SOUND TRANSIT EAST LINK PROJECT

Appendix H3

Ecosystems Technical Report

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Appendices

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Exhibits

Acronyms and Abbreviations

BMPs	best management practices
CAO	critical area ordinance
CWA	Clean Water Act
DDT	dichloro-diphenyl-trichloroethane
DNR	Washington Department of Natural Resources
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FAC	Facultative Plants
FACU	facultative upland plants
FACW	facultative wetland plants
GIS	geographic information system
GMA	Growth Management Act
HGM	hydrogeomorphic classification
I-405	Interstate 405
I-90	Interstate 90
LWD	large woody debris
MBTA	Migratory Bird Treaty Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NCCS	National Soil Survey Center
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetlands Inventory

OBL	obligate wetland plants
PEM	palustrine emergent marsh
PFO	palustrine forested
PGIS	pollutant-generating impervious surface
PHS	Priority Habitat and Species
ppt	parts per thousand
PSS	palustrine scrub shrub
R	riverine
RCW	Revised Code of Washington
SCS	United State Soil Conservation Service
SEPA	State Environmental Policy Act
SMA	Shoreline Management Act
SMP	Shoreline Master Program
SR	State Route
UPL	obligate upland plants
USACE	United State Army Corps of Engineers
USBEM	Urban Stream Baseline Assessment Evaluation Method
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WNHP	Washington Natural Heritage Program
WR	wetland resource
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

1.0 Introduction

An ecosystem is the interaction between plants, animals, microorganisms, and the physical environment in which they live. Ecosystems are made up of living organisms, including humans, and the environment they inhabit. Understanding this relationship is basic to the environmental review process and the assessment of impacts to ecosystems. This technical report addresses the ecosystem components—aquatic resources, upland vegetation and wildlife, and wetlands—in the vicinity of the East Link project alternatives. The report describes the affected environment and the expected short-term construction impacts, and long-term operational impacts of each of the project alternatives on these ecosystem resources. It also discusses measures intended to avoid and minimize impacts and compensatory mitigation for unavoidable impacts. The report is organized into five main parts, beginning with a summary of data-gathering activities, identification of related laws and regulations, definition of the study area, and assumptions (Section 1.0), followed by Section 2.0, Study Objectives and Methods; Section 3.0, Affected Environment; Section 4.0, Environmental Consequences; and Section 5.0, Potential Mitigation Measures. Section 6.0 provides reference information.

1.1 Data Gathered

Sound Transit conducted a literature and data review to identify and characterize potentially affected resources in and near the project vicinity. Existing documentation and information was compiled and reviewed first so that the field reconnaissance effort could focus on filling information gaps. Existing natural resource information was gathered from many local, state, and federal agencies. This information included published and unpublished reports, maps, web sites, aerial photographs, and interviews with agency staff familiar with resources within the project vicinity. The data sources are listed in the following subsections.

1.1.1 Agency and Public Contacts

Sound Transit contacted the following local jurisdictions, agencies, organizations, and individuals for up-to-date information on ecosystems resources:

- City of Bellevue Development Services, Transportation, Utilities, and Parks departments
- City of Redmond Planning and Community Development and Public Works departments
- East Lake Washington Chapter of the Audubon Society
- Friends of Marymoor Park
- Friends of Mercer Slough
- King County Department of Natural Resources, Parks Department, and Water Resource Inventory Area (WRIA) planning group
- Muckleshoot Indian Tribe
- Snoqualmie Tribe
- Suquamish Tribe
- Tulalip Tribe
- Yakama Tribe
- Duwamish Tribe
- National Marine Fisheries Service (NMFS)
- U.S. Army Corps of Engineers (USACE)
- U.S. Fish and Wildlife Service (USFWS)

- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Natural Resources (DNR) Natural Heritage Program
- Washington State Department of Ecology (Ecology)

1.1.2 Maps and Existing Documentation

Maps and other existing reports were an important resource used to identify ecosystem features within the project vicinity. The following map resources were used:

- Aerial photography of the project corridor
- Bear Creek Basin Plan (King County, 1992)
- *Bear Creek Extension Supplemental Draft Environmental Impact Statement* (EIS) (2004)
- *Bel-Red Corridor Project Draft EIS* (City of Bellevue, 2007)
- *Bel-Red Corridor Project Final EIS* (City of Bellevue, 2007)
- Best Available Science Review for King County, City of Redmond, and City of Bellevue
- Catalog of Washington Streams and Salmon Utilization maps
- Cities of Bellevue, Mercer Island, and Redmond for sensitive and protected species and habitat information
- Comprehensive plans for the Cities of Bellevue, Mercer Island, Redmond, and Seattle (2007)
- Draft Puget Sound Salmon Recovery Plan (Shared Strategy Development Committee, 2005)
- Hydric Soils of the State of Washington
- I-405 Corridor Program: NEPA/SEPA Draft EIS and Draft Preliminary Section 4(f) Evaluation (August, 2001)
- I-405 Bellevue Nickel Improvement Project (2006)
- *I-90 Two-Way Transit and HOV Operations EIS* (Sound Transit and WSDOT, 2004)
- Information from reports, maps, and personal communications from local WDFW habitat biologists
- King County Conservation District Soil Descriptions and Soil Report (2000)
- King County sensitive areas map folio and wetland inventory (2000)
- Mapping information from sources such as wetland delineation reports and stream studies by other consulting firms, as available
- Publications of the Washington Natural Heritage Program (WNHP), available at http://www.dnr.wa.gov/nhp/refdesk/pubs/index.html
- Reports, maps, and personal communications from City of Bellevue and WRIA sources
- Salmon and Steelhead Habitat Limiting Factors Report for the Lake Washington Watershed (WRIA 8) (Kerwin, 2001)
- Sammamish River Corridor Conditions and Enhancement Opportunities Report (King County, 1993)
- SE Leary Way Road Extension Draft EIS (March, 2004)
- *Sound Transit Central Link Light Rail EIS* (Sound Transit, 1999)
- Sound Transit Technical Back-up on Ecosystems: Central Link Light Rail Final EIS (November, 1999)
- Stream inventory maps for the City of Bellevue
- U.S. Geological Survey (USGS) topographic maps (1:24,000)
- U.S. Soil Conservation Service (SCS) soil survey maps of King County (U.S. Department of Agriculture [USDA] SCS, 1973)

- USFWS National Wetlands Inventory (NWI) maps (1:24,000)
- WDFW fish distribution database (http://wdfw.wa.gov/fish-sh.htm)
- WDFW Priority Habitats and Species (PHS) maps (1:24,000)
- Wetland and stream inventory maps for the cities of Bellevue, Mercer Island, Redmond, and Seattle, as available

1.2 Related Laws and Regulations

The following federal, state, and local laws, regulations, and agency jurisdiction and management guidance describe the applicable requirements for wetlands; threatened and endangered species, wildlife, and aquatic species and habitat for these species; and high-value habitats and species:

- Critical Area Ordinances (CAOs) for the Cities of Bellevue, Mercer Island, Redmond, and Seattle and King County
- Endangered Species Act (ESA)
- Executive Orders 89-10, 90-40, and 11990
- Growth Management Act (GMA) (Revised Code of Washington [RCW] 36.70A)
- Migratory Bird Treaty Act (MBTA)
- Bald and Golden eagle Protection Act
- Local agency Shoreline Master Programs (SMPs)
- Magnuson-Stevens Fishery Conservation and Management Act (MSA)
- National Environmental Policy Act (NEPA)
- Sections 404, 402, and 401 of the Clean Water Act (CWA)
- Washington State Water Pollution Control Act
- Shoreline Management Act (SMA)
- State Environmental Policy Act (SEPA)
- Washington State Hydraulic code (Washington Administrative Code [WAC] Chapter 222-110)
- WDFW PHS Management Recommendations

1.3 Study Areas

Each resource required a specific study area, described below.

1.3.1 Aquatic Resources

Aquatic habitats include ponds, lakes, rivers, and streams. The study area for aquatic resources is defined as 100 feet upstream and 300 feet downstream from where project limits crosses the stream and the entire stretch of any stream than runs parallel to a project alternative within 200 feet of the edge of the alternative. The 300-foot downstream limit is based on WAC 73-201A-400 and reflects the length of mixing zones in streams and rivers as agreed to by NMFS and USWFS for ESA consultation.

1.3.2 Vegetation and Wildlife Resources

Sound Transit has established distinct study areas for upland vegetation and wildlife resources. Wetland, as a vegetation type, was also assigned a separate study area.

- **Upland Vegetation.** The area within 100 feet of either side of the project alternatives and the area within the vicinity of stations, maintenance facilities, park-and-ride lots, traction power substations, and roadway widening, including any trees of significance (as defined by the applicable jurisdiction) within these areas.
- **Wetland (as a vegetation type).** Wetlands and wetland buffers within 200 feet of either side of the project alternatives. (See Section 1.3.3, Wetland Resources.)
- **Wildlife**. The study area for wildlife was determined by the types of species known to exist near the project.

1.3.3 Wetland Resources

Wetlands are defined by soil characteristics, presence or absence of hydrology, and dominance of vegetation adapted to wet environments. Many wetlands in the study area are considered jurisdictional waters of the United States by the USACE and are protected by federal regulations and local CAOs. The wetlands study area is defined as wetlands and wetland buffers within 200 feet of either side of the project alternatives and the area within the project limits including the trackway, stations, maintenance facilities, park-and-ride lots, traction power substations, and roadway widening. Wetland buffers, which are necessary to evaluate project effects, may extend beyond the wetland study area.

1.4 Assumptions

The process of analyzing and estimating project impacts requires a series of assumptions regarding the physical extent of impacts, the duration of impacts, site restoration following construction, and measures that would be implemented to avoid or reduce potential impacts. The following subsections identify these assumptions.

1.4.1 Impact Assessment

Determining project impacts on ecosystems requires assumptions regarding the physical extent of short-term construction impacts between the permanent project right-of-way and the construction staging areas, and long-term operational impacts within the permanent project right-of-way.

1.4.1.1 Short-Term Impacts

The spatial extent of water bodies and aquatic resources that may be adversely affected by construction activities varies depending on the type and magnitude of impact. The primary short-term impacts would be from sediment inputs to streams. Minor inputs would likely affect relatively short sections of stream before sediment drops out of suspension. Major inputs of sediment may be carried for longer distances. A short distance might be approximately 100 feet, while a major sedimentation event might affect a stream for 1,000 feet or more. The greatest risk of sedimentation impacts would be where earthwork is conducted close to a stream or river, while the lowest risk would be from earthwork conducted at a greater distant from a stream. The potential impact from accidental fuel spills follows a similar risk-potential pattern.

For wetlands and vegetation and wildlife, the construction limit is the area that would be disturbed during construction. This area is typically 60 feet wide in urban areas and up to 100 feet wide through undeveloped areas. Construction limits in undeveloped areas would be focused along the 112th SE Bypass (B3), BNSF (B7), and Marymoor (E2) alternatives. For analysis purposes, Sound Transit assumed that all lands within the construction limit would be disturbed during construction and that all vegetation would be removed.

Direct short-term impacts on wetland vegetation were determined by subtracting the areas within the project limit (i.e., the long-term operational impact area) from the total area affected within the construction limit. Indirect impacts on wetlands in a given area would generally begin as construction begins in the area and would persist for some period of time after construction and site restoration are completed. The duration of short-term impacts on wetlands would vary depending on the vegetation type and associated habitat functions that would be affected. For instance, many short-term impacts on emergent wetland functions could persist for a few years after construction because it would take a few years for restored areas to provide functions as they did at preconstruction conditions. Impacts resulting from loss of a forested wetland or upland area would persist for many years because of the time required for trees to mature to the point where they provide pre-construction functions.

1.4.1.2 Long-Term Impacts

It is assumed long-term impacts are the same as permanent impacts.

The permanent impacts on aquatic resources would vary from minor accidental spill impacts on fish habitats, to beneficial impacts, to adverse impacts when stream channels are either enclosed within new culverts or shaded by overhead tracks (i.e., riparian function impacts). It is assumed that shading impacts cover an area represented by the surface area of an overhead structure 30 feet wide extending over riparian vegetation. The width of riparian vegetation used to calculate the area of impact is defined by the CAOs of the City of Bellevue and the

City of Redmond and varies by stream type. Additional long-term impacts may also include stormwater runoff to surface waters, and accidental spills during operation of the facilities.

For vegetation and wildlife resources, the project limit is the width of the trackway (30 feet) and stations (approximately 60 feet by 380 feet) after construction. Removal of high-quality habitat supporting wildlife functions within the project limit would be permanently affected by project facilities and would be considered to have direct long-term impacts. Effects of operational noise on wildlife would be expected to be relatively minor compared to existing traffic noise.

Long-term wetland impacts from removal of wetland area and function are those that occur inside the project limits where the permanent alternatives (i.e., at-grade alternatives, columns for elevated alternatives, shading from elevated structures), stations, maintenance facilities, park-and-ride lots, traction power substations, and road widening would occur. It is assumed that these areas would be permanently affected and all wetlands and/or buffers within these areas would be lost. Additional long-term impacts may also include stormwater runoff to surface waters and accidental spills during operation of the facilities.

1.4.2 Site Restoration

For purposes of analysis and discussion of short-term impacts, Sound Transit assumed that areas supporting native upland or wetland vegetation and stream banks located outside of the project limit would be restored to their former condition following construction. Site restoration would be installed within 1 year following construction in each project segment. As noted above, the length of time that would be required for site restoration to effectively replace pre-project functions would vary.

1.4.3 Avoiding and Minimizing Impacts on Sensitive Natural Resources

Appendix A of this report provides a compilation of best management practices (BMPs) that could be used to avoid or minimize short- and long-term impacts of the East Link Project on sensitive natural resources, including state and federal protected species and their habitats, wetlands, and aquatic resources. These BMPs are either required by state or federal agencies to obtain the permits that would be necessary for the project or may be required to comply with permit conditions. It is assumed that these BMPs would be implemented at appropriate locations and that they would perform as intended to avoid or minimize impacts.

2.0 Study Objectives and Methods

This chapter describes the objectives and methods of the aquatic resources (Section 2.1), vegetation and wildlife resources (Section 2.2), and wetland resources (Section 2.3) investigations and the methods.

2.1 Aquatic Resources

This section describes the objectives of the aquatic resources investigations and the methods used to characterize these resources within the project corridor and to identify potential impacts on those habitats.

2.1.1 Aquatic Resources Study Objectives

The purpose of the aquatic resources investigation was to describe the aquatic resources in the East Link Project vicinity and the potential impacts to these resources. Objectives included the following:

- Identify important fisheries resources, such as anadromous and resident species reported to inhabit water bodies within the study area. Describe relevant aspects of salmonid seasonal use and life histories.
- Identify any federal- or state-listed endangered, threatened, or candidate aquatic species reported to inhabit water bodies within the study area.
- Conduct a reconnaissance-level survey of water bodies within the study area that may be affected by the project to describe fish and amphibian habitats and riparian zone conditions.
- Describe potential impacts on aquatic resources that may result from the project alternatives, including short-term construction impacts and long-term operational impacts.
- Propose BMPs and mitigation measures to avoid, minimize, and compensate for any adverse impacts.

2.1.2 Aquatic Resources Methods

2.1.2.1 Review of Existing Information

A literature and data review was performed to identify and characterize potentially affected resources in the study area. Sound Transit reviewed the sources listed in Section 1.1 to collect information regarding the presence of streams, rivers, and lakes and the resident and anadromous fish species and habitat within and near the project vicinity. Existing documentation and information were compiled and reviewed first so that the field reconnaissance effort could focus on filling information gaps.

2.1.2.2 Agency Coordination

Federal, state, and local agencies were contacted for information regarding existing conditions in the study area. For example, WDFW was contacted for information on PHS. The Washington Conservation Commission provided a copy of the Lake Washington Watershed habitat limiting factors report (Kerwin, 2001). Kit Paulson with the City of Bellevue provided information on species occurrence, habitat, watershed conditions, spawner surveys, and fish passage assessments at culverts for streams in the Kelsey Creek watershed.

2.1.2.3 Reconnaissance of Water Bodies

Sound Transit conducted reconnaissance-level aquatic habitat surveys during March 2007 at least 100 feet upstream and 300 feet downstream from each of the study area water-body crossings and along the entire reach of any stream running parallel to the project within 200 feet from the edge of the alternative and facilities. Aquatic habitat suitability (i.e., functional status) was evaluated based on the fish life histories, spawning and rearing habitat requirements, seasonal use, and field observations. The following stream habitat information was assessed during field reconnaissance:

- Overall habitat quality rating
- Habitat quality trend
- Water quality

- In-stream habitat
- Riparian habitat
- Anthropogenic factors

The habitat quality rating was subjective. The fisheries biologists who determined the ratings have extensive experience doing quantitative stream habitat surveys using King County methodologies, the Urban Stream Baseline Assessment Evaluation Method (USBEM), and other methodologies. They have experience applying data to rating systems such as USBEM, National Oceanic and Atmospheric Administration (NOAA) Fisheries Pathways and Indicators, and others. The USBEM method was developed for King, Snohomish, and Pierce counties for ESA compliance purposes (R2 Consultants, et al., 2000). The USBEM rating system is an urban stream adaptation of the NOAA Fisheries habitat rating system, which was developed in the context of forest harvest management in major rural watersheds to comply with ESA. In addition, aquatic resources were described, when possible and applicable, in a basin or subbasin context. Culverts were described and visually assessed for fish passage.

2.1.2.4 Water Body Classification and Stream Buffer Width Designations

Water body classification was determined based on the King County, DNR, City of Redmond, and City of Bellevue classification systems. The King County system is hierarchical and based on stream flow and salmonid usage. The King County system categories are as follows:

- Class 1: Streams that are designated as "Shorelines of the State"
- Class 2: Streams that are smaller than Class 1 and flow year-round during years of normal rainfall, or those used by salmonids
- Class 3: Streams that are intermittent or ephemeral during years of normal rainfall and are not used by salmonids
- Unclassified: A watercourse that has been identified but has not been classified

The DNR classification system categories are as follows:

- Type S: "Shorelines of the State" or "Shorelines of Statewide Significance"
- Type F: Fish
- Type Np: Nonfish – Perennial
- Type Ns: Nonfish – Seasonal
- Letter "U": Unknown

The City of Bellevue classification system categories are as follows:

- Type S water: All waters, within their bankfull width, as inventoried as "shorelines of the state," including periodically inundated areas of their associated wetlands
- Type F waters: Segments of waters that are not Type S waters and that contain fish or fish habitat, including waters used by hatcheries
- Type N waters: All segments of waters that are not Type S or F waters and that are physically connected to Type S or F waters by an aboveground channel system, stream, or wetland
- Type O waters: All segments of waters that are not Type S, F, or N waters and that are not physically connected to Type S, F, or N waters by an aboveground channel system, stream, or wetland

The City of Redmond classification system categories are as follows:

- Class I: Streams identified as "Shorelines of the State" under the City of Redmond Shoreline Master Program
- Class II: Natural streams that are not Class I and are either perennial or intermittent and have salmonid fish use or the potential for salmonid fish use
- Class III: Natural streams that are not Class I or Class II and are either perennial or intermittent and have one of the following characteristics:
  - Non-salmonid fish use or the potential for non-salmonid fish use

  - Headwater streams with a surface water connection to salmon-bearing or potentially salmon-bearing streams (Class I or II)

- Class IV: Natural streams that are not Class I, Class II, or Class III and are either perennial or intermittent, do not have fish or the potential for fish, and are non-headwater streams
- Intentionally Created Streams: Manmade streams defined as such in these regulations, and which do not include streams created as mitigation; purposeful creation must be demonstrated to the City of Redmond through documentation, photographs, statements and/or other evidence; intentionally created streams may include irrigation and drainage ditches, grass-lined swales, or other artificial watercourses unless they are used by salmonid fish or created for the purpose of stream mitigation.

Cities and counties (in areas that are not incorporated) have jurisdiction over stream buffers, which are regulated through the city's CAOs. Table 2-1 lists the stream buffer widths for the various stream classifications. The City of Redmond has different restrictions in the "inner" and "outer" portions of their buffer zones.

TABLE 2-1
Stream Categories, Buffers, for Streams Located in the Study Area

Classification System	Buffer Requirements (feet)
City of Bellevue	Type S: 100 Type F: 100 Type N: 50 Type O: 25
City of Redmond	Sammamish River: inner: 150 Bear Creek: inner: 150 Class 2: inner:100, outer: 50 Class 3: 100 Class 4 perennial: 36 Class 4 intermittent 25

2.1.2.5 Impact Assessment

Sound Transit evaluated potential impacts of the East Link Project on aquatic resources by overlaying the map of the project design on the habitat characterization map created for this project, including the location and size of storm drain pipes and stormwater treatment/detention ponds. Sound Transit reviewed proposed construction staging areas and construction methodologies to determine where erosion, dust, and vegetation disturbance/removal would directly or indirectly affect tributaries in the study area. Sound Transit also evaluated reports and assessments of similar projects and consulted resource agency biologists.

2.2 Upland Vegetation and Wildlife Resources

This section describes the objectives of the vegetation and wildlife investigations and the methods used to characterize the vegetation and wildlife habitats within the East Link Project vicinity and to identify potential impacts on those habitats. It includes a discussion of threatened and endangered species, species of concern, and high-value habitats within the vegetation and wildlife study areas.

2.2.1 Upland Vegetation and Wildlife Resources Study Objectives

The purpose of the vegetation and wildlife investigations was to describe the ecological resources in the study area and identify and describe potential impacts of the light rail system on them. Objectives included the following:

- Identify important terrestrial habitats and wildlife resources, such as anadromous and resident species reported to inhabit water bodies within and adjacent to the project
- Identify any federal- or state-listed endangered, threatened, or candidate species that may occur within the study area

- Identify suitable habitat for any federal-or state-listed endangered, threatened, or candidate species that may occur within the study area
- Conduct a reconnaissance-level survey of terrestrial habitats to describe plant communities and wildlife habitats within the study area that may be affected by the project
- Describe potential impacts from the project's build alternatives on plant communities and wildlife habitats, including short-term construction impacts, and long-term operational impacts
- Propose BMPs and mitigation measures to avoid, minimize, or compensate for any adverse impacts

2.2.2 Upland Vegetation and Wildlife Resources Methods

2.2.2.1 Review of Existing Information

Sound Transit obtained and reviewed existing data on study area plant communities, wildlife, and wildlife habitat from several sources, including local, state, and federal agencies. Sound Transit also obtained and reviewed existing maps and aerial photographs of the study area.

General wildlife guides, including Peterson guides to mammals, birds, and butterflies, were used to obtain basic distribution maps and general habitat requirements. More detailed distribution and status information was gathered from gap analysis data from the University of Washington (1997), *Wildlife-Habitat Relationships in Oregon and Washington* (Johnson and O'Neil, 2001), *Atlas of Oregon Wildlife* (Csuti, et al., 1991), and *Ecology and Conservation of the Marbled Murrelet* (Ralph, et al., 1995). Wildlife and plant databases were also accessed using internet resources; the NatureServe database (http://www.natureserve.org/) was one of the primary sources of information for plants and wildlife. Other sites used include the University of Montana's Butterflies and Moths of North America web site, the DNR, and the plant database for the United States Department of Agriculture (www.USDA.gov/).

