amount of the site available to mitigation activities), the landscape and local setting (amount/type of environmental degradation of adjacent parcels), and specific access and maintenance considerations. In addition, an evaluation of existing aquatic habitat on the site will be conducted to better evaluate the quality and quantity of functional uplift available onsite, as related to the project effects. Each site will be evaluated regarding its potential to provide the functions to support increased salmonid migration, feeding, and rearing/refugia functions.

The final screening/ranking will occur at a later date, and may include additional criteria, pending review by the project team and additional guidance provided by regulatory agencies. The ultimate goal of the aquatic mitigation screening process is to assign a relative ranking to the short list of the mitigation sites within each functional group. This will then allow the mitigation team to select a complementary group of mitigation projects/actions that will fully compensate for all project effects.

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