2.2.2.2 Identification of Threatened and Endangered Species and Species of Concern

Sound Transit analyzed the likely presence or absence of listed wildlife and plant species based on their known distributions and the presence of suitable habitat within the project vicinity, referred to as high-value habitat in this analysis. This process was also conducted to narrow the list of federally and state-listed species present in each of the project segments.

USFWS was contacted regarding federally listed plants and animals that may occur in the project vicinity. Data regarding the distribution of ESA-protected species were obtained from the USFWS online database (http://ecos.fws.gov/tess_public/StateListingAndOccurrence.do?state=WA).

Publications and general occurrence and distribution data for rare wildlife and plants were obtained from the WNHP website (http://www.dnr.wa.gov/nhp/refdesk/pubs/index.html). WNHP maintains site-specific data regarding rare, endangered, threatened, and sensitive wildlife, plants, and important ecological communities. WNHP publications that were reviewed included the currently updated version of the 1997 *Endangered, Threatened and Sensitive Vascular Plants of Washington* (WNHP, 1997), *Plant Associations in Washington's Puget Trough Ecoregion* (WNHP, 2007a), *Known High-Quality Rare Ecological Communities by (Washington) County* (WNHP, 2007b), and *Washington Herp Atlas* (an online atlas of information on rare amphibians and reptiles) (DNR, et al., 2005).

Priority species in Washington include all state endangered, threatened, sensitive, and candidate species, as well as federal endangered, threatened, candidate, and species of concern. State monitor species are not considered priority species but are monitored for status and distribution. They are managed by the WDFW, as needed, to prevent them from becoming endangered, threatened, or sensitive. WDFW maintains several geographic information system (GIS) databases that contain information on priority species in Washington. Sound Transit obtained data regarding rare species and habitats from the WDFW PHS database. In addition to publicly available information, WDFW provided site-specific data regarding the occurrence of rare plant communities, plants, wildlife, and wildlife habitat in the project vicinity in response to a project-specific request for these data. WDFW publications (available at http://wdfw.wa.gov/) that were reviewed included *Priority Species and Habitats* and several volumes of *Management Recommendations for Washington's Priority Species* and *Management Recommendations for Washington's Priority Habitats.*

Further literature reviews were required to determine whether habitat suitable for any state priority or listed species occurred within the project vicinity. This research was necessary because of the nature of PHS wildlife distribution data, which typically are very complete for larger, higher-profile species that are easily monitored and for which there are active monitoring efforts but often less comprehensive for lower-profile species.

Sound Transit used additional literature review combined with general habitat determinations for each affected potential habitat area to evaluate habitat suitability and potential presence for all PHS wildlife species occurring and likely occurring within the study area. Species that are not likely to occur in the study area were removed from consideration. Species occurrence in the study area was further assessed based on the habitat requirements of that species, habitats present in the study area, the location of known populations, and whether any historical or recent sightings of that species have occurred in King County. Any species that fit those criteria were added as either known to occur in the study area, likely present (i.e., having known historical or recent sightings and suitable habitat present), possibly occurring (i.e., habitat requirements fulfilled at the site and populations known to occur in the study area), or rare in the study area.

High-value habitats are identified as areas with unique or significant value to many species. These areas are not protected by state regulations. However, WDFW has developed management guidelines for land use activities that may affect high-value habitats. Field investigations were conducted in March and April 2007 to verify any priority species or habitats identified by WDFW and to assess potential impacts on these resources from the East Link Project.

2.2.2.3 Coordination with Agencies and Interest Groups

Local, state, and federal agencies were contacted for information regarding existing site conditions for areas located within the project study area. The King County Department of Natural Resources, the King County Parks Department, the City of Bellevue Parks Department, WDFW, and USFWS were contacted for information regarding the presence of sensitive or protected habitats, wildlife, and plant species.

Robert Schafer from the City of Bellevue Parks and Community Services Department provided a list of special status and listed species for Mercer Slough. Sharon Claussen of the King County Parks Department provided design maps of the mitigation wetland located in Marymoor Park. Bill Ritchie of WDFW was contacted for additional information regarding the protective buffer zones for bald eagle nests located in the study area. Kathy Bean from the City of Redmond offered information on the status listing and management of red-tailed hawks and great blue herons within their jurisdictional boundaries.

Sound Transit also discussed the East Link Project with interest groups such as Friends of Mercer Slough and Friends of Marymoor Park to obtain additional information about the particular area and potential impacts. Michael Hobbs from Friends of Marymoor Park provided a detailed history on the two bald eagle nests and the status of the purple martin *(Progne subis)* and osprey *(Pandion haliaetus)* nests at Marymoor Park. In addition, Don Norman from Norman Wildlife Consulting and Herons Forever provided information regarding the status of the historical heronry on SE Leary Way in Redmond.

2.2.2.4 Vegetation Classification, Mapping, and Field Investigations

The system used to classify upland and riparian vegetation types within the study area was modified slightly from the accepted vegetation classification system used for Sound Transit's Central Link Project (Sound Transit, 1999), which was developed from the King County Wildlife Habitat Profile (1987). However, there are several differences between the basic characteristics of the vegetation types used for the East Link Project and those described by Sound Transit for the Central Link Project. For the East Link Project, the mapped vegetation categories included the following (for more description, see Section 3.2 of this report):

- Riparian forest
- Urban mostly vegetated – coniferous forest
- Urban mostly vegetated – deciduous forest
- Urban mostly vegetated – mixed forest
- Urban moderately vegetated
- Urban sparsely vegetated
- Blackberry

Others categories, such as open waters and wetlands, are also mapped and addressed in other sections of this report. The first four categories are viewed as offering high-value habitat for a variety of wildlife species. For purposes of wildlife habitat, the remaining categories (moderately, sparsely, and blackberry vegetation) offer only moderate or low habitat value.

There are minor differences between the East Link categories and those used in Central Link. Sound Transit described the urban, mostly vegetated type as "dominated by open mowed lawns; large native and ornamental trees (generally 40–70 feet tall); some patches of ornamental and native shrubs may occur" and assigned a high habitat value rating to these areas (Sound Transit, 1999). During the East Link study, however, Sound Transit did not find areas with mowed lawns and enough of an overstory of trees and shrubs to allow the areas to be classified as "mostly vegetated." Identified areas with characteristics approaching this nature were classified instead as urban moderately vegetated for several reasons. First, Sound Transit mapped smaller polygons than were mapped for the Central Link analysis. This allowed areas with mowed lawns to be distinguished from areas with a more natural understory or ground cover. Second, and more important, the canopy cover of trees and shrubs described in Sound Transit's 1999 Central Link Project EIS was considerably lower than the canopy cover of more natural areas. These classified for East Link as urban mostly vegetated—coniferous forest, urban mostly vegetated—deciduous forest, and riparian forest. Most of the areas classified as urban mostly vegetated for East Link have higher habitat values than those classified by Sound Transit in 1999 because of the location of these areas and their connectivity or association with larger habitat patches.

Some of the East Link vegetation types include more than one habitat type described by King County (Table 2-2). Wildlife values attributed to the King County habitat types differ at times from the values assigned to the vegetation types during the Central Link and East Link studies of the respective study areas. Wildlife value within a vegetation type at a specific location can vary considerably and depends on several factors: size of the area; presence of (or proximity to) other valuable habitat; level and type of human disturbance; diversity of plant species; presence of multiple vegetation layers (i.e., tree, shrub, forb, and emergent layers); and presence of threatened, endangered, or sensitive species. Wildlife values were not attributed to each occurrence of a vegetation type along the project corridor but instead were assigned to the vegetation type as a whole.

Nonwetland areas within 100 feet of either side of the project alternatives that appeared to provide some level of potential value for wildlife were initially mapped using 1 inch = 200 feet scale color aerial orthophotographs (i.e., aerial photographs adjusted to remove tilt distortion). All vegetation type polygons were classified and mapped regardless of size. Vegetation type polygons were digitized onto aerial photographs (scaled at 1 inch = 200 feet) for subsequent use in field reconnaissance of the study area.

All upland vegetation polygons classified as urban mostly vegetated—coniferous forest or urban mostly vegetated—deciduous forest, riparian forest, and urban moderately vegetated areas were visited during the field reconnaissance to verify the initial classification. The initial vegetation classification of each site and polygon boundaries were modified if needed based on the field review.

TABLE 2-2
Vegetation/Habitat Types and Associated Wildlife Value for East Link and King County Systems

Vegetation/Habitat Type		Wildlife Value	
East Link[a]	King County[b]	East Link[c]	King County[b]
Urban sparsely vegetated	Urban and suburban, poorly vegetated	Low	Low
Urban moderately vegetated	Urban and suburban, moderately vegetated	Moderate	Moderate
Urban mostly vegetated – coniferous forest	Urban and suburban, mostly vegetated	High	High
Urban mostly vegetated – deciduous forest	Second-growth, lowland deciduous forest	High to very high	Very high
Wetland	Southern portion of Mercer Slough Nature Park and portions of the Sturtevant Creek wetland. Grassy areas dominated by reed canarygrass with scattered thickets of willows, dogwoods. No native-plant wet meadows, and no meadows not dominated by reed canarygrass. Mercer Slough Nature Park website lists "meadow" as one of the Park's habitat types (along with wetlands, forests, and bog).	Moderate to very high depending on vegetation type and extent of area	High
	Shrub wetlands	Moderate to high	Moderate
	Forested wetland	High to very high	Moderate

TABLE 2-2
Vegetation/Habitat Types and Associated Wildlife Value for East Link and King County Systems

Vegetation/Habitat Type		Wildlife Value	
East Link[a]	King County[b]	East Link[c]	King County[b]
Riparian forest	Riparian forest	High	High
	Riparian shrub/forb	High	Very high
Open water – lakes	Lake Bellevue (highly disturbed, low wildlife value). Sammamish Lake is outside the corridor by 0.5 to 0.75 mile Lake Washington just on the other side of the Interstate 90 overpasses	High (except for lake Bellevue)	High
Open water – ponds	No natural ponds Stormwater detention pond by SE Leary Way Kelsey Creek Pond just below the water control structure by 127th Place NE	High	Very high
	Rivers and streams	Moderate to high	Moderate

Source: Sound Transit (1999) and King County (1987).

[a] East Link vegetation types adapted from designations developed for the Central Link study area by Sound Transit (1999).
[b] King County habitat types and wildlife values represent designations from the King County (1987) Wildlife Habitat Profile.
[C] East Link wildlife values were modified from those assigned to the Central Link Project based on field observations.

2.2.2.5 General Wildlife Habitat Value

Aerial photographs were used to locate all forested areas, which Sound Transit then assessed for plant diversity, plant density, and signs of wildlife use. Each of the urban mostly vegetated—coniferous forest, urban mostly vegetated—deciduous forest, and riparian forest polygons were assessed in the field by two biologists. A qualitative wildlife habitat functional value assessment form was adapted from the Washington State Department of Transportation (WSDOT) Wetland Functions Characterization Tool for Linear Projects (WSDOT, 2000) for use in evaluating general wildlife habitat value in the study area. The template for the data form is provided in Appendix B, and completed forms are available upon request. The qualitative functional value form assessed factors such as the following:

- Relative vegetation density, age and growth form, and species and structural diversity
- Dominant plant species composition
- Location relative to sources of human disturbance
- General levels of development in the vicinity of the site
- Connectivity to other areas of valuable wildlife habitat
- Presence of movement barriers
- Presence of water and, if present, water type
- Specific factors affecting the potential habitat value for amphibians, mammals, and birds

These qualitative wildlife habitat assessment forms were not completed for wetlands because a separate wetland functional assessment form was used for those areas (see Section 2.3, Wetland Resources). The results of the wetland delineation and wetland functional analysis were used to identify important wildlife habitats of wetlands. These data were used to supplement information received from WNHP and WDFW, which covered both upland and wetland species.

2.2.2.6 Impact Analysis

Vegetation and Habitat

Expected impacts of project construction and operational impacts on vegetation and wildlife habitat were determined by evaluating the acreage of major vegetation types that would be directly or indirectly impacted by the alternatives.

Wildlife

Sound Transit assessed impacts on wildlife using several approaches, including quantitative and qualitative methods, and measured direct habitat loss based on the extent of impacts to various plant communities. Qualitative assessment was accomplished based on factors such as the regional significance of the habitat, its value (such as a site's role as a wildlife movement corridor), the degree of fragmentation and loss of the habitat

following project implementation, overall habitat quality, and the potential for enhancing or restoring unique plant communities or wildlife habitat or connectivity.

Short-term construction and long-term operational impacts on wildlife, including disturbances from increases in human access, noise, and light, were also evaluated. Information presented by the USFWS regarding the impacts of noise on wildlife was used to assist in this aspect of the analysis (USFWS, 2007a). The potential for the introduction of noxious and/or invasive species invasions because of the project were also evaluated. Impacts on rare species were assessed by considering both direct habitat loss and indirect impacts from habitat loss and human disturbance.

A program called VIEWSHED GIS was used to determine potential impacts to bald eagles. The program predicts whether project construction activities occurring with the 0.5-mile nest buffer could be seen from each of the eagle nest sites. Recorded features include the presence of large hills or open areas and the position of the nest or roost in the landscape. The program also considers topographic features to conduct the analysis. Once the required data is gathered, viewsheds are created using the VIEWSHED GIS software. These viewsheds show the lands within a half mile that are visible from each bald eagle nest or roost. Potential impacts are assessed based on distances between bald eagle nests or roosts and construction areas and whether there is an unobstructed line-of-sight between the nest or roost and construction areas.

2.3 Wetland Resources

2.3.1 Wetland Resources Study Objectives

Earlier project reconnaissance findings show that wetlands are located within the construction limits for several project alternatives. As a result, specific objectives of this analysis include the following:

- Catalog the existing conditions of the wetlands and wetland buffers located within 200 feet of either side of the proposed project alternatives.
- Determine each project alternative's short- and long-term impacts on wetlands.
- Describe measures to avoid, minimize, or compensate for impacts.

2.3.2 Wetland Resources Methods

Wetlands were identified through existing mapping inventories and published documents, field evaluations, and communications from various agencies. Federal, state, and local regulations were referred to assist in classifying and rating wetlands and to confirm project compliance with existing laws.

2.3.2.1 Review of Existing Information

Existing wetland data was gathered from a variety of sources—including federal, state, and local agencies—reviewed in the office, and then evaluated in the field. Existing digital GIS information was obtained from the City of Redmond and the USFWS National Wetlands Inventory (NWI). The NWI database was the primary wetland mapping tool used.

2.3.2.2 Agency Coordination

During this review, several state and local agencies were contacted. The cities of Bellevue and Redmond were contacted regarding their wetland map inventories. WSDOT was contacted for permission to access the Mercer Slough wetlands along the Interstate 90 (I-90) overpass and for information regarding the wetland existing on the old WSDOT property adjacent to 188th Avenue SE in Bellevue. The King County Parks Department was contacted for information regarding the Marymoor Park mitigation wetland. Construction plans for the wetland were obtained and permission granted for accessing the site for evaluation.

2.3.2.3 Wetland Determination

General field reconnaissance work was completed in February and March 2007 for the East Link Project using aerial photographs from 2005. The aerial photographs were at a scale of 1:24,400 and were used to evaluate existing mapped wetlands and to help pinpoint potential sensitive areas that were not included in any of the wetland maps or inventories. In order to determine whether wetlands were present, potential existing wetland

data was plotted onto the aerial photograph map books created for the project, and the East Link Project alternatives were then added to the map books with 100-foot boundaries from the centerline. The boundary widths were placed on either side of the centerline to expand the study area in case the centerlines were shifted or adjusted along their alignment. In addition, Sound Transit examined an additional 200 feet on either side of the project alternatives to locate any additional wetland resources that might have been omitted from the existing wetland inventories and maps and that might have included buffers that intersect the study area.

The *1987 Corps of Engineers Wetland Delineation Manual* (USACE, 1987), the *1997 Washington State Wetlands Identification and Delineation Manual* (Ecology publication #96-94) (Ecology, 1997), and the *2004 Washington State Wetland Rating System for Western Washington Manual* (Ecology publication #04-06-025) (Ecology, 2004) were used to determine the presence, class, and category of wetlands in the study area. For the Draft EIS, reconnaissance-level wetland assessments were completed and no formal wetland delineations have been conducted. Formal wetland delineation would be conducted for the preferred alternative identified as part of the Final EIS.

Using the USACE and Ecology manuals, each of the potential wetland sites was evaluated for the presence or absence of hydric soils, the dominance of hydrophytic vegetation, and the presence or absence of wetland hydrology. A discussion of these three wetland criteria is included in the methodology sections below. Once the sites were visited, if they were classified as wetlands, they were added into the project database and identified on project maps.

Soils

To help locate potentially missed wetland sites, Sound Transit used data obtained from the USDA Natural Resources Conservation Service (2007) and from King County (2006) to create 1:2,400 mapbooks that show the different soil boundaries and soil types within the study area. Before entering a site, the mapped soil types were verified to be either hydric or nonhydric soils. This information was especially useful for areas in the City of Bellevue and Bel-Red corridor area, because fencing prevented access to several sites. Wetland soil determinations were based on existing soil classification for the following known wetland complexes: East and West 140th Avenue (Wetland Resource [WR] -10 and WR-11), Bear Creek (WR-12), Kelsey Creek Riparian and Kelsey Creek Ponded (WR-8 and WR-7), 118th Avenue SE (WR-5), and Mercer Slough /I-90 (WR-4) wetlands.

In areas where permission was given, Sound Transit dug 16-inch-deep soil pits to view the soil profile. Soil matrix color was noted using a Munsell Soil Color Chart (Greytag Macbeth, 2000). Matrix texture was also noted. Within the upper 10 inches of the soil profile, soils were only considered wetland soils if the soil chroma was 2 or lower with redoximorphic features or 1 or lower without such features. If redoximorphic features were present in the soil, the color, size, abundance, and texture were noted. Soil pits were dug in 8 of the 13 wetlands located within the study area. Soil pits were not dug in the other wetlands because access restrictions were not resolved at the time of this Draft EIS. Data on the WSDOT property wetland located east of 118th Avenue SE were obtained from the I-405 Bellevue Nickel Improvement Project EIS.

Vegetation

Plant communities were evaluated in February and March 2007 to determine the presence and dominance of hydrophytic vegetation. Deciduous and herbaceous species were still dormant during this time of year, so dormant shrubs and trees were identified by bark, branch growth patterns, and fallen leaves around the base of the plant. Herbaceous vegetation was identified by last year's growth, which was still evident on most species. Hydrophytic vegetation exists when more than 50 percent of the dominant plants in each strata (i.e., tree layer, shrub layer, and/or herb layer) are either obligate, facultative wetland, or facultative indicator plants (Table 2-3). Wetland indicator status was determined using the 1996 *National List of Vascular Plant Species That Occur in Wetlands* (Reed, et al., 1988; http://www.fws.gov/nwi/bha/download/1996/national.pdf).

Hydrology

The hydrology of each site was also evaluated during February and March 2007. Signs of water were followed toward their sources. Indicators of wetland hydrology, including water-stained vegetation and debris dams, were noted. Aerial maps were used to determine the water sources and where to extend the search.

TABLE 2-3
Wetland Plant Indicator Status

Indicator Status	Indicator Symbol	Wetland Definition
Obligate Wetland Plants	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated <1%) in nonwetlands
Facultative Wetland Plants	FACW	Plants that occur usually (estimated probability >67 to 99%) in wetlands, but which also occur (estimated probability 1 to 33%) in nonwetlands
Facultative Plants	FAC	Plants with a similar likelihood (estimated probability33 to 67%) of occurring in wetlands and nonwetlands
Facultative Upland Plants	FACU	Plants that occur sometimes (estimated probability 1 to <33%) in wetlands, but which occur more often (estimated probability >67 to 99%) in nonwetlands
Obligate Upland Plants	UPL	Plants that occur rarely (estimated probability <1%) in wetlands, but occur almost always (estimated probability >99%) in nonwetlands under natural conditions

Source: Reed, et al., 1988

2.3.2.4 Wetland Functions and Classification

Wetlands were classified following federal and state guidelines. The Cowardin system (Cowardin, et al., 1979) was used to define and describe the physical attributes of wetlands in the study area (Table 2-4). In addition, the Hydrogeomorphic Classification (HGM) (Brinson, 1993) for each wetland was ascertained using guidance found in the *Washington State Wetland Rating System for Western Washington Revised* (Hruby, 2004). The HGM classification system breaks wetlands down into categories based on their hydrodynamics, hydrologic source, and geographic setting.

Ecology's Western Washington Rating Form (1993) and local CAOs were used to determine the category of each wetland based on functional capabilities. Higher quality functions yield higher category placement with Category 1 being the highest functioning wetlands and Category 4 the lowest. Wetland-buffer width varies with a given wetland category, which also varies with the specific jurisdiction (Table 2-5). Wetland buffers are not given their own category but are associated with the category of wetland they abut.

Wetland buffers were added to mapped wetlands and shown on aerial maps to display the total wetland footprint (including both wetland and buffer) occurring within the construction limits of each project alternative. In some cases, existing buildings, parking lots, and roads within wetland buffer areas reduced buffer widths.

TABLE 2-4
Cowardin Classifications of Wetlands Located within the East Link Project Vicinity

Cowardin Classification	Definition
Palustrine Emergent Marsh (PEM)	Vegetation standing in a few inches to 3 feet of water. PEM are dominated by erect, rooted herbaceous freshwater hydrophytic vegetation.
Palustrine Scrub Shrub (PSS)	Areas dominated by woody vegetation <6 meters (20 feet) tall. Woody shrub component consisting of shrubs and small trees.
Palustrine Forested (PFO)	Areas dominated by woody vegetation >6 meters (20 feet) tall.
Riverine (R)	Wetlands contained within a channel with a salinity <0.5 part per thousand (ppt). Wetlands inside a channel that are dominated by trees, shrubs, and other persistent vegetation, including mosses, lichens, and emergents, and/or wetlands with >0.5 ppt salinity, are listed as PEM, PSS, or PFO.

TABLE 2-5
Wetland Categories, Buffers, and Mitigation Ratios for Wetlands Located in the East Link Project Vicinity

Classification System	Buffer Requirements[a]		Mitigation Ratios[a]	
City of Bellevue[b]	Category 1: Category 2: Category 3: Category 4:	110 – 225 feet 75 – 225 feet 60 – 110 feet 40 feet with no setback	Category 1: Category 2: Category 3: Category 4:	6:1 3:1 2:1 1.5:1
City of Redmond	Category 1: Category 2: Category 3: Category 4:	50 – 300 feet 50 – 300 feet 60 – 110 feet 40 –150 feet	Category 1: Category 2: Category 3: Category 4:	6:1 to 24:1 1:1 to 12:1 1:1 to 8:1 1:1 to 6:1

[a] Variations in buffer width are due to functional scores and other criteria for each jurisdiction. Similarly, variations in mitigation ratios are based upon the type of mitigation offered (e.g., creation, restoration, re-establishment) and the Cowardin class affected.

[b] All Category 1, 2, and 3 Wetlands in Bellevue have a 20-foot setback that prohibits placement of any structure within 20 feet of the wetland boundary.

2.3.2.5 Wetland Functional Assessment

As mentioned previously, the presence and quality of functions provided by each wetland resource were assessed during site visits using the *Washington State Wetland Rating System for Western Washington Revised* (Hruby, 2004). The rating system defines four main wetland functional categories (i.e., special criteria, hydrologic, biological, and water quality improvement). For wetlands found in western Washington, there are 13 criteria that are components of the four main wetland functional categories. At each wetland, all 13 criteria are scored based on observations of wetland characteristics in the field. The numbers are then tallied for each main category and the totals placed in a low, moderate, or high category.

2.3.2.6 Impact Analysis

The functions and values that exist in each wetland and their level of performance were evaluated during site visits. Once all wetland and buffer resources were cataloged, each project alternative was assessed for impacts on wetlands and buffers within the study area. Recommendations for avoiding and minimizing wetlands and buffer impacts, as well as potential mitigation activities, were also developed. Details of the characteristics of each wetland site are described in the sections below. Nonwetland waters of the United States, such as creeks and streams, are discussed in Section 2.1, Aquatic Resources.

3.0 Affected Environment

The East Link Project would be constructed in a generally urban area with variable levels of human activity. Portions of the project would be constructed in highly urbanized cities such as Seattle, Bellevue, and Redmond or along heavily traveled highways, including I-90, I-405, and State Route (SR) 520. This chapter describes the affected environments for aquatic resources (Section 3.1), upland vegetation and wildlife resources (Section 3.2), and wetland resources (Section 3.3).

3.1 Aquatic Resources

East Link would be constructed in an urban area that has already experienced a moderate to high degree of alteration to aquatic habitats. The degree of alteration varies from water body to water body, with the greatest alteration occurring where urban development is the greatest, such as some of the tributaries to Kelsey Creek in Bellevue. Some of the smaller streams and headwater reaches have been placed in long pipe systems. The least-altered stream in the study area is Bear Creek in Redmond. However, recent development in that watershed has been extensive.

3.1.1 Drainage System Configuration

The Lake Washington System (i.e., WRIA 8) is composed of two major subbasins: the Sammamish River and the Cedar River. Table 3-1 lists the water bodies that would be potentially affected by the East Link Project. In addition, there are independent tributaries to Lake Washington and Lake Sammamish. The Kelsey Creek system, the primary watershed with associated potential impacts from the East Link Project, is located in Segments B, C, and D. Exhibit 3-1 shows the water bodies in and around the study area.

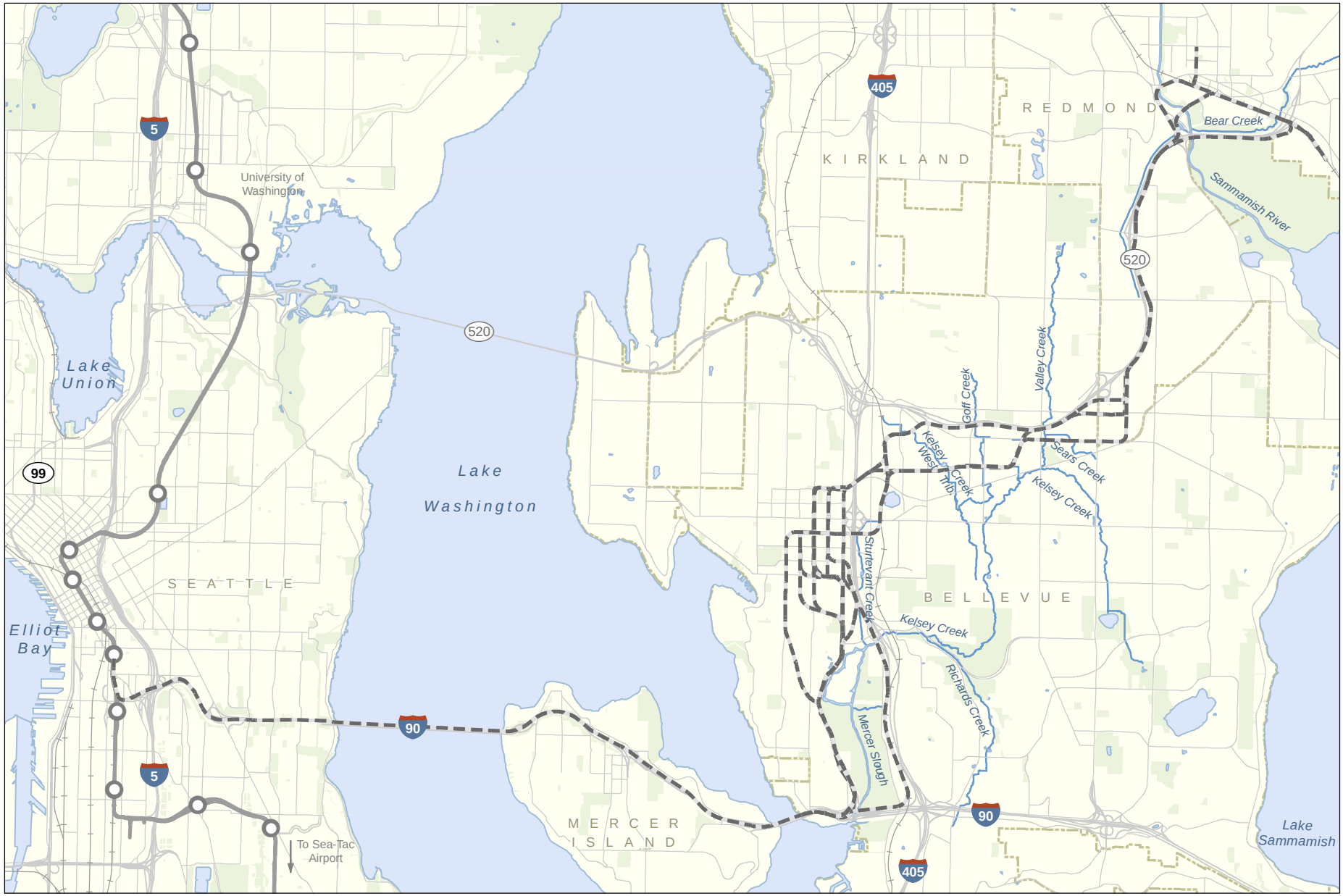
3.1.2 Fish and Other Aquatic Species and Habitat

This section describes the aquatic species and habitat in the study area by segment.

3.1.2.1 Segment A

Lake Washington is the second largest lake in Washington, with a surface area of 22,138 acres. The lake lies at an elevation of 22 feet. The lake is about 20 miles long, averages about 1.5 miles wide, and is oriented in a north-south direction. The maximum depth is 214 feet. The major sources of water that enter the lake are the Cedar River (55 percent of the average inflow) and the Sammamish River (27 percent of the average inflow). The remainder of inflow comes from May Creek, Kelsey Creek, Juanita Creek, Thornton Creek, Lyon Creek, and other, smaller creeks. The lake drains to Puget Sound through the Lake Washington Ship Canal, an artificial waterway constructed in 1916. The ship canal was built to allow ship traffic to access freshwater moorage in Lake Union and Lake Washington via the Hiram Chittenden Locks, which were built at the same time.

Many species of resident fish, both native and introduced, inhabit Lake Washington (Table 3-2). Several species of introduced fish are very abundant, such as yellow perch (*Perca flavescens*) and smallmouth bass (*Micropterus dolomeiui*). Many of these species were introduced when the live fish exhibit at the 1909 Alaska-Yukon-Pacific Exposition was released into Lake Washington. These include tench (*Tinca tinca*) and common carp *(Cyprinus carpio)*, both native to Europe. There are five species of anadromous salmonids found in the Lake Washington watershed. Table 3-3 lists the species present, at least as transients, and their stock status. Anadromous fish are those species that begin their life in freshwater, migrate to the ocean to rear, and then return to freshwater to spawn. The most abundant of these is sockeye salmon (*O. nerka*). Sockeye is the only species to rear in the lake for a whole year as juveniles. Sockeye enter the lake as adults starting in June and remain in the lake until September, when temperatures drop in the tributary streams where they spawn. The primary spawning areas are in the Cedar River, Issaquah Creek, and Bear Creek, but substantial numbers also use nearly all of the larger tributary streams, including Kelsey Creek. Juveniles enter the lake as fry during late winter and early spring, and most rear in the lake for one year. Sockeye smolts leave the lake in spring to enter Puget Sound, and then migrate to the open ocean. A resident form of sockeye, called Kokanee, does not migrate out to sea but remains in fresh water throughout its life cycle.



Source: Data from King County (2006) and Sound Transit (2007).

Stream
East Link Alternative
Central Link Alignment and Station
City Limits

N
0 1 Miles

Exhibit 3-1
Waterbody Features
Segments A, B, C, D, and E
East Link Project

TABLE 3-1
Description of Water Bodies Potentially Affected by the East Link Project

Basin	Water Body	Alternatives Crossing or Adjacent to Water Body[a]	WRIA Number	King County Class	WDNR Class	Stream Length (miles)	Basin Area (square miles)	Comments
Lake Washington	Lake Washington	A1	8	1	S	NA	692	A regionally important lake and designated as a "shoreline of statewide significance."
	Mercer Slough	B1, B2A, B2E, B3, B7	8-0059	1	S	1.2	2.1	Chinook gather in the mouth of Mercer Slough under the I-90 crossing. All salmonids destined for Kelsey Creek pass through Mercer Slough.
	Sturtevant Creek	B3, B7, C1, C2, C2, C3, C4, C7, C8,	8-0262	2	F	1.0	1.2	Urbanized area results in flashy (high and low extremes) flow regimes.
	Kelsey Creek	B7	8-0259	2	F	8.6	11.4	The largest stream in Bellevue. This is an urban stream of regional significance due to high presence of Chinook.
	West Tributary to Kelsey Creek	D5, D2A, D2E, D3	8-0264	2	F	2.8	1.6	Pacific giant salamander documented. Urbanized area results in flashy flow regimes.
	Goff Creek	D2A, D2E, D3, D5, MF3	None	2	F	1.5	1.1	Impassable culvert at Bel-Red Road. Urbanized area results in flashy flow regimes.
	Unnamed Tributary to Kelsey Creek	D2A, D2E, D3	None	3	Ns	Unk	Unk	Very small, intermittent. Urbanized area results in flashy flow regimes.
	Valley Creek	D2A, D2E, D3, D5	8-0266	2	F	2.5	2.2	Urbanized area results in flashy flow regimes.
	Sears Creek	D3	8-0267	2	F	0.6	0.9	Most of drainage is piped. Urbanized area results in flashy flow regimes.
Sammamish Basin	Sammamish River	E1, E2, E4	8-0057	1	S	13.8	240	All salmonids destined for Bear and Issaquah creeks pass through the Sammamish River.
	Bear Creek	E1, E2, E4	8-0105	1	S		50	Identified as one of the top six natural resource basins in King County. Designated as a "Shoreline of Statewide Significance."

[a] Alternative names:

A1 = I-90 Alternative
B1 = Bellevue Way Alternative
B2A = 112th SE At-Grade Alternative
B2E = 112th SE Elevated Alternative
B3 = 112th SE Bypass Alternative
B7 = BNSF Alternative
C1T = Bellevue Way Tunnel Alternative
C2T = 106th NE Tunnel Alternative
C3T = 108th NE Tunnel Alternative
C4A = Couplet Alternative
C7E = 112th NE Elevated Alternative
C8E = 110th NE Elevated Alternative
D2A = NE 16th At-Grade Alternative
D2E = NE 16th Elevated Alternative
D3 = NE 20th Alternative
D5 = SR 520 Alternative
E1 = Redmond Way Alternative
E2 = Marymoor Alternative
E4 = Leary Way Alternative

TABLE 3-2
Resident Fish Species Found in Lake Washington

Common Name	Scientific Name	Resident Fish Status
Kokanee salmon	*Oncorhynchus nerka*	Native
Cutthroat trout	*O. clarki*	Native
Rainbow trout	*O. mykiss*	Native
Northern pikeminnow	*Ptychocheilus oregonensis*	Native
Rocky Mountain whitefish	*Prosopium williamsoni*	Native
Peamouth chub	*Mylocheilus caurinus*	Native
Large-scale sucker	*Catostomus macrocheilus*	Native
Coast range sculpin	*Cottus aleuticus*	Native
Prickly sculpin	*Cottus asper*	Native
Riffle sculpin	*Cottus gulosus*	Native
Three-spined stickleback	*Gasterosteus aculeatus*	Native
Longfin smelt	*Spirinchus thaleichthys*	Native
Pacific lamprey	*Entosphenus tridentatus*	Native
Brook lamprey	*Lampetra planeria*	Native
River lamprey	*Lampetra fluviatilis*	Native
Redside shiner	*Richardsonius balteatus*	Native
Largemouth bass	*Micropterus salmoides*	Introduced (non-native)
Smallmouth bass	*Micropterus dolomeiui*	Introduced (non-native)
Yellow perch	*Perca flavescens*	Introduced (non-native)
Common carp	*Cyprinus carpio*	Introduced (non-native)
Brown bullhead	*Ictalurus nebulosus*	Introduced (non-native)
Black crappie	*Pomoxis nigromaculatus*	Introduced (non-native)
White crappie	*Pomoxis annularis*	Introduced (non-native)
Bluegill	*Lepomis macrocheilus*	Introduced (non-native)
Tench	*Tinca tinca*	Introduced (non-native)
Atlantic salmon	*Salmo salar*	Introduced (non-native)
Goldfish	*Carassius auratus*	Introduced (non-native)
Pumpkinseed sunfish	*Lepomis gibbosus*	Introduced (non-native)

Source: Pfeifer and Bradbury, 1992.

TABLE 3-3
Summary of Stock Status in Lake Washington Watershed: Anadromous Salmonids

Species	Stock[a]	Stock Status	Stock Origin	Escapement Range[b]	Escapement Average	Production Notes[c]
Summer/fall Chinook	Issaquah	Healthy	Non-native	500 – 5,000	2,000	Composite production[d]
Summer/fall Chinook	Cedar River	Unknown	Native	600 – 4,300	1,900	Wild production
Sockeye	Lake Washington	Healthy	Non-native	76,000 – 625,000	275,000	Wild production
Coho	Lake Washington/ Sammamish tributaries	Depressed	Mixed	Unknown	Unknown	Composite production[d]
Coho	Cedar River	Healthy	Mixed	Unknown	Unknown	Wild production
Steelhead	Lake Washington Basin	Depressed	Mixed	470 – 1,820	Unknown	Composite production
Cutthroat trout	Lake Washington Basin	Healthy	Native	Unknown	Unknown	Wild production

Source: WDFW, et al., 1992

[a] A stock is an interbreeding population
[b] Escapement = Number of fish that make it to the spawning grounds.
[c] Composite production: Hatchery plus wild production. Hatchery production is at the WDFW hatchery in Issaquah and to a lesser degree at the University of Washington hatchery.

Adult spawner Chinook salmon (*Oncorhynchus tshawytscha*) enter the lake from early July through the end of October. Residence time in the lake is thought to be relatively brief, although the early-arriving fish may linger if tributary temperatures are too high. When tributary temperatures drop in fall, Chinook migrate up into the tributary streams and rivers to spawn. There is a major hatchery program for Chinook at the Issaquah Creek hatchery and a smaller program at the University of Washington. All Chinook in the Lake Washington system are "ocean-type," meaning they rear in freshwater as juveniles for only 3 to 6 months. There are two juvenile life-history variants in the population. One variant enters the lake as fry and rears in the lake until late spring/early summer before entering Puget Sound. The second variant rears in streams until late spring/early summer before migrating into and through the lake and out to sea. This second, and most common, variant does not spend much time in the lake.

Adult spawner coho (*O. kisutch*) begin entering Lake Washington around mid-August and continue through the end of January. Residence time is variable. Spawning occurs in nearly all tributaries, including Bear Creek, Kelsey Creek, and Kelsey Creek tributaries. Juveniles enter the lake in April and May on their way out of the system after rearing in streams for 1.5 years. A few juveniles are thought to rear in the lake as well. A large number of coho are produced at the WDFW salmon hatchery in Issaquah, but most coho in the system are from natural production.

Steelhead and resident rainbow trout *(O. mykiss)* are present in the Lake Washington system but are not abundant. Adult spawner steelhead enter the lake starting in December and continue to enter the Lake until April. They spawn in late winter and spring in tributary streams and rivers, including Bear Creek. Wild juvenile steelhead rear in tributaries for 2 years. Hatchery steelhead reared in the Issaquah hatchery rear for 1 year. Steelhead smolts move into the lake from tributary streams in April on their way out of the system. They stay in the lake for a month or two, migrating out before mid-June (Kerwin, 2001). Resident rainbow trout are present in the lake all year long.

Coastal cutthroat trout in both resident and anadromous forms are present in Lake Washington in moderate abundance. Resident fish are present in the lake all year long. Sea-run cutthroat enter the lake in late winter and early spring to spawn in spring in tributary streams. Juveniles return to the lake at 1 to 2 years of age. The resident fish stay, and the anadromous smolts migrate out later in spring and early summer to rear in Puget Sound.

Bull trout (*Salvelinus confluentus*) have been observed entering Lake Washington through the fish ladder viewing area at the locks, where every year, one or two fish are seen traveling into the lake. Many researchers believe that

these fish are seasonal visitors rather than fish produced within the system. However, the USFWS assumes for regulatory purposes that natural production is possible in the system.

3.1.2.2 Segment B

Exhibit 3-2 shows the streams and fish passage features in Segment B. The primary features are discussed in the following subsections.

Mercer Slough

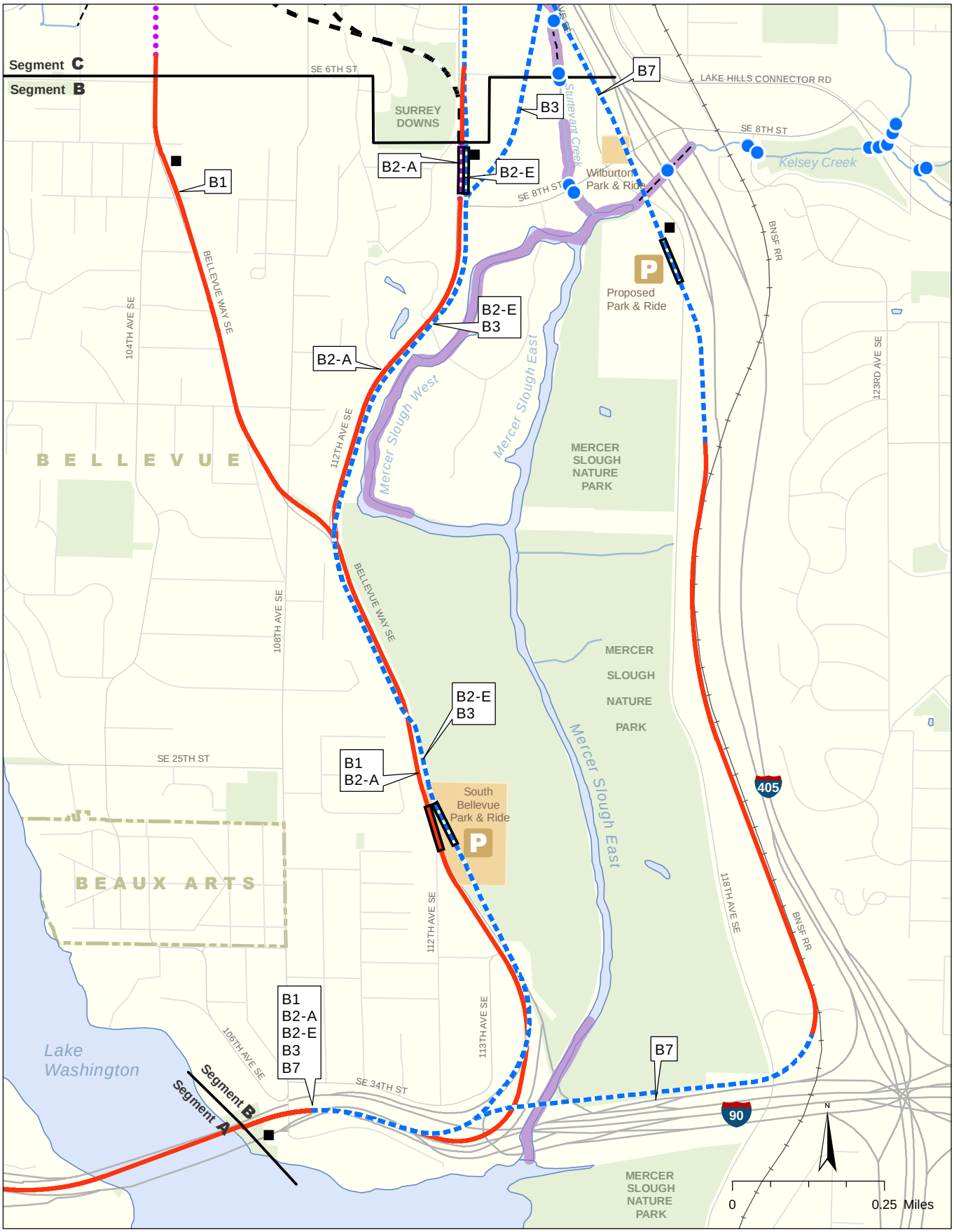
Mercer Slough is a remnant of a much larger embayment that was left after Lake Washington was drawn down 10 feet when the Montlake Cut connection between Lake Washington and Lake Union was established in 1916. Exhibit 3-2 shows the current location and extent of the slough. The Mercer Slough Nature Park (which contains most of the Mercer Slough water body) and associated wetland complex were part of this former bay of Lake Washington. The upper half mile of the slough is split into two channels by a large island with an office campus on it. The distance from the Kelsey Creek outlet to Lake Washington is about 1.75 miles. The basin surface area that drains into Mercer Slough through Kelsey Creek is about 19,200 acres. Subbasin impervious surface area ranges from 32 to 68 percent. The slough is at the same elevation as Lake Washington, so the water input from Kelsey Creek does not result in any perceptible flow.

Mercer Slough averages about 40 feet wide and is probably no more than 8 feet deep. Although the bottom could not be observed due to turbidity during the study, it is a reasonable assumption that the bottom is composed largely of organic material and silt. The upper end, just below the Kelsey Creek outlet, may have some gravel and sand deposits from the creek. The habitat character would be better described as lake or lacustrine habitat rather than pool habitat morphology. There are no riffles, runs, or glides. The riparian zone is narrow in the vicinity of the office park, averaging about 20 to 30 feet wide. Species composition is a mixture of red alder (*Alnus rubra*), big-leaf maple (*Acer macrophyllum*), willows (*Salix* sp.), blackberries (*Rubus procerus*), and an occasional Douglas-fir (*Pseudostuga menziesi*i) or Sitka spruce (*Picea sitchensis*). In the lower portion of the slough, bordered on both sides by the nature park, the riparian zone is very wide. Overall salmonid habitat quality, however, is poor due to the lack of riffles and gravel and due to high summer water temperatures. Salmon runs throughout the Kelsey Creek basin pass through Mercer Slough as a migratory corridor. Some rearing function is possible, especially for coho during the cooler months. Run size varies from year to year. In 2006, escapement (the number of fish returning to the stream) was 229 Chinook, 503 sockeye, and 5 coho. Steelhead and cutthroat numbers are unknown because they were not surveyed.

Kelsey Creek

Kelsey Creek is one of the largest independent tributaries to Lake Washington. It has a drainage area of 2,816 acres. The mainstem is about 8.6 miles long, with headwaters at Phantom Lake in east Bellevue. Including tributaries, there are about 19 miles of open stream channels in the basin. Kelsey Creek first flows north until the vicinity of Bel-Red Road, where it turns west, then south before flowing into Mercer Slough in south Bellevue. The drainage area is about 42 percent impervious surface. Topographic relief through the basin is 300 feet for an average slope of 0.7 percent, which is fairly gradual. Kelsey Creek has a number of tributaries, including the West Tributary, Goff Creek, Valley Creek, Sears Creek, Sunset Creek, and Richards Creek.

Kelsey Creek supports runs of anadromous salmonids, including Chinook salmon, coho salmon, sockeye salmon, and sea-run cutthroat trout. Resident fish include rainbow trout, cutthroat trout, sculpins, lampreys, and suckers. Chinook are known to occur as far upstream as Larson Lake. Coho salmon are known to occur where Chinook occur, and probably farther upstream as well. Sockeye are known to spawn up to river mile 5.0 (which is upstream of the study area). The most recent spawner survey (2006) for Kelsey Creek and tributaries estimated run size at 200 Chinook, 5 coho, and 503 sockeye (Watershed Company, 2007).Factors limiting the production of salmonids in Kelsey Creek and all its tributaries are those common to urban streams. Fine sediment levels are high in spawning riffles, impairing egg survival and aquatic insect production. Logging and urban development have lowered pool density and channel complexity. Hydrology has been altered due to an increase in the amount of impervious surfaces, which causes higher peak flows and lower summer base flows. Stormwater draining from roadways and degraded riparian zones, which reduces shading, have caused water temperature to increase. Kelsey Creek is on the Ecology 303(d) list of streams with impaired water quality for exceeding allowable levels of fecal coliform bacteria and three pesticides: dieldrin, heptachlor epoxide, and dichloro-diphenyl-trichloroethane (DDT).



Source: Data from City of Bellevue (2005), King County (2006) and CH2M HILL (2007).

Fish Passage Type
- No Barrier

Stream Habitat Quality
- Poor

- Open Channel
- Piped Stream
- Route At Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Proposed Station
- City Limits

Exhibit 3-2 **Streams and Fish Passage Features Segment B**
East Link Project

In the vicinity of the BNSF Alternative (B7) crossing at Kelsey Creek, the creek flows in either a culvert or a fish ladder. On the upstream side of the B7 crossing, the creek is in a long but fish-passable culvert under I-405. On the downstream side of the crossing, the culvert outlet drops into a concrete fish ladder that empties directly into Mercer Slough. Spawning and rearing habitat value in this reach is limited to a fish migratory corridor and is considered poor.

Sturtevant Creek

Sturtevant Creek is a small, highly urbanized creek draining 773 acres of Bellevue, including much of the downtown area. The basin is 1.9 miles long, starting in the vicinity of Lake Bellevue. The stream flows generally south, with its outlet at Mercer Slough. The topographic drop is 120 feet. All tributary inflow is through piped systems. The basin's impervious surface is 68 percent. As a result of the high percentage of impervious surface area and general lack of stormwater detention facilities, Sturtevant Creek has a highly "flashy" flow regime, meaning it is quick to peak after a rainfall event then quick to drop back to base flow. Much of the watershed, including the mainstem, is in pipes and culverts. Coho salmon are known to use Sturtevant Creek up to I-405, where there is an impassable culvert. The stream also supports peamouth chub.

The SE 8th Street crossing is through a large-diameter, fish-passable culvert set into grade with a flat gradient and natural sand/silt substrate surface. The reach downstream is a short, deep glide backwatered by Mercer Slough. Banks are stable, and the riparian zone, while narrow, is moderately thick with mixed conifer and alder trees. The reach upstream is largely an unstable, narrow, incised glide with a silty bottom. It has the appearance of a channel that was once channelized straight through a wetland area then no longer maintained, and it is readjusting to site conditions by side-cutting to meander. It breaks into multiple channels in the wetland as a result of beaver activity. Riparian vegetation is patchy, alternating between willows and reed canarygrass (*Phalaris arundinaceae*). Spawning and rearing habitat quality is poor.

3.1.2.3 Segment C

Exhibit 3-3 shows the main streams and fish passage features in Segment C.

Sturtevant Creek

The reach of Sturtevant Creek beginning from SE 6th Street and moving northward up to I-405 improves in habitat quality steadily in the upstream direction until reaching the impassable culvert at I-405. Just upstream from the SE 6th Street crossing, the creek is generally a shallow, wide glide on sandy substrate. In this reach, the creek flows next to one office building and under another. There is no riparian vegetation, and Spawning and rearing habitat quality is poor.

In the short reach adjacent to the Hilton Hotel, north of the SE 6th Street crossing, the gradient increases and transforms into a pool/riffle complex. Some clean gravel is present in riffles. Although there is ample shade due to large bordering trees, all of the streamside cover of trees or shrubs has been cleared and lawns have been established on both sides. Despite this, habitat quality is considered good because there are pools and riffles with moderately clean gravel. This reach represents virtually the only usable habitat in Sturtevant Creek for salmonids. The upstream end of this reach ends at the impassable I-405 culvert. Also, peamouth chub are known to spawn in Sturtevant Creek.

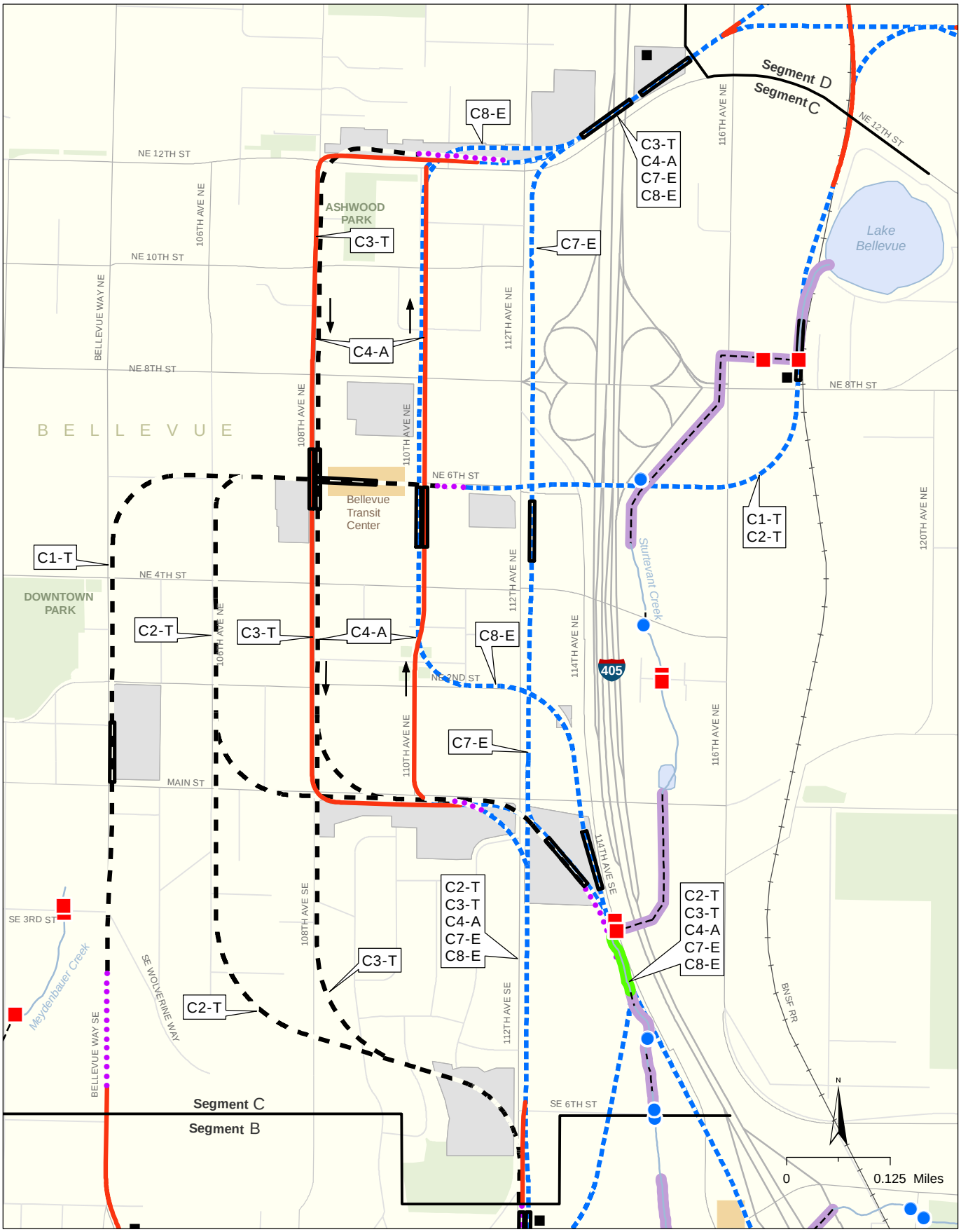
Sturtevant Creek leaves Lake Bellevue as a featureless glide in the ditch alongside of the BNSF railway tracks. Riparian vegetation is sparse and mostly grasses. The bottom substrate composition is silt and organic material. Habitat quality is poor. No fish use has been reported for this reach, except that goldfish are known to be present in Lake Bellevue.

Lake Bellevue

Lake Bellevue is a small lake that forms the headwaters to Sturtevant Creek. It is entirely surrounded by offices and businesses, some of which are built on pilings in the lake. The only fish known to be present in the lake are goldfish (*Carassius auratus*).

3.1.2.4 Segment D

Exhibit 3-4 shows the streams and fish passage features in Segment D.



Source: Data from City of Bellevue (2005), King County (2006) and CH2M HILL (2007).

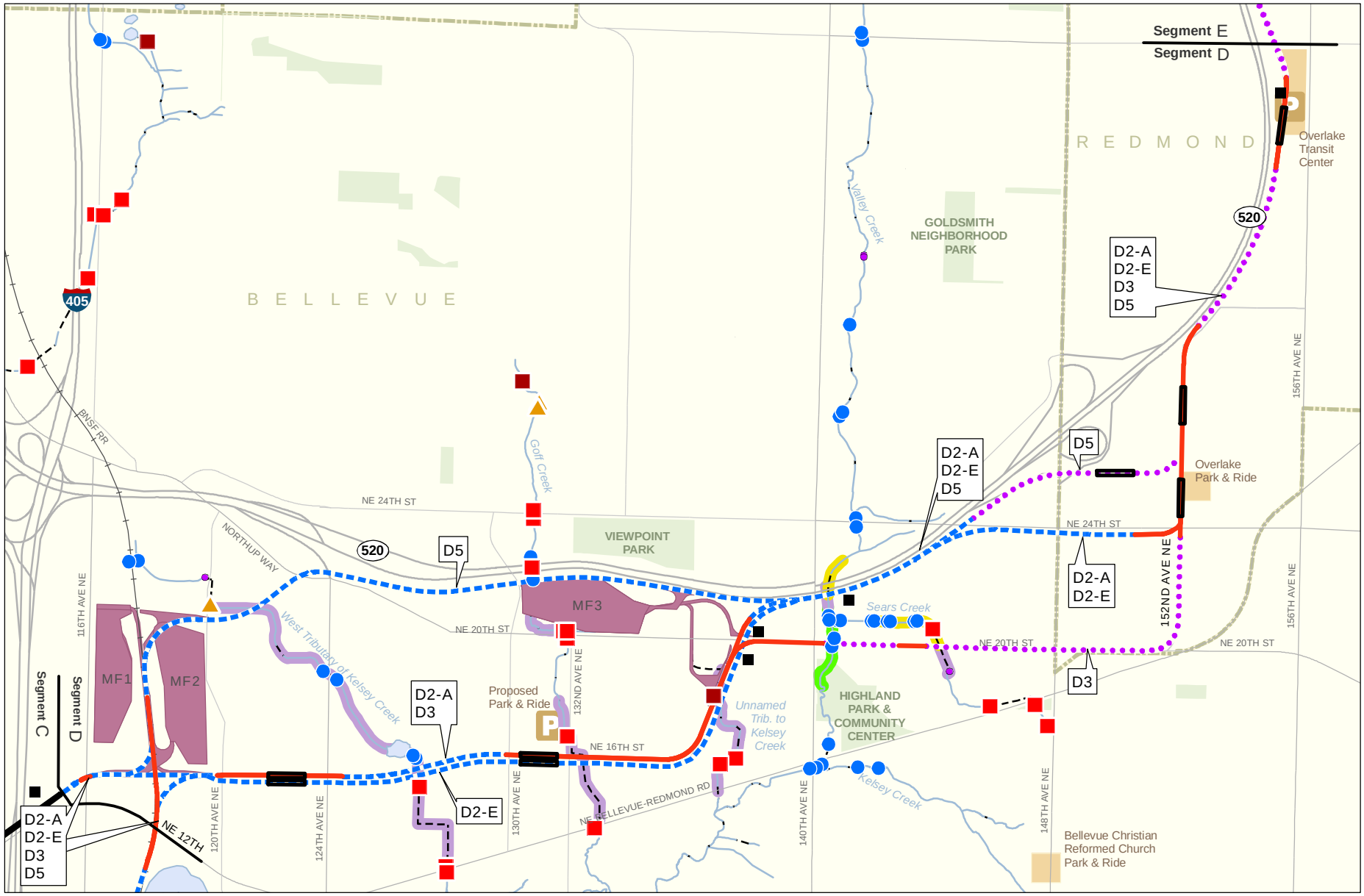
Fish Passage Types
- No Barrier
- Definite Barrier

Stream Habitat Quality
- Good
- Poor
- Open Channel
- Piped Stream

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Traction Power Substation
- Proposed Station
- Tunnel Staging Area
- City Limits

Exhibit 3-3 **Streams and Fish Passage Features Segment C**
East Link Project



Source: Data from City of Bellevue (2005), City of Redmond (2005), King County (2006), and CH2M HILL (2007).

Fish Passage Types
- N/A
- No Barrier
- Partial Barrier
- Definite Barrier
- Upstream of Barrier

Stream Habitat Quality
- Good
- Fair
- Poor
- Open Channel
- Piped Stream

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Traction Power Substation
- Proposed Station
- Maintenance Facility
- City Limits

N

0 0.25 Miles

Exhibit 3-4 **Streams and Fish Passage Features Segment D**
East Link Project

West Tributary to Kelsey Creek

The West Tributary to Kelsey Creek starts in the vicinity of the I-405/SR 520 interchange. It flows southeast, then south, entering Kelsey Creek at river mile 2.6. There are 2.8 miles of open channel with many long culverts in this 1,001-acre basin. The average channel slope is gradual at 0.8 percent. The basin is close to completely built out, with industrial areas in the upper reaches and residential developments elsewhere. The impervious surface of the basin is 44 percent. Chinook salmon, coho salmon, sockeye salmon, and cutthroat trout have been reported in the lower reaches of the West Tributary. The current upstream limit to migratory fish is at Bel-Red Road. The City of Bellevue conducted electro-fishing at two upstream locations and caught no fish. They did, however, catch a Pacific giant salamander (*Dicamptodon tenebrus*).

NE 16th At-Grade (D2A), NE 16th Elevated (D2E), and NE 20th (D3) Alternatives Crossing. D2A, D2E, and D3 cross the West Tributary to Kelsey Creek at a location on the downstream side of the point where a concrete weir about 3 feet high causes the channel to pond. The weir is an impassable barrier to fish movement. The water in the pond is 2 to 3 feet deep with a bottom composition of silt and organic material. The riparian vegetation is composed of medium to large red alders and willows. The width of the riparian zone is very narrow, with a building on one side and a commercial parking lot on the other. Spawning and rearing habitat quality is poor. Just upstream, there is a stormwater detention facility with a large concrete dam. The area upstream of the dam floods periodically and has abundant signs of beaver activity.

SR 520 Alternative (D5) Crossing. D5 crosses the West Tributary in a reach with a riparian zone that is tightly confined (i.e., 100 feet wide) between a bus parking lot and a Safeway bakery. The riparian zone, while narrow, is heavily forested with mature alder and willows. The channel is completely impounded by beaver dams throughout the entire reach, and during field reconnaissance, a beaver was observed swimming in a pond. The bottom of the West Tributary in this area could not be seen, so the depth is unknown but is at least 3 feet. The bottom is probably silt and organic material. Spawning and rearing habitat for salmonids is poor.

Goff Creek

The 680-acre Goff Creek basin is small and narrow. Its headwaters are in Bridle Trails State Park. The stream flows south for about 1.4 miles, entering the West Tributary to Kelsey Creek just south of Bel-Red Road. The basin is rural in the upper reach, residential in the middle reach, and commercial in the reach south of SR 520. Impervious surface is 30 percent, and the basin as a whole has a slope of 2.0 percent.

Cutthroat trout are known to inhabit Goff Creek throughout its length. Sockeye salmon use the lower reach for spawning. During the 2006 spawner survey, 12 live Chinook and 8 carcasses were observed in Goff Creek. An impassable culvert at Bel-Red Road prevents fish access to upstream reaches.

NE 16th At-Grade (D2A), NE 16th Elevated (D2E), and NE 20th (D3) Alternatives Crossing. Goff Creek is confined in a culvert for over 200 feet in either direction of the crossing centerline of D2A, D2E, and D3. The City of Bellevue lists this piped segment as impassable. Habitat for salmonids was rated as poor.

SR 520 Alternative (D5) Crossing. This alternative crosses Goff Creek on the highway fill slope of SR 520. The culvert under the crossing is perched with a 5-foot drop and is thus impassable to fish movement. The 200-foot reach upstream from the crossing is all in a culvert under SR 520. The reach downstream from the crossing is tightly confined between a parking lot and a commercial building. The stream is confined on each side with 4- to 6-foot-high rock walls because the streambed is set below the parking lot and building. There is no riparian vegetation other than planted ornamental ivy and a few low shrubs, but the channel receives afternoon shading from the building. Channel morphology is mostly riffle on fairly clean small gravel. Substrate conditions are suitable for trout spawning. There are only two pools in the survey reach. Overall spawning and rearing habitat quality was rated as fair during the survey.

Unnamed Tributary to Kelsey Creek

This watercourse is very small and intermittent, located between Goff Creek and Valley Creek and running north-south parallel to them. The entire basin lies within a commercial district. The watercourse exits a pipe system just south of NE 20th Street on the shoulder of 136th Place NE. The watercourse then flows south for about 0.2 mile, mainly in culverts and pipes, to Kelsey Creek. The unnamed tributary is not known to support fisheries resources.

NE 16th At-Grade (D2A), NE 16th Elevated (D2E), and NE 20th (D3) Alternatives Crossing. In the vicinity of the crossing for the NE 16th At-Grade (D2A), NE 16th Elevated (D2E), and NE 20th (D3) alternatives, this

watercourse is a grass-lined ditch. There are no habitat features such as pools or riffles. Gradient is flat and substrates consist of grass, silt, and sand. There is neither riparian vegetation nor suitable habitat for fish. Spawning and rearing habitat was rated as poor.

Valley Creek

Valley Creek originates in Redmond just north of the Bellevue/Redmond border. The basin area is 1,391 acres. The creek flows through commercial areas between SR 520 and Bel-Red Road. It flows in a southerly direction for 2.5 miles to enter Kelsey Creek at Bel-Red Road and 140th Avenue NE. The basin is mostly built out, with single-family residences dominating the land use. The impervious surface within the basin is estimated to be 32 percent. The basin slope is gradual at 1.1 percent. Historical information shows sockeye, Chinook, and coho salmon present throughout the mainstem of Valley Creek as far upstream as the Bellevue Municipal Golf Course outfall culvert. Cutthroat trout are assumed to be present throughout the basin as well.

NE 20th Alternative(D3) Crossing. This alternative crosses Valley Creek at NE 20th Street. The reach downstream of the crossing is riffle/run morphology with a few pools. Wetted width was about 6 to 10 feet at the time of survey in March 2007. Substrate character is mostly small gravel with excessive sand, making spawning conditions marginal to poor. Riparian vegetation is mature red alder and willows, starting at 20 feet wide and getting much wider in the downstream direction. Bank condition is good and overall spawning and rearing habitat quality is rated as good.

Upstream from the crossing, between NE 20th Street and NE 21st Street, the stream has a meandering character, forming a few good pools; at the pools, the banks are undercut. There is a riffle with clean gravel of a size suitable for trout but not salmon. The riparian community on the west side of the creek is almost entirely blackberries with some small alders mixed in. The riparian community on the east side is mostly reed canarygrass, with a few blackberry patches. A mayfly hatch occurred while the survey was being conducted. Mayflies are an indicator of better water quality conditions. Overall, this reach is fairly good spawning and rearing habitat due to in-stream characteristics.

NE 16th At-Grade (D2A), NE 16th Elevated (D2E), and SR 520 (D5) Alternatives Crossing. The reach downstream from SR 520 is confined between a building and a parking lot. The entire reach is a shallow, featureless glide with a sand/silt bottom. There are no pools, riffles, or large woody debris (LWD). The riparian community is mostly mowed grasses with building structure or asphalt within 10 to 20 feet of the channel. Part of the reach has a 10-foot-wide cluster of willows on the west side of the channel. Overall spawning and rearing habitat quality is poor. The 200-foot-wide assessment area around the alternative centerline does not extend beyond the northern side of SR 520.

Sears Creek

Sears Creek is a small drainage of 577 acres. Most of the drainage's surface water is conducted in piped systems, with only a small fraction in an open channel. Although the basin is 1.5 miles long, the length of open channel is only about 1,100 feet. The basin is 64 percent impervious surface and the average slope in the basin is 4.3 percent. Considerable use by Chinook salmon, coho salmon, and cutthroat trout occurs up to the Bel-Red Road culvert. Spawning by Chinook and coho salmon has been reported below NE 20th Street.

NE 20th Alternative (D3) Crossing. D3 crosses Sears Creek at NE 20th Street. The culvert under NE 20th is approximately 450 feet long. The outlet is about 150 feet downstream from the street and about 8 to 10 feet lower than the street. The owner of a nearby business reported that the outlet blocks fish passage based on the accumulation of salmon that occurs when spawners are present. The stream in this reach is tightly confined between NE 21st Street and a parking lot for a strip mall; NE 21st Street is only about 15 feet from the channel and the parking lot is only 3 to 5 feet from the channel. The riparian zone is composed of bare, bark-mulched ground and a few small scattered alders and blackberries. The banks in this reach consist entirely of riprap. Despite these deficiencies, the reach was rated as fair spawning and rearing habitat quality because there are several pools formed intentionally with riprap boulders, and there are patches of clean gravel in short riffles. Although the channel is straight, there is a fair amount of channel complexity.

3.1.2.5 Segment E

Exhibit 3-5 shows the streams and fish passage features in Segment E.

Sammamish River

The Sammamish River is 13.8 miles long, extending from the outlet of Lake Sammamish in Redmond to the inlet of Lake Washington in Kenmore. The basin drains 240 square miles, of which 97 are in the Lake Sammamish basin, 50 in the Bear Creek basin, and the balance in the Swamp Creek, North Creek, and Little Bear Creek basins. The Sammamish River once looked very different from how it does today. Prior to Euro-American settlement, the Sammamish River was twice as long and had a complex, highly sinuous, meandering channel with abundant associated forested wetlands. Lake Washington backwatered much of the lower river. The area was logged from the 1870s through the early 20th century. When Lake Washington was lowered by 10 feet in 1916, the overall gradient in the Sammamish River was increased accordingly and many wetland areas were drained. As agriculture expanded in the Sammamish Valley, more wetlands were drained and turned into farmed fields. Farmers began to straighten the channel around 1911. In 1962, the USACE deepened and channelized the river to its present location.

At present, habitat in the Sammamish River is highly degraded. In the vicinity of the three potential river crossings, river character is essentially the same. Channel morphology is all glide habitat, which is one of the least desirable habitat types for salmonids. Glides make up 98.2 percent of the river's length (R2 Resource Consultants, 1999). When the river was dredged, all of the LWD was removed, and the only LWD present today were installed in a few locations. When the land was cleared, the riparian trees were removed as well. The current riparian community is composed primarily of Himalayan blackberries and reed canarygrass, both of which are non-native and invasive. The trees that are present are mostly young alders. This leaves the river highly exposed to sunlight, which causes high temperatures in the summer. The river is on Ecology's 303(d) list for violation of state temperature and oxygen standards. Substrate consists of sand and silt, and it probably never contained much gravel due to the low gradient and position below Lake Sammamish.

The Sammamish River provides little rearing and probably no spawning function for salmonids but serves as an important migratory corridor for tributaries. The river is known to seasonally contain Chinook salmon, coho salmon, sockeye salmon, and Kokanee salmon, steelhead, and cutthroat trout. Most of the sockeye are bound for Bear Creek and most of the Chinook are bound for the WDFW hatchery in Issaquah.

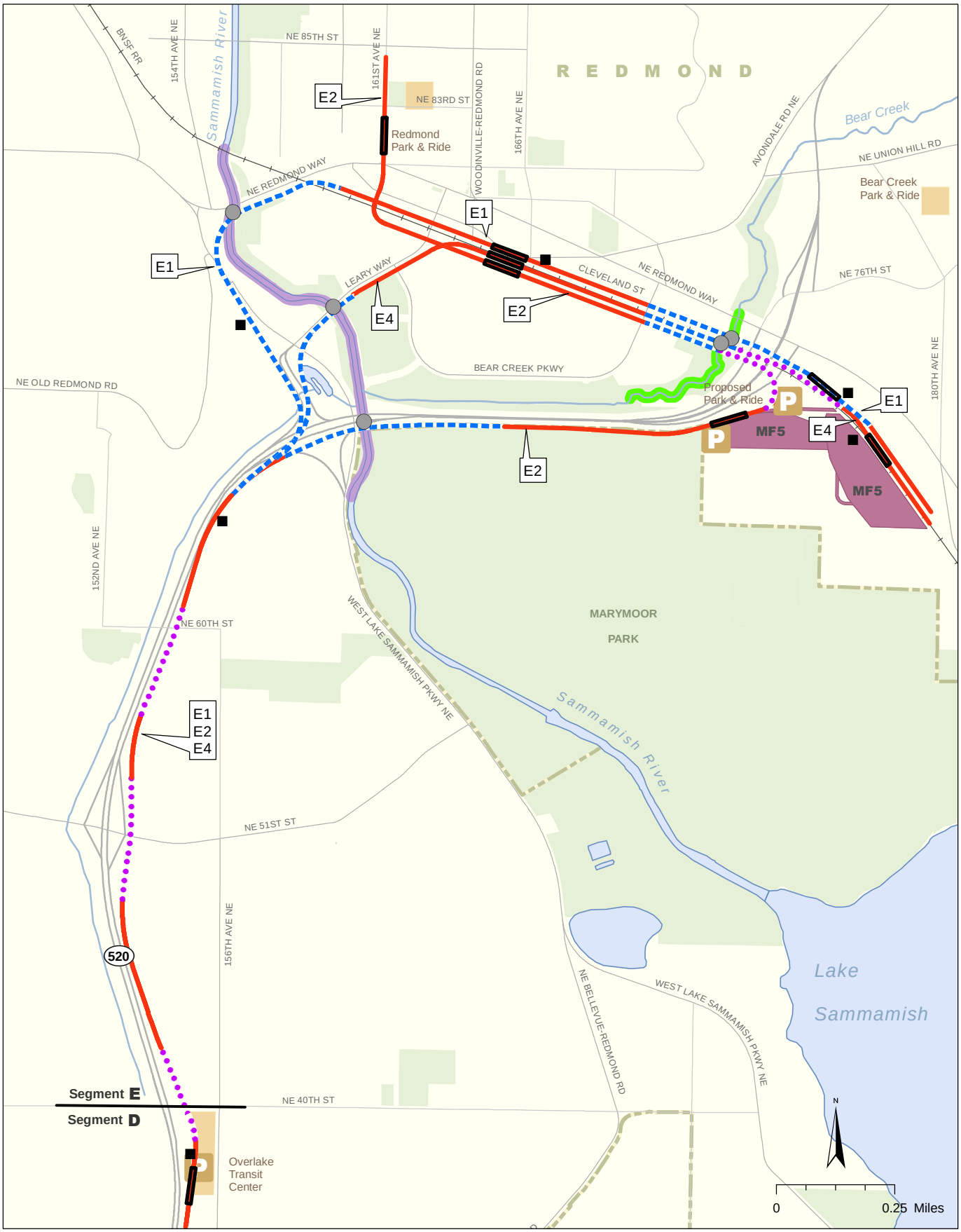
Redmond Way Alternative (E1) Crossing. This crossing is located on the upstream (south) side of the Redmond Way bridge. Habitat is all glide except for a short riffle on either side of a manmade gravel bar. The gravel bar is enhanced by two large rootwads. There are other log clusters on the banks as well. This has the appearance of a habitat enhancement project. The riparian zone is a narrow band of mixed deciduous trees on the west bank and a narrow band of blackberries or grasses on the east bank. Except for the gravel bar, bottom composition is sand and silt and overall spawning and rearing habitat quality is poor.

Marymoor Alternative (E2) Crossing. This crossing lies to the south and just upstream of the SR 520 bridge. Most of the habitat found in the vicinity of this crossing is glide, which is typical for the entire Sammamish River. The exception to this is upstream at the confluence of Bear Creek, where there is a large pool. Substrates are uniformly sand and silt except directly under the SR 520 bridge, where it is cobble and riprap. The banks under the bridge are also riprap. The riparian zone is about 30 to 50 feet wide and mostly vegetated by blackberries and young alders. There are some young conifer plantings on the north side of the bridge. Overall spawning and rearing habitat conditions are poor. Some afternoon shade would be provided in the future when the young riparian trees grow taller.

Leary Way Alternative (E4) Crossing. This crossing is located to the south and upstream of the Leary Way bridge. As elsewhere in the Sammamish River, glide habitat is dominant in this reach. However, there is a short man-made riffle composed of riprap on the north, downstream side of the existing bridge. Other than this artificial riffle, substrate is composed of sand and silt. The riparian zone is narrow with asphalt trails on either side of the river and has only 40 to 50 feet of width on steep banks. The riparian vegetation is composed almost entirely of blackberries with a few scattered small alders. Just upstream from the bridge, there is a group of larger red alder trees on the south bank that provides some afternoon shade. Overall spawning and rearing habitat quality in this reach is poor.

Bear Creek

The Bear Creek basin drains about 50 square miles of suburban and rural land. The basin has three subbasins: Bear Creek, Cottage Lake Creek, and Evans Creek. Throughout the basin, there are more than 100 miles of streams, nine lakes, and over 2,000 acres of wetlands. Urban development is spreading throughout the basin, with



Source: Data from CH2M HILL (2007), City of Redmond (2005), and King County (2006).

Bridge Stream Crossing

Stream Habitat Quality

- Good
- Poor

- Open Channel
- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Traction Power Substation
- Proposed Station
- Maintenance Facility
- City Limits

Exhibit 3-5 **Streams and Fish Passage Features Segment E**
East Link Project

an associated shift from forest to impervious surfaces and landscaped areas; yet, Bear Creek remains one of the most productive systems in the region. The diversity and number of aquatic resources in the Bear Creek basin distinguished it as one of the top six natural resource basins in King County in the Waterways 2000 Program (Kerwin, 2001).

The Bear Creek basin is known to support Chinook salmon, coho salmon, sockeye salmon, Kokanee salmon, steelhead, and cutthroat trout. The basin also might support bull trout, although none have been found to date. Spawner counts have not been made in the basin, but WDFW operates a smolt trap at the location of the potential rail crossing under the East Link Segment E alternatives. In 1999, the estimated number of smolt or fry outmigrants was 14,525 Chinook smolts, 1,772 steelhead smolts, 3,413 cutthroat smolts, and 1,514,669 sockeye fry. The count for coho in 1997 was 64,102 smolts (Seiler et al., 2000).

Redmond Way (E1), Marymoor (E2), and Leary Way (E4) Alternatives Crossing. The crossing of Bear Creek for the Redmond Way (E1), Marymoor (E2), and Leary Way (E4) alternatives is at the same location as the existing abandoned BNSF Railway timber bridge. Habitat in the vicinity is a mixture of pools and runs. Substrates are gravel and cobble. This is a known sockeye spawning area. The riparian zone upstream of the bridge is entirely blackberries. Downstream from the crossing, riparian vegetation on the north bank is medium-sized mixed conifer and deciduous trees. On the south bank, vegetation is patchy mixed conifer and deciduous trees and grassy areas that have been planted with willows and conifers. This area serves as an overflow channel/wetland area. It was built in association with a major channel relocation/habitat enhancement project downstream of the crossing. There are more than 100 logs with rootwads embedded in the banks of the meandering channel. Beaver activity is apparent, and the willow plantings are suffering from it. Habitat values of the riparian community will be good once the plantings have matured. Overall spawning and rearing habitat quality in this reach is good.

3.1.3 Tribal Fishing

Although there is no commercial fishing in the study area, Sound Transit consulted with the Muckleshoot Tribe about Usual and Accustomed Treaty Rights that provide tribes with unique fishing, hunting, and gathering rights. The tribe expressed concern about the effects of the project on their fishing event on Lake Washington, which typically occurs in July after consultation with WDFW. The tribes expressed no other fishing concerns.

3.1.4 Federal and State Threatened, Endangered, and Candidate Species

Table 3-4 lists the federal- and state-threatened, endangered, and candidate aquatic species known to occur in the study area. The following subsections describe the distribution of these species.

TABLE 3-4
Federal and State Threatened, Endangered, and Candidate Species Known to Occur in Study Area

Species	Federal Status	State Status
Puget Sound Chinook salmon	Threatened	Candidate
Puget Sound steelhead	Threatened	none
Coastal Puget Sound bull trout	Threatened	Candidate
River lamprey	Species of concern	Candidate
Western toad	Species of concern	Candidate

3.1.4.1 Puget Sound Chinook Salmon

Chinook salmon are present in a number of the larger streams in the study area. Their known distribution in the project vicinity is as follows:

- Lake Washington
- Kelsey Creek: At outlet, in Mercer Slough, and above study area
- West Tributary to Kelsey Creek: Up to Goff Creek
- Goff Creek: Up to Bel-Red Road
- Valley Creek: Up to the Bellevue Golf Course (above SR 520)
- Sears Creek: Up to NE 20th Street
- Sammamish River
- Bear Creek: In and north of the study area

3.1.4.2 Puget Sound Steelhead Trout

Steelhead trout are present in low numbers throughout the Lake Washington basin in the larger tributaries. Their known distribution within the study area is as follows:

- Lake Washington
- Mercer Slough
- Kelsey Creek: Currently not known to be present in the entire basin; their presence historically is probable
- Sammamish River: Throughout the study area and upstream
- Bear Creek: In and upstream from the study area

3.1.4.3 Coastal Puget Sound Bull Trout

Bull trout are only known to use Lake Washington and possibly tributaries as seasonal rearing areas. Spawning and early rearing areas have not been found to date. Such areas may be present, however, in upper tributaries to the Cedar River and possibly cold tributaries to Bear Creek.

3.1.4.4 River Lamprey

Although there are no direct observations of river lampreys in the study area, their presence is likely. They are known to exist in tributaries of Lake Washington and Lake Sammamish such as the Cedar River and Issaquah Creek.

3.1.4.5 Western Toad

Western toads (*Bufo boreas*) use three different types of habitat: breeding habitats, terrestrial summer range, and winter hibernation sites. Preferred breeding sites are permanent or temporary water bodies that have shallow sandy bottoms. After breeding, adult western toads disperse into terrestrial habitats such as forests and grasslands. They may roam far from standing water, but they prefer damp conditions. Western toads spend much of their time underground; although they are capable of digging their own burrows in loose soils, they generally shelter in small mammal burrows, beneath logs, and within rock crevices. They hibernate in burrows below the frost line, up to 3.6 feet underground. The PHS database for the study area did not have sighting evidence for the western toad. However, they are known to exist in the region and may be present in small numbers within the study area. Suitable habitats may exist in Mercer Slough; larger, low-gradient rivers and streams; and in adjacent undeveloped uplands.

3.1.5 WDFW Priority Habitats and Species

The list of WDFW priority species and habitats shown in Table 3-5 was obtained from the WDFW PHS database. The list was reduced to species documented or believed to be present in water bodies in the study area. Reports of green sturgeon *(Acipenser medirostris)* in Lake Washington are old. Channel catfish *(Ictalurus punctatus)* are rare and non-native. Only a few bull trout have been documented in Lake Washington, and they were observed entering the lake through the fish ladder at the locks.

TABLE 3-5
WDFW Priority Species and Habitats Occurring in Specific Water Bodies in Project Vicinity

Species	Present in Specific Water Body[a]										
	LW	MS	KC	StC	WT	GC	UT	VC	SrC	SR	BC
River lamprey (*Lampetra fluviatilis)*		X	X							X	X
Green sturgeon *(Acipense medirostris)*	X										
Channel catfish *(Ictalurus punctatus)*	X	X									
Longfin smelt (*Spirinchus thaleichthys)*	X										
Bull trout (*Salvelinus confluentus)*	X									Unk	Unk
Dolly Varden char (*S. malma malma)*	X									Unk	Unk
Chinook salmon (*Oncorhynchus tshawytscha*)	X	x	X		X	X		X	X	X	X
Coho salmon (*O. kisutch)*	X	X	X	X	X	X		X	X	X	X
Sockeye salmon (*O. nerka*)	X	X	X		X	X				X	X
Kokanee salmon (*O. nerka)*	X									X	X
Cutthroat trout (*O. clarki)*	X	X	X	X	X	X		X	X	X	X
Rainbow trout/Steelhead (*O. mykiss)*	X	X	X					X		X	X

TABLE 3-5
WDFW Priority Species and Habitats Occurring in Specific Water Bodies in Project Vicinity

Species	Present in Specific Water Body[a]										
	LW	MS	KC	StC	WT	GC	UT	VC	SrC	SR	BC
Western toad (*Bufo boreas)*	X	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk	Unk
Habitats											
In-stream	X	X	X	X	X	X	X	X	X	X	X
Riparian	X	X	X	X	X	X	X	X	X	X	X

[a] Water body codes: LW= Lake Washington; MS = Mercer Slough; KC = Kelsey Creek; StC = Sturtevant Creek; WT= West Tributary to Kelsey Creek; GC = Goff Creek; UT = Unnamed tributary to Kelsey Creek; VC = Valley Creek; SrC = Sears Creek; SR = Sammamish River; BC = Bear Creek.

Unk – Possible presence of species, but verification is unknown.

3.2 Upland Vegetation and Wildlife Resources

The urban nature of the project vicinity negatively affects species diversity, favoring species that can use altered environments and are more tolerant of human activity. However, the project vicinity also includes a few areas with larger, relatively intact habitats that support a wider array of wildlife species than is found in highly urbanized areas.

The investigation identified nine vegetation types, including wetlands and open water, within the East Link study area, using color aerial photographs and field verification. Table 3-6 provides descriptions of these vegetation types and examples of where they occur within the study area. Exhibits 3-6 to 3-9 show mapped upland vegetation types.

TABLE 3-6
Vegetation Types Identified in East Link Investigation

Vegetation Type	Examples of Occurrence	Description
Urban sparsely vegetated	Landscaping along highways	Commercial and industrial properties, road rights-of-way, and neighborhoods with a few or small patches of ornamental and native trees and considerable human activities.
Urban moderately vegetated	Areas of parks that have been planted with trees and shrubs, as in Marymoor Park	Dominated by open mowed lawns. Large native and ornamental trees (generally 40 to 70 feet tall) also present. Some patches of ornamental and native shrubs may occur. Tree and shrub canopy cover values generally less than 30 percent.
Urban mostly vegetated – coniferous forest	West side of Bellevue Way	Forest patches generally dominated by Douglas fir with lesser amounts of black cottonwood, big-leaf maple, red alder in the overstory. Occasionally shore pine and red cedar. Canopy cover variable but generally greater than 40 percent. Douglas firs mostly more than 50 feet tall. Shrub layer often dominated by Himalayan blackberry but also includes salmonberry, snowberry, salal, Indian plum, rhododendron, and others. Herb layer, when present, includes grasses, sword fern, fringe cup, and nettles.
Urban mostly vegetated – deciduous forest	East side of Bellevue Way	Forest patches with black cottonwood, big-leaf maple, red alder (40 to 70 feet tall) and few conifers in the overstory. Canopy cover 40 to 80 percent. Understory tree cover may include big-leaf maple, black cottonwood, red alder, and Pacific madrone. Shrubs similar to those of coniferous forest type.
Urban mostly vegetated – Mixed deciduous / coniferous forest	East side of the BNSF Railway	A few small areas with a roughly even mix of deciduous trees and conifers in the overstory.
Wetland	Mercer Slough Nature Park	Generally dominated by sapling-shrub layer of red alder, willow, black cottonwood, Himalayan blackberry, and red elderberry. Some black cottonwoods and big-leaf maples 30 to 50 feet tall. Other sites dominated by emergent species such as common cattail and reed canarygrass. A Labrador tea and willow shrub dominated bog is located in the central portion of Mercer Slough Nature Park. The southern portions of Mercer Slough are dominated by reed canarygrass with scattered shrub patches of dogwood and willow. Overall, the presence of an herb layer is dependent on the density of the shrub layer.

TABLE 3-6
Vegetation Types Identified in East Link Investigation

Vegetation Type	Examples of Occurrence	Description
Riparian forest	South end of Mercer Slough Nature Park	Vegetated banks along river edges. Often dominated by willow and red alder. Large big-leaf maple, black cottonwood, and red alder trees may occur. Non-native shrubs (Himalayan blackberry and Scot's broom), grasses, thistles, and other weeds are common. Areas dominated by blackberry were classified separately from riparian forest because of the much lower habitat value of blackberry-dominated areas.
Blackberry	Along roads and highways	Areas dominated by blackberry with little or no tree canopy
Open water	Lake Washington	Highly variable community including saline and fresh waters, deep or shallow waters, rivers, creeks, and large water bodies.

The relative function of each plant community in providing habitat for wildlife are described based on reconnaissance-level field observations, literature review (including *Wildlife-Habitat Relationships in Oregon and Washington* [Johnson and O'Neil, 2001]), professional opinion, and agency consultation. The following habitats provide the highest upland (non riparian or wetland) habitat value:

- Urban mostly vegetated – coniferous forest
- Urban mostly vegetated – deciduous forest
- Urban mostly vegetated Mixed deciduous / coniferous forest
- Riparian forest

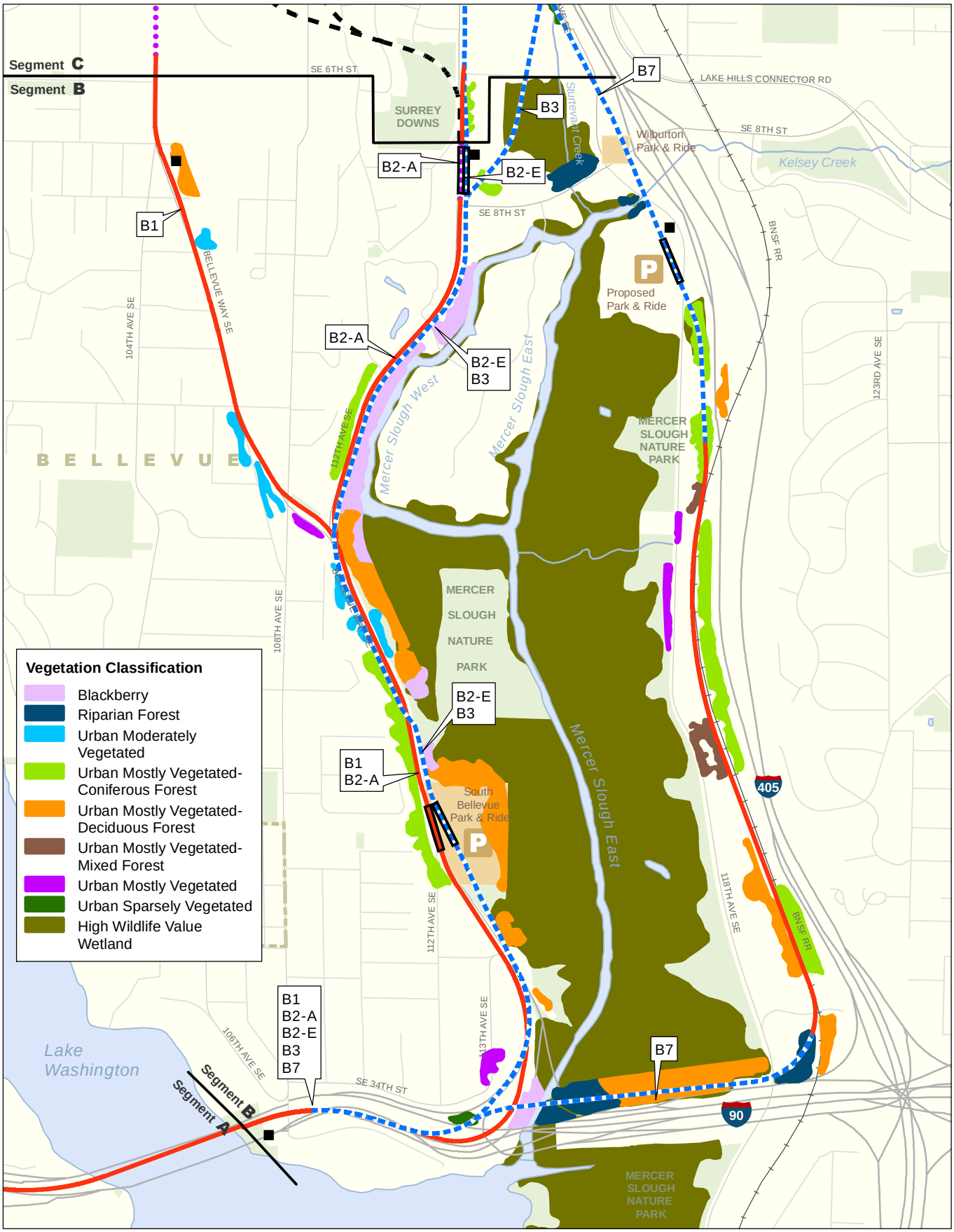
Lists of observed plants and observed or expected wildlife species are presented in the report as well.

3.2.2 Beneficial Habitats

Wildlife use of urban habitats depends on the general location of the habitat, the size and type of undisturbed habitats, the degree of connectivity and extent of travel corridors between and among these habitats, and the types and levels of human activity. Much of the East Link Project occurs in commercial, industrial, and residential areas that provide habitat only for adaptable species such as sparrows, finches, doves, rats, mice, raccoons, opossums, and squirrels. Larger habitat patches and those connected to other natural areas or heavily vegetated residential neighborhoods support a larger variety of species including several species of songbirds, black-tailed deer, and raptors including American kestrel *(Falco sparverius)*, red-tailed hawk *(Buteo jamaicensis)*, and great horned owl *(Bubo virginianus)*. Species such as the American robin *(Turdus migratorius)*, song sparrow *(Melospiza melodia)*, Steller's jay *(Cyanocitta stelleri)*, American crow *(Corvus brachyrhynchos)*, spotted towhee *(Pipilo maculates)*, black-capped chickadee *(Poecile atricapillus)*, white-crowned sparrow *(Zonotrichia leucophrys)*, northern flicker *(Colaptes auratus)*, Bewick's wren *(Thryomanes bewickii)*, and red and white breasted nuthatches *(Sitta spp.)* are also fairly common. Streams and larger water bodies provide habitat for many waterfowl species, including Canada goose *(Branta canadensis)*, belted kingfisher *(Megaceryle alcyon)*, red-breasted merganser *(Mergus serrator)*, common merganser *(M. merganser),* western grebe *(Aechmophorus occidentalis)*, double-crested cormorant *(Phalacrocorax auritus)*, mallard *(Anas platyrhynchos)*, lesser scaup *(Aythya affinis)*, American coot *(Fulica Americana)*, as well as many of the species associated with wetlands.

There are several large areas of native habitat in East Link Project study area, the largest of which is Mercer Slough Nature Park. However, this park is surrounded on all sides by residential and commercial developments, roads, and highways, which limits its value for wildlife species that require large undisturbed areas and undeveloped travel corridors.

Patches of deciduous, coniferous, and mixed forests occur in Segments B, D, and E. Most of these areas are fragmented and separated from surrounding habitat areas by commercial, urban, and residential developments and roads. Despite their isolation, these areas still provide habitat for forest-associated resident and migratory songbirds, as well as for hawks, owls, great blue herons *(Ardea herodias)*, woodpeckers, reptiles, and small mammals. These areas include the Mercer Slough I-90 wetland (WR-4) in Segment B, the forested area located in the southern portion of the BNSF Matrix wetland (WR-6) in Segment D, the Redmond Center forest in Segment E, and small forested patches along SE Leary Way and West Sammamish Parkway in Segment E. These habitat areas



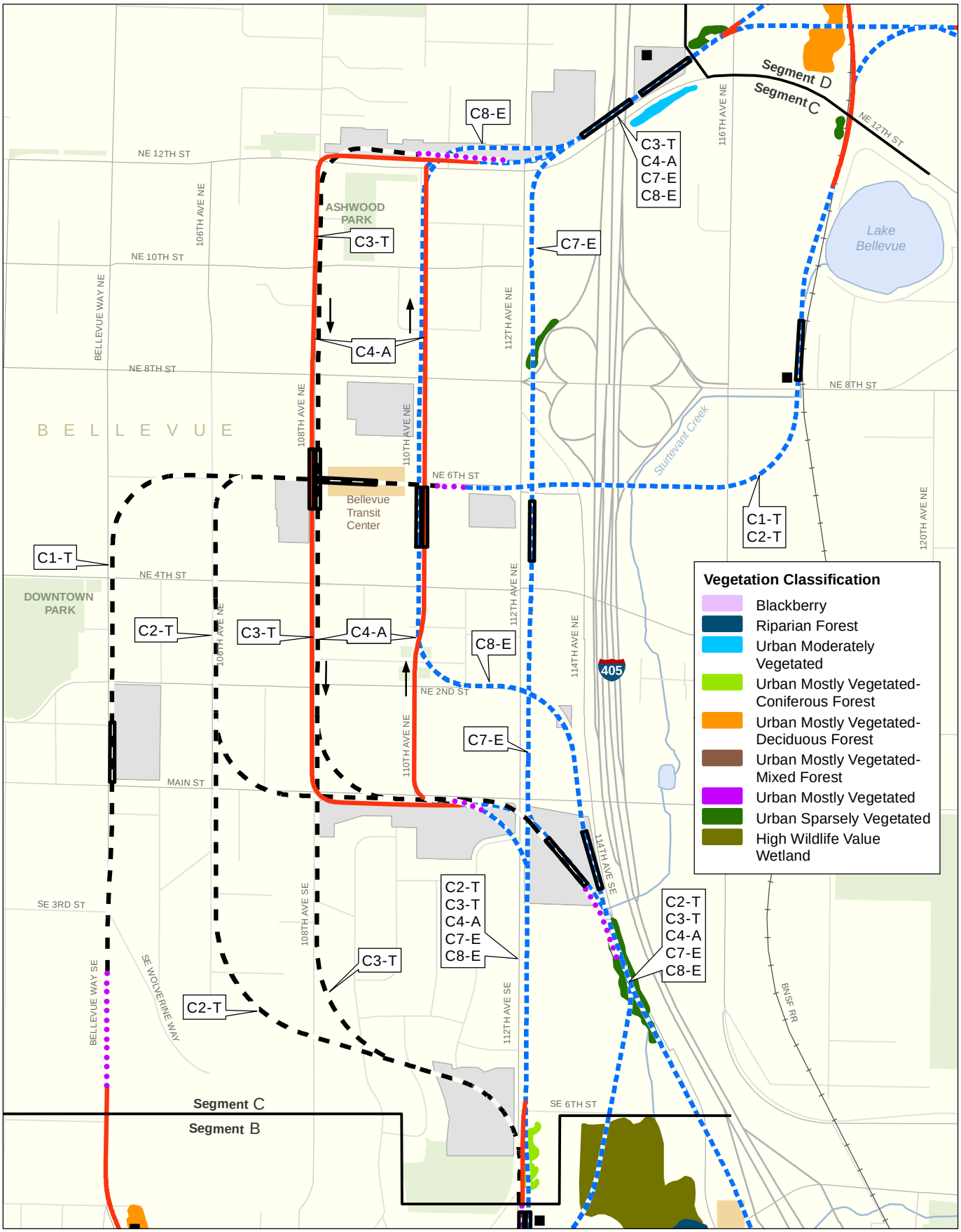
Source: Data from City of Bellevue (2005), King County (2006), NWI USFWS (2006) modified by CH2M HILL; CH2M HILL (2007).

- Route At Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Proposed Station
- City Limits

0 0.25 Miles

N

Exhibit 3-6
Vegetation and Wildlife Habitat
Segment B
East Link Project



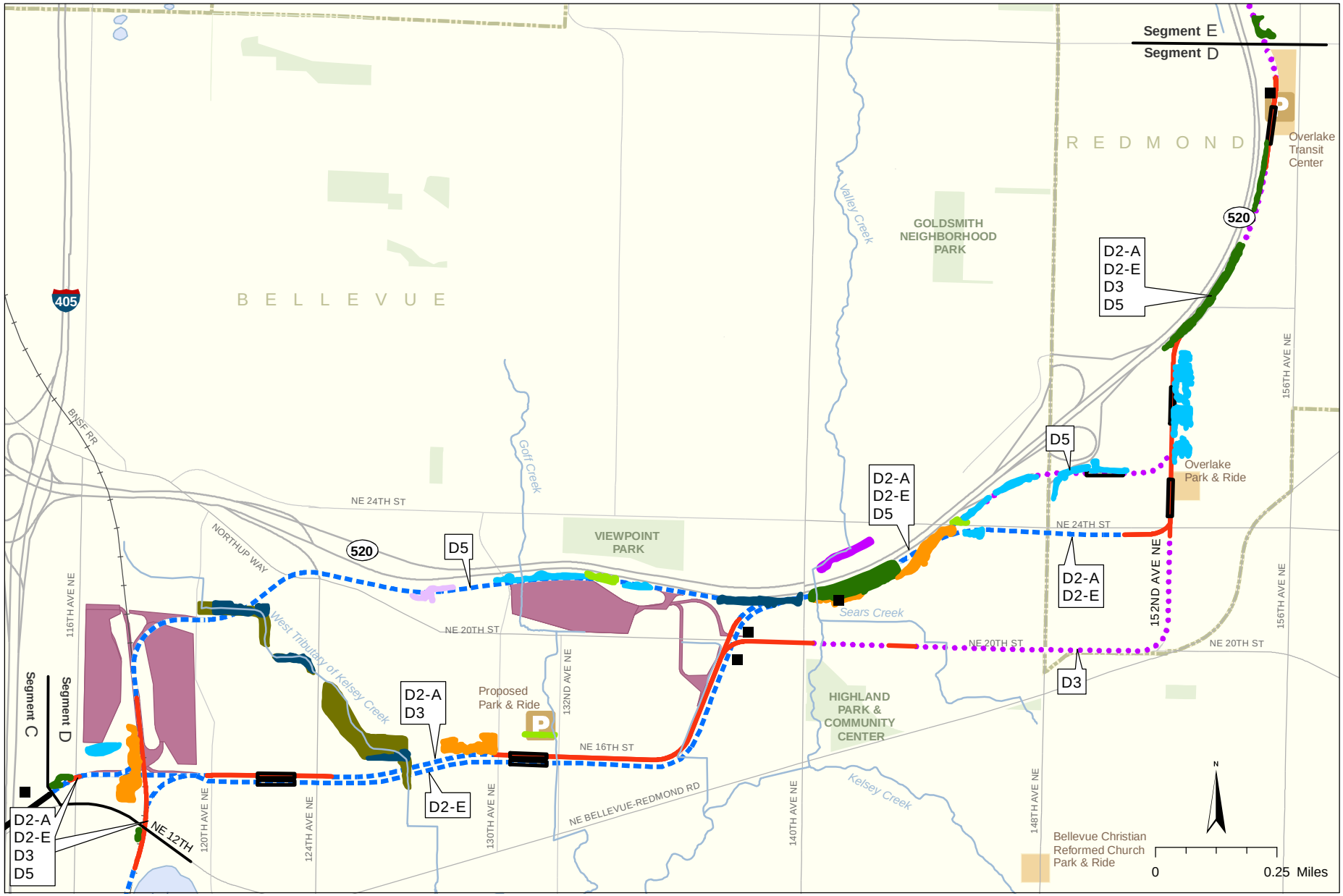
Source: Data from City of Bellevue (2005), King County (2006), NWI USFWS (2006) modified by CH2M HILL; CH2M HILL (2007).

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Proposed Station
- Tunnel Staging Area
- City Limits

N

0 0.125 Miles

Exhibit 3-7
Vegetation and Wildlife Habitat
Segment C
East Link Project

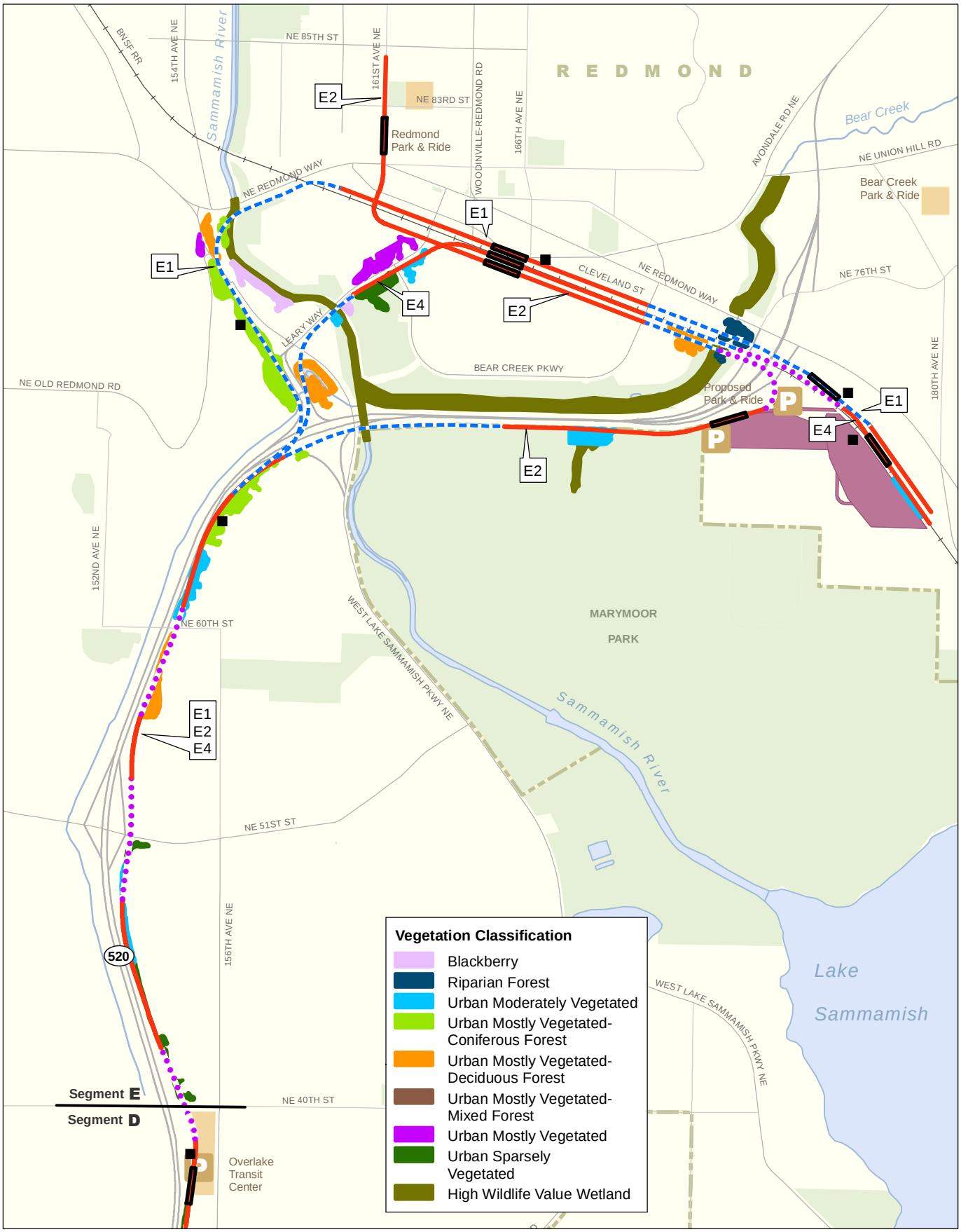


Vegetation Classification

- Blackberry
- Riparian Forest
- Urban Moderately Vegetated
- Urban Mostly Vegetated-Coniferous Forest
- Urban Mostly Vegetated-Deciduous Forest
- Urban Mostly Vegetated-Mixed Forest
- Urban Mostly Vegetated
- Urban Sparsely Vegetated
- High Wildlife Value Wetland
- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel
- Traction Power Substation
- Maintenance Facility
- Proposed Station
- City Limits

Source: Data from City of Bellevue (2005), City of Redmond (2005), King County (2006), NWI USFWS (2006) modified by CH2M HILL; CH2M HILL (2007).

Exhibit 3-8
Vegetation and Wildlife Habitat
Segment D
East Link Project



Source: Data from City of Redmond (2005), King County (2006), NWI USFWS (2006) modified by CH2M HILL; CH2M HILL (2007).

Route at Grade
Elevated Route
Route in Retained Cut
Route in Tunnel
Traction Power Substation
Proposed Station
Maintenance Facility
City Limits

N
0 0.25 Miles

Exhibit 3-9
Vegetation and Wildlife Habitat
Segment E
East Link Project

are described below and shown in Exhibits 3-6 to 3-9 and Exhibits 3-1 to 3-5 in Section 3-1. Many of these sites are recognized as WDFW priority habitats.

3.2.2.1 Segment A

Lake Washington supports a wide variety of aquatic and semi-aquatic fish and wildlife species. More than 15 species of waterfowl use the lake at different times of the year. It is also used by foraging bald eagles *(Haliaeetus leucocephalus)*, osprey, peregrine falcons *(Falco peregrinus)*, and great blue herons, among many other species.

3.2.2.2 Segment B

Mercer Slough Nature Park in Segment B is the largest freshwater wetland remaining along the shores of Lake Washington. The park encompasses 320 acres and is composed of herbaceous, scrub-shrub, and forested wetlands; upland forests; meadows; a scrub-shrub bog; and a blueberry farm. More than 170 bird species are listed as breeding, foraging, or migrating through the park. Amphibians, reptiles, and a number of small mammal species, including red-winged blackbird *(Agelaius phoeniceus)*, yellow-rumped warbler *(Dendroica coronata)*, common yellowthroat *(Geothlypis trichas)*, violet-green swallow *(Tachycineta thalassina)*, cliff swallow *(Petrochelidon pyrrhonota)*, barn swallow *(Hirundo rustica)*, Anna's hummingbird *(Calypte anna)*, and several species of wading birds, in addition to several bat species, are also found within the park's boundaries. Red-tailed hawks and great blue herons are also regularly seen in this area.

3.2.2.3 Segment D

Wetlands with some ponding water and riparian areas with small-stemmed emergent vegetation provide habitat for amphibians. In Segment D, these areas include Kelsey Creek Ponded (WR-7), Kelsey Creek Riparian (WR-8), East of 140th Avenue NE (WR-10), West of 140th NE (WR-11), and BNSF Matrix (WR-6) wetlands.

The Kelsey creek runs through the study area, eventually merging into Mercer Slough just west of I-405 in Bellevue. Kelsey Creek is surrounded by commercial and urban development for most of its length. A water control feature at the Metro bus maintenance facility off of 124th Avenue NE creates a large ponded area before the creek exits the other side of the road. An active beaver dam is located just upstream from the water control device in a forested riparian corridor, dominated by deciduous trees. The habitat just downstream from the water control device is a mixed emergent, scrub-shrub, and riparian area. This area supports breeding and migratory songbirds and waterfowl and likely supports amphibians and small mammals.

3.2.2.4 Segment E

The Sammamish River (also known as Sammamish Slough) is bordered by a mowed grass park with widely planted ornamental trees to the east and by roads and residential and commercial development to the west. The riparian corridor south of the NE Redmond Way Bridge is dominated by Himalayan blackberries from the top of the bank down to the water's edge. Although the bank offers little habitat for wildlife, the watercourse is still used by a variety of waterfowl. Canada geese, mallards, great blue herons, and double-crested cormorants were observed in the slough during visits in May 2007. Signs of beaver activity were also observed along the slough near the NE Redmond Way Bridge. South of the SR 520 bridge, a red-breasted merganser, common merganser, belted kingfisher, and lesser scaup were observed during site visits conducted in mid-April 2007. In addition, approximately 36 double-crested cormorants use two cottonwood trees behind SE Leary Way as a winter roost. The roost is located just above the western bank of the Sammamish River.

There is a relatively large coniferous forested area located adjacent to SE Leary Way and the Sammamish River. The Redmond Center heronry was located in this forested section until its abandonment in 2004 due to bald eagle harassment and the increase in development immediately adjacent to the forest stand. The forest is dominated by Douglas-fir trees and has an understory of Indian plum and Himalayan blackberry.

Beaver and other small mammals, as well as woodpeckers, forest- and wetland-associated songbirds, common waterfowl, hawks, and owls occur along Bear creek and its associated riparian habitats. Special status avian species observed at Bear Creek include great blue heron, osprey, and bald eagle. One or more bat species may forage in and around the creek and riparian area. A restoration project along the banks of Bear Creek exists downstream from the proposed light rail crossing of the creek. Non-native vegetation has been removed and replanted with native shrubs and tree saplings.

Marymoor Park was once part of the floodplain of Lake Sammamish. Currently, the Sammamish River runs through a portion of the park and enters Lake Sammamish at the southern boundary of the park. Marymoor Park is 640 acres and has a variety of habitats, including herbaceous, scrub-shrub and forested wetlands, riparian corridors, mature deciduous upland forests, and grassy fields. Two bald eagle nests, an osprey nest, and a red-tailed hawk nest are located within the park's boundaries. Three pairs of red-tailed hawks were observed at several locations at Marymoor Park during the vegetation surveys conducted in April 2007. More than 195 bird species have been recorded, primarily breeding and migratory songbirds and waterfowl. Reptiles and a variety of small mammals and deer also occur in the park. Although habitat exists within its boundaries for several bat species, none is listed as occurring at Marymoor Park and no formal bat surveys have been conducted. Salmon spawn in the river, and during the salmon spawning runs, groups of juvenile bald eagles congregate in Marymoor Park along the Lake Sammamish shoreline. Approximately 31 juvenile bald eagles were counted one evening in September 2006. A small mitigation wetland is located on the northern end of the park, abutting the park's boundary with SR 520.

3.2.3 Washington Department of Fish and Wildlife Priority Habitats and Vegetation Types

Table 3-7 lists the types of WDFW-designated priority habitats that occur in the East Link study area and the location of key habitats.

TABLE 3-7
WDFW Priority Habitats That Occur in East Link Study Area

WDFW Priority Habitat Type	WDFW Criteria for Designation as a Priority Habitat Type	Corresponding East Link Vegetation Types and Locations[a]
Freshwater Wetlands and Fresh Deepwater	Comparatively high fish and wildlife density, high fish and wildlife species diversity, important fish and wildlife breeding habitat, important fish and wildlife seasonal ranges, limited availability, high vulnerability to habitat alteration	Wetland and open water including Lake Washington (A1) and much of Mercer Slough Nature Park (B1, B2A, B2E, B3, B7)
In-stream	Comparatively high fish and wildlife density and species diversity, important fish and wildlife seasonal ranges, limited availability, high vulnerability to habitat alteration, dependent species	Kelsey Creek, West Tributary of Kelsey Creek, Valley Creek (D2A, D2E, D3, D5) Goff Creek (D5) Bear Creek and Sammamish River (E1, E2, E4)
Riparian	High fish and wildlife density, high fish and wildlife species diversity, important fish and wildlife breeding habitat, important wildlife seasonal ranges, important fish and wildlife movement corridors, high vulnerability to habitat alteration, unique or dependent species	Riparian areas along: - Mercer Slough (B7) - West Tributary of Kelsey Creek (D2A, D2E, D3, D5) - Bear Creek (E1, E2, E4)
Urban Natural Open Space	Comparatively high fish and wildlife density, high fish and wildlife species diversity, important fish and wildlife breeding habitat, important fish and wildlife movement corridors, limited availability, high vulnerability to habitat alteration	Urban mostly vegetated – coniferous forest and deciduous forest (B1, B2A, B2E, B3, B7)

Source: WDFW Priority Habitats and Species (http://wdfw.wa.gov/hab/phshabs.htm)

[a]Alternative Designations:
A1 = I-90
B1 = Bellevue Way
B2A = 112th SE At-Grade
B2E = 112th SE Elevated
B3 = 112th SE Bypass
B7 = BNSF
D2A = NE 16th At-Grade
D2E = NE 16th Elevated
D3 = NE 20th
D5 = SR 520
E1 = Redmond Way
E2 = Marymoor
E4 = Leary Way

3.2.4 Federal and State Threatened, Endangered and Candidate Species, Species of Concern

Other than the aquatic species discussed in Section 3.1 of this report, there is one ESA-listed species (marbled murrelet *[Brachyramphus marmoratus]*), which is listed but not likely present, and four federal candidate or species of concern that are likely to be present in the study area. These are described herein. Other state-priority species known or likely to be present in the study are identified in Table 3-8. Appendix C lists the ESA-listed and state-priority species that are known in the study area and that are likely present and possibly present within the project vicinity based on the known or general distribution of the species, their habitat preferences, and the

presence of potentially suitable habitat for the species. This report does not discuss those species "possibly present" other than by way of addressing the high-value habitats that may be suitable habitat for these species.

Site-specific distribution data are available for only a few of these species, and no species-specific surveys or habitat assessments were conducted for this project. The USWFS Threatened and Endangered Species System web site for species and habitats listed in King County indicated that there is a federally threatened wildlife species under the ESA: the marbled murrelet. ESA-listed fisheries resources that may potentially occur within the study area are addressed in Section 3.1, Aquatic Resources, of this report. Database searches indicated that there are no federal-listed and no state-listed plants in the study area. Based on the available known and general distribution data, habitat requirements and habitats present in the vicinity of the study area, no priority terrestrial small mammal, large mammal, reptile, or insect species other than butterflies occur or are likely to occur within a half mile of any of the project segments.

TABLE 3-8
State Priority Species Likely or Known to Occur in East Link Study Area

Name	State Status[a]	Presence, Preferred Habitat, and Probable Location in Study Area
Bird		
Pileated woodpecker (*Dryocopus pileatus*)	State candidate	**Known in the study area.** Typically found in forests with a component of dead and dying trees and snags for foraging and nesting. Found at Marymoor Park and throughout the study area. One bird observed near I-405 south of SE 8th Street. Likely habitat along the BNSF (B7) and Marymoor (E2) alternatives due to larger clusters of larger trees and snags.
Purple martin (*Progne subis*)	State species of concern	**Known in the study area.** Nests in structures over water bodies, including natural cavities, pilings, and man-made housing structures. Forages over open water or wet areas for insects while in flight. Nesting observed at Marymoor Park in 2003 (Alternative E2), but no activity since. Habitat may also be present in Segment B.
Western grebe (*Aechmophorus occidentalis*)	State species of concern	**Known in the study area.** Nests in colonies numbering up to several hundred birds east of the Cascade Mountain Range and is a winter resident on Lake Washington and Puget Sound The highest likelihood of occurrence is in Segment A.
Merlin (*Falco columbarius*)	State species of concern	**Likely present in the study area.** Seen during the nesting season at Marymoor Park. Commonly found throughout western Washington, including urban areas, in winter and during migration. May occur in Segments A, B, D, and E.

[a] Washington priority species include only native Washington fish and wildlife species that are listed as endangered, threatened, or sensitive, or as candidates for these designations as established in the Washington Administrative Code.

3.2.4.1 Marbled Murrelet

The marbled murrelet is listed as a federal and state threatened species and may occur in Segment A. The population is rapidly declining, and the USFWS has determined that the population is currently not self-sustaining (Csuti, et al., 1991; Ralph, et al., 1995; Wahl, et al., 2005). During the nonbreeding season, marbled murrelets are rare and infrequent visitors to Lake Washington that have been observed on the lake in the past but have not been documented to use the lake since the early 1990s and are not expected to be in the project vicinity. Therefore, no impacts are expected

3.2.4.2 Bald Eagle

Bald eagles were listed as threatened under the ESA until July 2007, when they were delisted because of the success of recovery efforts. However, bald eagles are still protected by two other federal laws: the Bald and Golden Eagle Protection Act and the MBTA. Both laws prohibit killing, selling, or otherwise harming eagles, their nests, or eggs. On June 5, 2007, the USFWS clarified its regulations implementing the Bald and Golden Eagle Protection Act and published a set of National Bald Eagle Management Guidelines. These actions are designed to give landowners and others clear guidance what actions they take on their property are consistent with the Bald and Golden Eagle Protection Act and the MBTA. The Bald Eagle Protection Act requires the establishment of rules defining buffer zones around bald eagle nest and roost sites. If the activity is within a half mile of an eagle nest or within a quarter mile of an eagle roost, WDFW is notified and works with the landowner to develop a Bald Eagle Management Plan (see WAC 232-12-292, Section 4.4).

There are no communal bald eagle roosts, winter concentration areas, or buffers for such areas within a half mile of any of the proposed alternatives or project elements. However, there are five active eagle territories located within a half mile of one or more of the alternatives (eagle territories vary in size depending upon the amount of food available and the density of eagles in the area). Three of the territories were known to be active with incubating adults in April 2007. The other two territories were active in 2006, but their status for 2007 is unknown.

Bald eagles have strong site fidelity, so it is likely the birds are still within their territories and may have built new nests nearby. Therefore, all five nesting territories were included in this analysis. Table 3-9 shows the location of bald eagle nests in relation to the project alternatives and the results of the VIEWSHED analysis.

Four bald eagle nests are located either on the shoreline of Lake Washington or near the lake. Bald eagles are sighted in Segments A, B, and E. WDFW and the bald eagle recovery plan designated 800-foot-wide buffers around nests and shoreline foraging areas (see Appendix D for detailed WDFW management recommendations). The USFWS also designated larger territories around bald eagle nests and foraging areas. The buffers and territorial designations include relatively large areas of Lake Washington shoreline. None of the alternatives is located within any of the 800-foot-wide nest or shoreline buffers. The I-90 (A1), Bellevue Way (B1), 112th SE At-Grade (B2A), 112th SE Elevated (B2E), 112th SE Bypass (B3), and BNSF (B7) alternatives are within the larger territories of three nests.

There is an additional bald eagle nest located just over a half mile from SR 520 and the Marymoor Alternative (E2). This nest is very hard to see because it is hidden in a fork in a large maple or cottonwood tree in a densely forested area of Marymoor Park. Neither the highway nor the Marymoor Alternative (E2) would be visible from this nest site because of its location below the top of the forest canopy and the dense surrounding forest.

As many as 33 bald eagles, all but 2 of them juveniles, and several herons have been reported foraging along the shore of Lake Sammamish during the fall period (Norman, 2007b). The shortest distance between the study area and Lake Sammamish is about 0.75 mile and there is no direct line of sight between the lake and the study area. Bald eagles are suspected of foraging for salmon along Bear Creek during the fall and winter.

TABLE 3-9
Location of Bald Eagle Nests in Relation to Project Alternatives, Visibility from Nests, and Distance from Nest to Alternative

WDFW PHS Bald Eagle Nest Number	Segments Within Half Mile of Nest	Shortest Distance, Nest to Segment (miles)	Segments Likely Visible from Nest	Minimum Distance to Visible Part of Segment (miles)	Area Visible from Nest
4712252059	A1, I-90	0.4	I-90 (A1)	0.4	Short sections of Mercer Island
4712252952	A1, I-90	0.6	I-90 (A1)	0.6	Short sections of Mercer Island
4712252056	A1, I-90 B1, Bellevue Way	0.5	I-90 (A1)	0.5	Much of Mercer Island
4712252017	B1, Bellevue Way	0.5	None	> 1	Much of Mercer Island and east quarter of Lake Washington
4712261026	E1, Redmond Way E4, Leary Way	0.5	None	> 1	None

3.2.4.3 Peregrine Falcon

Peregrine falcons are a federal-species of concern and state-monitored species. The WDFW PHS database indicates that there are three peregrine falcon eyries within a half mile of the study area. One is located under the I-90 floating bridge across Lake Washington just above the Seattle shoreline, and the second is located under the West Channel Bridge on the Mercer Island side. WSDOT has indicated that there has not been a recorded successful nest under the I-90 floating bridge for the past 2 years. The nest under the Channel Bridge has been successful for the past 3 to 4 years and is expected to remain successful until the adults die. The third nest is located in Downtown Bellevue. Sightings and potential viable habitat occur in Segments A, B, and E.

3.2.4.4 Olive-Sided Flycatcher

The olive-sided flycatcher (*Contopus borealis*) is a federal species of concern. It nests in coniferous forest and mixed coniferous-deciduous forests and woodland, often with service berry and mountain-mahogany. They also are attracted to burned-over areas with standing dead trees. Most nesting sites contain dead standing trees, which are used as singing and feeding perches. The cause of precipitous declines in populations across known distributions is not fully understood. The small brood size, climate changes, deforestation in wintering areas, and declines in insect populations may all play a role in olive-sided flycatcher decline. It breeds in coniferous forests in North America. Common in most forest openings throughout Washington and sometimes found in city parks or suburban areas, especially during migration. The olive-sided flycatcher may have potential habitat in Segments B and E.

3.2.4.5 Willow Flycatcher

Willow flycatchers *(Empidonax traillii)* are a federal species of concern. Willow flycatchers are strongly tied to brushy areas of willow, alder, and similar dense stands of riparian shrubs, especially where such riparian areas are bordered by open stands of cottonwood. They prefer thickets, open second growth with brush, swamps, wetlands, stream sides, and open woodlands. Water and deciduous shrubs appear to be the essential habitat elements for nesting areas. This species is declining because of several factors, including loss of riparian vegetation cover from recreational uses and grazing pressure, and heavy nest parasitism by cowbirds. Water diversions and flood control that prevent willow and alder regeneration and deforestation on wintering grounds are also likely factors in long-term population instability. The willow flycatcher breeds in deciduous thickets, especially in willow thickets. Nest sites are often close to water. They are known to be present in Segments B and E.

3.2.5 Critical Area Ordinances

Title 21A of the GMA requires counties and cities in Washington to designate and protect critical areas, in accordance with RCW 36.70A.170. The GMA requires local jurisdictions to designate and protect critical areas, using the best available science in developing policies and regulations to protect critical area functions and values. The GMA is intended to protect the public's health and safety by requiring county and city governments to create locally based plans and regulations that are centered on land use and natural resource issues as guided by the state legislature. Critical areas are one of the two primary natural resource areas addressed in the GMA planning process. Critical areas include wetlands, critical recharge areas for potable water aquifers, frequently flooded areas, geological hazard areas, and fish and wildlife habitat conservation areas.

Fish and wildlife habitat conservation areas are the primary way the WDFW works to conserve wildlife habitat in Washington State. While WDFW is charged with protecting and maintaining fish and wildlife populations, WDFW has little authority over the habitats used by fish and wildlife species. Protection is primarily achieved through the voluntary actions of landowners and through existing state regulations, including the State Environmental Policy Act (SEPA), the GMA, the Forest Practices Act, and the Shoreline Management Act (SMA). WDFW primarily serves an advisory role, by reviewing proposals for development and offering guidelines for species management on private property. WDFW has written management guidelines for all state- and priority-listed species. Priority species include species and wildlife congregations that are priorities for conservation due to their population status, sensitivity to disturbance, and economic, recreational, or tribal importance. These species may or may not be listed as an endangered, threatened, sensitive, or candidate species by the state or federal government. The management recommendations are generalized guidelines and are not enforceable regulations, except through CAOs enforced by local jurisdictions.

In order to meet the requirements established by the GMA, King County and the cities of Bellevue, Mercer Island and Redmond created CAOs to ensure the management and protection of lands used by listed and locally important species. The details of these ordinances and management recommendations are available in Appendix E.

The following paragraphs summarize applicable ordinances within the study area:

Section 198 of the King County Comprehensive Plan requires the county to protect the active breeding sites of these species, as well as the immediate area surrounding each site to prevent any disturbance to breeding activities. The species include the bald eagle, great blue heron, osprey, peregrine falcon, northern spotted owl (*Strix occidentalis*), marbled murrelet, Townsend's big eared bat (*Corynorhinus townsendii)*, Vaux's swift, red-tailed hawk, and goshawk (*Accipiter gentilis*).

The **City of Mercer Island Comprehensive Land Use Plan** includes Ordinance No. 05C-12, which details its critical areas regulations. In order to streamline its critical areas regulations, the City of Mercer Island adopted WDFW's Priority Habitat and Species program in its entirety in 1998.

Under **Bellevue's Land Use Code 20.25H.025**, any habitat associated with a species of local importance is to be designated a critical area. Furthermore, if a habitat associated with a species of local importance is impacted by a proposed development, the proposal shall implement the WDFW wildlife management recommendations designed for that species. If the habitat does not include a critical area or critical area buffer, but is occupied by a locally important species, then only the guidelines in the wildlife management recommendations need to be

followed. Species of local importance include great blue heron, red-tailed hawk, bald eagle, peregrine falcon, osprey, pileated woodpecker, purple martin, common loon (*Gavia immer*), western grebe, merlin, great egret, green heron, Vaux's swift, Townsend's big-eared bat, and western toad.

The **City of Redmond's Critical Areas Ordinance** (Ordinance #2259) applies species protection to state species of concern, Priority species designated by WDFW, and locally important species. The only locally important species is the great blue heron.

3.3 Wetland Resources

Five major wetland complexes containing 13 wetlands were found in the study area and are discussed in Section 3.1. No wetlands were found in Segments A and C, so these segments are not included in exhibits or discussions of wetlands. Exhibits 3-10 through 3-12 illustrate the wetlands found in the study area. Most of these wetlands are associated with Mercer Slough, Kelsey Creek, or Bear Creek. In addition to these larger systems, several smaller wetlands were found in the study area in the vicinity of Valley Creek and near the BNSF Railway in the Bel-Red corridor. All wetlands in the study area have been altered and are surrounded by urban and residential environments.

3.3.1 Analysis of Wetland Determinations

3.3.1.1 Soils

The National Soil Survey Center's (NCCS) soil survey map for King County lists 20 soil series in the study area (Table 3-10). Of these 20 series, six are classified as hydric soils: Bellingham Silt Loam, Norma Sandy Loam, Puget Silty Clay Loam, Seattle Muck, Snohomish Silt Loam, or Tukwila Muck (USDA SCS, 1988).

TABLE 3-10
Soil Series Found within Sound Transit East Link Study Area

Soil ID	Soil Name and Description	Soil Location	Hydric?
AgC	Alderwood gravelly sandy loam 6 – 15% slope	Steep slope west of West Sammamish Parkway	No
AgD	Alderwood gravelly sandy loam 15 – 30% slope	118th Avenue SE	No
AmC	Arents, Alderwood material 6 – 15% slope	Bus parking lot	No
Bh	Bellingham Silt Loam	Between 152nd Avenue NE and 156th Avenue NE in Overlake	Yes
Ea	Earlmont silt loam	Along Bear Creek Parkway	No
EvB	Everett gravelly sandy loam 0 – 15% slope	Redmond	No
EwC	Everett-Alderwood gravelly sandy loams 6 – 15% slope	West of Bellevue Way	No
InA	Indianola loamy fine sand 0 – 4% slope	Along 520 in Redmond	No
KpB	Kitsap silt loam 0 – 8% slope	118th Avenue SE	No
KpC	Kitsap silt loam 8 – 15% slope	118th Avenue SE	No
KpD	Kitsap silt loam 15 – 30% slope	118th Avenue SE	No
No	Norma sandy loam	Downtown Bellevue	Yes
Ur	Urban land	Bellevue, Overlake, Redmond	No
Pc	Pilchuck loamy fine sand	On the upper banks of the Sammamish River	No
Pu	Puget silty clay loam	Bellevue, Redmond	Yes
Re	Renton silt loam	Segment C west of Lake Bellevue	No
Sk	Seattle muck	Kelsey Creek Riparian area, Mercer Slough	Yes
So	Snohomish silt loam	Southwest Mercer Slough	Yes
Su	Renton silt loam	By the horseshoe-shaped detention pond	No
Tu	Tukwila muck	BNSF Matrix Wetland and north of Sturtevant Creek	Yes

Source: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx.

All the hydric soils listed in Table 3-10 have a seasonal water table that reaches above or just below the surface. Runoff is slow for these soils and available water capacity is high. In addition, the hazard of stream overflow is severe. Soil descriptions can be found at the King County Conservation District web site (http://www.kingcd.org/pub_soil_des.html) and the USDA web site included in Table 3-10.

3.3.1.2 Vegetation

Non-native and aggressive native plant species dominate the wetlands within the study area. Non-native and aggressive native plant species tolerate many disturbances and can out-compete less-tolerant native species and thus dominate a wetland. This cycle lowers wetland diversity, habitat complexity, and the range and level of functions the wetland provides. Disturbances that can lead to wetland dominance by non-native and aggressive native plant species include altered water regimes, filling, and disturbance to soils. Non-native species that are dominant in the study area include Himalayan blackberry, evergreen blackberry *(Rubus laciniatus)*, reed canarygrass, and purple loosestrife *(Lythrum salicaria)*. Portions of Mercer Slough and Bear Creek, and the small Mercer Slough tributary is dominated by a solid Himalayan blackberry monoculture. The riparian emergent stratum at Sturtevant Creek is solid reed canarygrass that reaches nearly 4 feet in height. Native aggressive plant species include soft rush (*Juncus effusus*) and horsetail (*Equisetum arvense* and *E. telemateia*). Both of these species were present in most of the wetlands surveyed.

3.3.1.3 Hydrology

Signs of altered hydrology were evident throughout the study area. Along Segment B, portions of wetland that were once a part of the main Mercer Slough complex are separated by paved roads, office complexes, and medium-density residential communities. Hydrologic connection between these wetlands and Mercer Slough still exists via culverts that run beneath 118th Avenue SE as well as via groundwater movement. In addition, several wetland complexes have been created or enlarged due to human activities in the study area. Both drainage wetlands adjacent to Valley Creek in Segment D (WR-10 and WR-11) receive most of their source water from SR 520 runoff and other impervious surface runoff from surrounding office and retail buildings and parking lots. In Segment E, the Marymoor Park mitigation wetland (WR-13) was built in a historic floodplain area of Bear Creek. The surface and floodwater connection between the area south of SR 520 and Bear Creek, however, has been severed due to road and building construction in the Redmond area.

3.3.2 Wetland Descriptions

The following section describes the wetland complexes located in the study area by segment as illustrated in Exhibits 3-10 through 3-12 and listed in Table 3-11.

3.3.2.1 Segment B

Mercer Slough Complex and Subsites (WR-1 through WR-5)

The Mercer Slough wetland complex is located in the southwestern corner of Bellevue. One hundred and fifty years ago, Mercer Slough and its wetlands were a mix of swamps, marshes, and shallow watered areas along Lake Washington. When the Lake Washington Ship Canal and Chittenden Locks were completed in 1917, the water level in Lake Washington dropped nearly 9 feet, exposing most of the banks now seen along Mercer Slough. Today, the 326-acre Mercer Slough Nature Park encompasses most of the remaining wetland complex and the slough. For this study, the Mercer Slough wetland was divided into five subsites, including fringe wetlands that are hydrologically connected to Mercer Slough and exist outside the park's boundaries. Sturtevant Creek wetland (WR-3) to the north, 118th Avenue SE wetland (WR-5) to the east, and an unnamed drainage wetland (WR-4) to the southeast near the BNSF Railway and I-90 overpass are three of the subsites. The other two subsites are located roughly to the north and south of the South Bellevue Park-and-Ride Lot (WR-2 and WR-1, respectively); these two portions of the wetland complex were separated due to the differences in habitat disturbances and fragmentation. Wetlands on the east side of the Mercer Slough wetland complex are located outside the study area. Allied Waste wetland patch are dominated by one or two of these species. The entire west bank of the western

The Mercer Slough complex is a mixture of PFO/PSS and PEM wetlands. Many, if not most, of the wetlands in the Mercer Slough complex grow in deep organic soils and/or bogs. PEM dominates the east and west tributaries of Mercer Slough. Throughout Mercer Slough Nature Park, reed canarygrass dominates the understory. Dominant tree species of PFO/PSS include black cottonwood (*Populus balsamifera*) and red alder, with an

Source: Data from NWI USFWS (2006) modified by CH2M HILL; King County (2006).

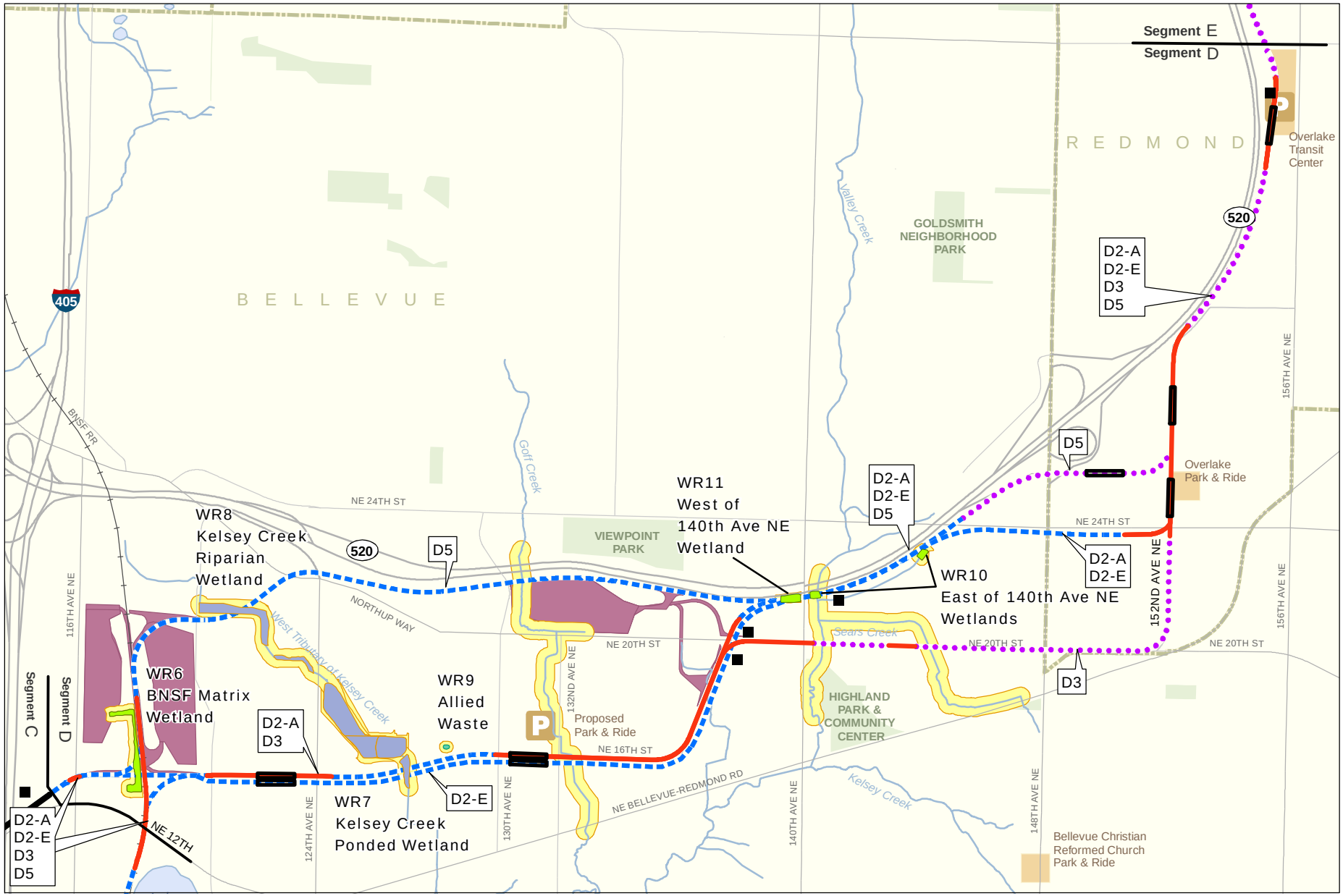
Wetland Categories

- Category 1
- Category 3
- Category 4
- Wetland/Stream Buffer

- Route At Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Traction Power Substation
- Proposed Station
- City Limits

Exhibit 3-10
Wetland Resources
Segment B
East Link Project



Wetland Catagories

- Category 1
- Category 3
- Category 4
- Ponded Feature
- Wetland/Stream Buffer

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

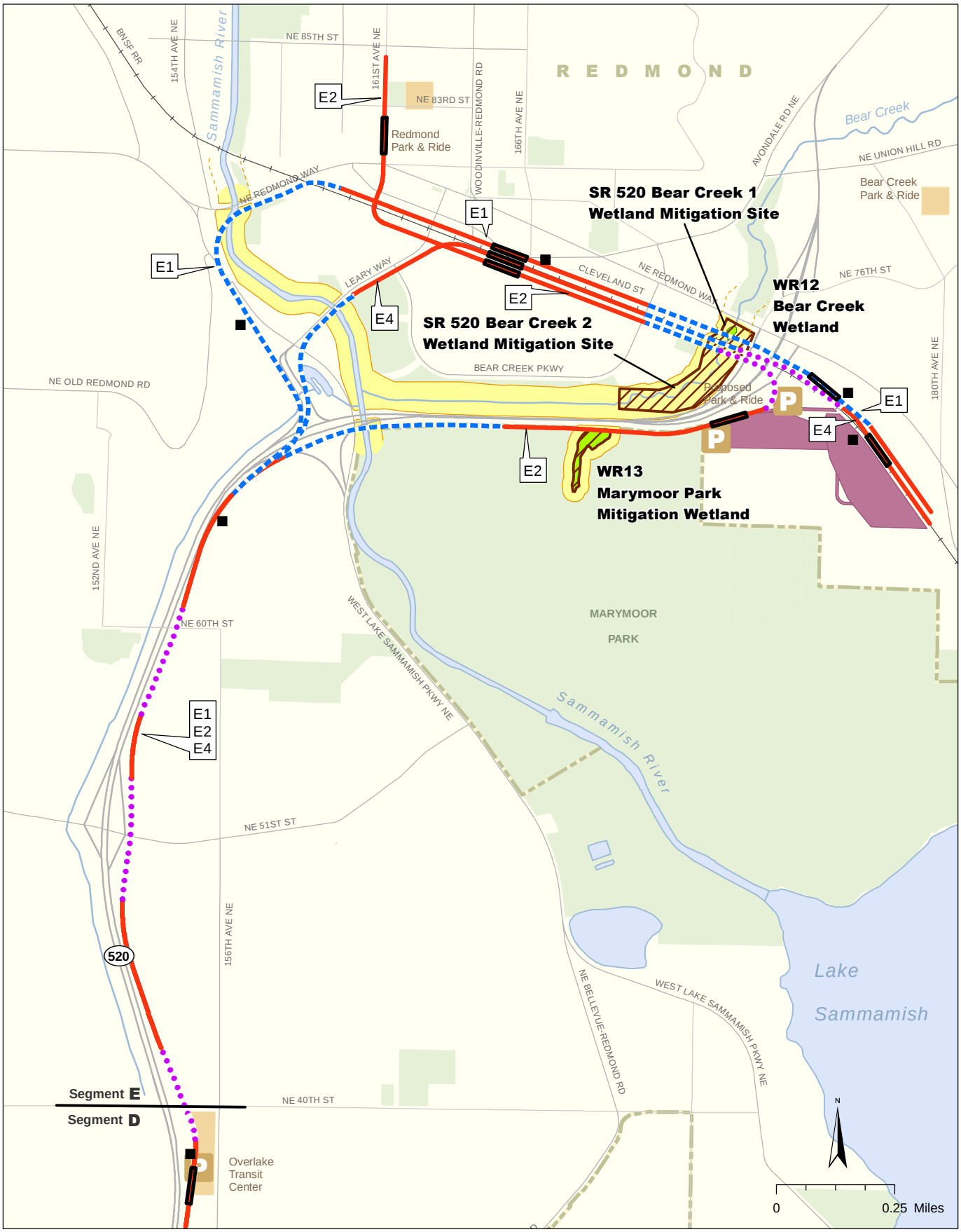
- Traction Power Substation
- Proposed Station
- Maintenance Facility
- City Limits

Source: Data from NWI USFWS (2006) modified by CH2M HILL, City of Bellevue (2005), City of Redmond (2005), and King County (2006).

N

0 0.25 Miles

Exhibit 3-11
Wetland Resources
Segment D
East Link Project



Wetland Categories

- Category 1
- Category 3
- Category 4
- Wetland Mitigation Site
- Wetland/Stream Buffer

- Route at Grade
- Elevated Route
- Route in Retained Cut
- Route in Tunnel

- Traction Power Substation
- Proposed Station
- Maintenance Facility
- City Limits

Source: Data from NWI USFWS (2006) modified by CH2M HILL; King County (2006).

Exhibit 3-12
Wetland Resources
Segment E
East Link Project

understory of willows (*Salix* spp.), red-osier dogwood (*Cornus stolinifera*), and salmonberry (*Rubus spectabalis*). In disturbed areas, Himalayan blackberry is also common in the shrub layer, primarily along the West Tributary to Mercer Slough near the I-90 overpass at the southern end of the park and along the park boundary adjacent to Bellevue Way SE.

The southern and mid-section of Mercer Slough Nature Park support several different wetland types. Lake Washington forms the southern boundary of the park. Emergent vegetation with patches of shrubs and small trees dominate the wetlands just north of the lake. Labrador tea (*Ledum groenlandicum*) with a shrub overstory of Pacific willow (*Salix lasiandra*) growing in bogs dominate the PEM/PSS situated in the central portion of the park. Soils found in this area of Mercer Slough Nature Park are peat and Seattle muck.

The northern section of the park is highly fragmented and disturbed. Office complexes are located within 20 feet of the West Mercer Slough Tributary. Himalayan blackberry and other non-native plant species dominate the banks of the tributary. A portion of the wetland on the west side of the park remains drained and pumped for the production of blueberries. All the wetlands associated with Mercer Slough were rated as Category I wetlands. In addition there are five WSDOT wetland mitigation sites within Mercer Slough Park (see Table 3-12 and Exhibit 3-10.

Mercer Slough/I-90 Wetland (WR-4)

Located where I-90 crosses 118th Avenue SE, the Mercer Slough/I-90 wetland receives its water from runoff from I-90 and an office park complex adjacent to the wetland. Water quality during field visits in March 2007 was low. The water emitted a faint odor, and thick mats of orange bacteria were present throughout the length of the watercourse. Salmonberry is the dominant shrub, and the forest canopy is well established with red alder and black cottonwoods. This site has patches of Japanese knotweed *(Fallopia japonica)* along its southern bank. This is a Category 1 wetland.

118th Avenue Wetland (WR-5)

This wetland is located between I-405 and 118th Avenue SE on property that once housed a WSDOT facility. During field investigations of the I-405 Bellevue Nickel Improvement Project in 2006, WSDOT staff rated this wetland as Category 2 with high wildlife and habitat functions; however, Sound Transit rated it as a Category 1 wetland due to its hydrologic connection to the Category 1 wetlands located within Mercer Slough Nature Park. Salmonberry, black cottonwood, reed canarygrass, and Himalayan blackberry dominate the site.

Sturtevant Creek Wetland (WR-3)

Sturtevant Creek emerges from Lake Bellevue and travels southwest towards Mercer Slough. Just north of Mercer Slough, a riparian wetland complex has developed on the east and west banks of Sturtevant Creek. This wetland complex has good diversity of shrubs established within its boundary, including Pacific ninebark (*Physocarpus capitatus*), spirea (*Spirea douglassi*), red-osier dogwood, Indian plum *(Oemleria cerasiformis)*, salmonberry, willows, and saplings of cottonwoods and alders. The herbaceous layer is a monoculture of reed canarygrass. Himalayan blackberry is also found in several thickets. This wetland is classified as a Category 1 wetland due to its high species diversity, hydrologic connection to Mercer Slough, and associated interior wetlands.

3.3.2.2 Segment D

BNSF Matrix Wetland (WR-6)

The BNSF matrix wetland is highly disturbed and sits on fill soil, making delineation of the resource less straightforward than other wetlands in the study area. Upland plants and wetland plants grow within 3 feet of one another in the northern and southern arms of the parcel. The northern arm of the site supports most of the wetland vegetation, while upland species dominate the southern portions of the parcel. Dominant species in the northern arm include small-fruited bulrush (*Scirpus microcarpus*), Indian plum, Douglas spirea, sword fern, black cottonwood, and red alder. European holly *(Ilex aquifolium*) and English ivy (*Hedera helix*) are present in the wetland area as well. The BNSF matrix wetland is a Category 3 wetland due to its disturbed condition.

Kelsey Creek Riparian (WR-8) and Ponded (WR-7) Wetlands

The Kelsey Creek watershed drains 75 percent of the City of Bellevue and a portion of the City of Redmond. All the received water in the creek then drains into Mercer Slough from the north through a large concrete culvert. Wetlands associated with Kelsey Creek are largely narrow, fringe wetlands growing along the creek. A riparian buffer zone extends for several more feet upslope of the fringe wetlands.

Three ponds exist along Kelsey Creek in the study area near the King County Metro Maintenance Base along 124th Avenue NE. To the west of the road, a beaver dam has created a small, natural pond and removed any emergent vegetation along the bank. To the east of 124th Avenue NE, a water-control device installed at the south end of the pond system has converted Kelsey Creek to a water detention pond, and several snags and weakened trees remain in the center of this pond. Shallow water and low-lying banks of the detention pond support a thick growth of reed canarygrass, while the upper banks are covered with shrubs and trees. Downstream of the water-control structure, water collects in a small pond with an associated PEM/PSS/PFO wetland dominated by reed canarygrass, red-osier dogwood, and black cottonwood. The creek flows out of this pond into a subsurface culvert. All three ponded sections of Kelsey Creek are Category 3 wetlands.

Allied Waste Wetland (WR-9)

During field investigations, a small Category 4 wetland was located to the east of the Allied Waste Facilities parking lot. The wetland is located behind a retail office complex between 124th Avenue NE and 130th Avenue NE, and heavy industrial and retail development surround the site. The wetland measures roughly 30 feet by 30 feet and is dominated by reed canarygrass and Himalayan blackberry. Stormwater from the surrounding buildings drains into the wetland by following a 1- to 3-foot-wide drainage channel. The drainage ditch supports wetland plants tolerant of disturbances, including horsetail and soft rush. Soils in the canarygrass/blackberry patch were fill soils that met hydric soil criteria because mottles were present within 10 inches of the surface.

East of 140th Avenue NE (WR-10) and West of 140th Avenue NE (WR-11) Wetlands

To the east and west of 140th Avenue NE, two drainage ditches carry runoff from SR 520 and the surrounding developed areas into Valley Creek. Both drainages receive their water as runoff from SR 520 and extensive parking lot, office, and retail complexes. The drainage east of 140th Avenue NE supports a small PSS/PFO wetland that has water entering the site via a culvert. Red-osier dogwood, Himalayan blackberry, Indian plum, and willows dominate the wetland, along with an overstory of alders and black cottonwoods. Reed canarygrass was also found in the area; however, the dense shading provided by the shrubs seems to be controlling the spread of canarygrass. The wetland edges and the banks of the waterway become dominated by blackberry thickets as the ditch and water head west towards Valley Creek.

The drainage to the west of 140th Avenue NE also supports a PSS/PFO wetland complex. Spirea, red-osier dogwood, and willows are the dominant shrubs, with a large thicket of dogwood running along the edge of the wetland and retail buildings. Black cottonwoods and alders form the forest component. Reed canarygrass is also present in the wetland. Both the east and west drainages are Category 3 wetlands.

3.3.2.3 Segment E

Marymoor Park Mitigation Wetland (MR-13)

Historically, Marymoor Park received flood water from Bear Creek. In the late 1800s, pioneers drained and farmed the area. Today, Marymoor Park is a 630-acre facility with several natural wetlands and a mitigated wetland located on the property. The park's mitigation wetland is located adjacent to the Velodrome and is bordered to the north by SR 520. The wetland was created to compensate for impacts on a natural wetland that occurred in the early 1990s during the widening of the SR 520. The mitigation wetland was planted with a variety of native trees and shrubs, and site visits in March and April of 2007 found the plantings thriving and in good health, with red alder, black cottonwood, and wild rose dominating the site. However, reed canarygrass is invading the site and competing with the native plants for resources. The Marymoor Park mitigation wetland is a Category 2 wetland.

Bear Creek Wetland (WR-12)

Bear Creek is part of the greater Lake Washington-Cedar River drainage, which includes Lake Sammamish and the Sammamish River and extends to Lake Washington. The Bear Creek subbasin is 14,300 acres, and the creek itself is 12.4 miles long. Wetlands along the creek receive floodwaters regularly during winter and during spring rain and snowmelt events. There are extensive restoration and flood detention projects along Bear Creek. The wetland and buffer areas along the creek where the Redmond Way (E1), Marymoor (E2), and Leary Way (E4) alternatives are proposed are heavily infested with reed canarygrass and Himalayan blackberry. In several areas, these two plant species exclude all other plant growth. Restoration activities downstream have removed the blackberry and most of the canarygrass and replaced non-native plants with native shrubs and tree saplings. A flood detention project along the south side of Bear Creek at the old BNSF railway crossing buffers the creek from SR 520 and prevents any overbank flooding into surrounding upland areas. Willow cuttings and other shrubs

have been planted to slow water flow through the detention area during flood events. The Bear Creek wetland is a Category 2 wetland.

3.3.3 Wetland Mapping

The 13 wetlands identified in the East Link wetland analysis are jurisdictional wetlands expected to be regulated by the local jurisdictions and/or the USACE. Exhibits 3-10 to 3-12 show the 13 wetlands. Table 3-11 shows the location and jurisdictional authority for each wetland resource and indicates where each resource is located in reference to the project alternatives. In Appendix F, Attachment 1, the wetlands are labeled as WR-1 through WR-13.

3.3.4 Wetland Classification

Of the 13 jurisdictional wetland systems in the study area, five are Category 1, two are Category 2, five are Category 3, and one is Category 4 (Table 3-12).

Mercer Slough contains the most extensive network and highest quality of wetlands in the study area. All of the Category 1 wetlands in the study area are associated with Mercer Slough. This is why there are several mitigation sites in Mercer Slough, as noted in Table 3-12. Several Category 2 and 3 wetlands exist outside of the Mercer Slough Nature Park complex. However, because these wetlands are hydrologically connected to Mercer Slough, they were given the same category and buffer size as the wetlands located within the Mercer Slough Nature Park. WR-12 (Bear Creek) and WR-13 (Marymoor Mitigation Wetland) are the only Category 2 wetlands within the study area.

3.4 Wetland Function Assessment

The existing functions and attribute levels vary between project wetlands for several reasons: the location of the wetland in the landscape, the surrounding land use activities, and the past type and level of disturbances the wetland experienced. The criteria and scores for each wetland against the four main wetland functional categories (i.e., hydrologic functions, biological and water quality functions, and special criteria functions) are shown in the summary tables in Appendix F, Attachment 1.

Wetlands located within the Mercer Slough complex associated with Segment B (WR-1 through WR-5) offer the widest range and highest functional level in the study area for three reasons:

- They scored moderate for hydrology and habitat functions and high for water quality.
- They scored a high function rating.
- They met the standards for several special criteria, including supporting a rare habitat type (i.e., bogs) and being located inside a protected area.

Mercer Slough wetlands also provide important educational and recreational functions in the Bellevue area.

Other wetlands in the study area also met special function criteria standards as they provide additional functions and support to surrounding waterways that offer salmon spawning and rearing habitat. These wetlands include WR-7 (Kelsey Creek Ponded) and WR-12 (Bear Creek). While the wetlands are not used for spawning or rearing, the waterways that the wetlands discharge to support the largest run of Chinook salmon in the City of Bellevue.

WR-3 (Sturtevant Creek) and WR-5 (118th Avenue SE) both were rated low for hydrologic and habitat functions. WR-3 scored moderate for water quality functions, however, while WR-5 scored low. The higher water-quality function rating was given to WR-3 due to the dense growth of reed canarygrass the wetland supports. Despite its classification as a noxious weed, reed canarygrass performs many water quality improvement functions, including sediment trapping and nutrient removal from the water column, although not at the level of native vegetation. In addition, WR-3 is larger and has denser plant growth and higher vegetation diversity than WR-5. WR-5, which WSDOT analysts had previously rated, scored high for providing habitat functions and support (WSDOT, 2006); however, this function was not apparent during the East Link Project surveys, and WR-5 received a low score for habitat functions.

TABLE 3-11
List of Wetlands and Wetland Buffers Located within the East Link Study Area by Alternative

Wetland Number[a]	Wetland Name	Location	Jurisdiction	Wetland and Buffer Located in Given Alternatives[b]							
Segment B				**B1 Wetland**	**B1 Buffer**	**B2A/B2E Wetland**	**B2A/B2E Buffer**	**B3 Wetland**	**B3 Buffer**	**B7 Wetland**	**B7 Buffer**
WR-1	Bellevue Way South of Park-and-Ride Lot (includes: I-90 Mercer Slough interpretative center pond, I-90 Mercer Slough East Meadow, I-90 Mercer Slough Phase 1, and I-90 seismic retrofit wetland mitigation sites)	Mercer Slough	USACE/ City of Bellevue	X	X	X	X	X	X	X	X
WR-2	Bellevue Way North of Park-and-Ride Lot	Mercer Slough	USACE/ City of Bellevue			X	X	X	X		X
WR-3	Sturtevant Creek	Mercer Slough	USACE/ City of Bellevue					X	X		
WR-4	Mercer Slough I-90	Mercer Slough	USACE/ City of Bellevue							X	X
WR-5	118th Avenue SE	Mercer Slough	USACE/ City of Bellevue							X	X
Segment D				**D2A/D2E 6th and 12th Wetland**	**D2A/D2E 6th and 12th Buffer**	**D3 6th and 12th Wetland**	**D3 6th and 12th Buffer**	**D5 Wetland**	**D5 Buffer**		
WR-6	BNSF Matrix	Mercer Slough	USACE/ City of Bellevue						X		
WR-7	Kelsey Creek Ponded	Kelsey Creek	USACE/ City of Bellevue					X	X		
WR-8	Kelsey Creek Riparian	Kelsey Creek	USACE/ City of Bellevue	X	X	X	X				
WR-9	Allied Waste	NE 15th Place Wetland	City of Bellevue	X	X	X	X				
WR-10	East of 140th Avenue NE	Valley Creek	USACE/ City of Bellevue	X	X			X	X		
WR-11	West of 140th Avenue NE	Valley Creek	USACE/ City of Bellevue	X	X			X	X		

TABLE 3-11
List of Wetlands and Wetland Buffers Located within the East Link Study Area by Alternative

Wetland Number[a]	Wetland Name	Location	Jurisdiction	Wetland and Buffer Located in Given Alternatives[b]							
Segment E				**E1 Wetland**	**E1 Buffer**	**E2 Wetland**	**E2 Buffer**	**E4 Wetland**	**E4 Buffer**		
WR-12	Bear Creek (includes SR 520 Bear Creek 1 and 2 wetland mitigation sites)	Bear Creek	USACE/ City of Redmond	X	X	X	X	X	X		
WR-13	Marymoor Mitigation Wetland	Marymoor Park	USACE/ City of Redmond			X	X				

[a] WR = Wetland Resource
[b] Alternative names:

A/E = At grade and elevated
B1 = Bellevue Way Alternative
B2A = 112th SE At-Grade Alternative
B2E = 112th SE Elevated Alternative
B3 = 112th SE Bypass Alternative
B7 = BNSF AlternativeD2A = NE 16th At-Grade Alternative
D2E =NE 16th Elevated Alternative
D3 = NE 20th Alternative
D5 = SR 520 AlternativeE1 = Redmond Way Alternative
E2 = Marymoor Alternative
E4 = Leary Way Alternative

TABLE 3-12
Cowardin Classification, HGM Classifications, and Category for Wetlands Located in the Study Area

Locator	Wetland	Location	Cowardin Class[a]	HGM Class	Category[b]
WR-1	Bellevue Way South of Park and Ride	Mercer Slough	PEM/PSS/PFO	Riverine Lacustrine Fringe Depressional	1
WR-2	Bellevue Way North of Park and Ride	Mercer Slough	PEM/PSS	Riverine	1
WR-3	Sturtevant Creek	Mercer Slough	PEM/PSS	Riverine	1
WR-4	Mercer Slough I-90	Mercer Slough	PEM/PSS/PFO	Lacustrine Fringe Riverine Depressional	1
WR-5	118th Avenue SE	Mercer Slough	PSS/PFO	Slope	1
WR-6	BNSF Matrix	Mercer Slough	PSS/PFO	Slope	3
WR-7	Kelsey Creek Ponded	Kelsey Creek	Riverine PSS/PFO	Riverine	3
WR-8	Kelsey Creek Riparian	Kelsey Creek	Riverine PFO	Riverine	3
WR-9	Allied Waste	NE 15th Place Wetland	PEM/PSS	Depressional/ Slope	4
WR-10	East of 140th Avenue NE (2 parts)	Valley Creek	PSS/PFO	Depressional/ Slope	3
WR-11	West of 140th Avenue NE	Valley Creek	PSS/PFO	Depressional/ Slope	3
WR-12	Bear Creek	Bear Creek	Riverine PSS/PFO	Riverine	2
WR-13	Marymoor Park Mitigation Wetland	Marymoor Park	PSS/PFO	Depressional	2

[a] PEM = palustrine emergent marsh; PSS = palustrine scrub shrub; PFO= palustrine forested; R= riverine

[b] Category rating is for City of Bellevue or Redmond

WR-12 and WR-13 also provide several important functions. WR-12 was rated moderate for all three parameters and had the second highest score of any wetland included in the field investigation. WR-13 was rated as offering moderate habitat and water quality functions but low hydrologic functions. These ratings were based primarily on the site's small size and distance from local waterways. If reed canarygrass were controlled at the mitigation site, the habitat functional ability of the wetland would likely improve as planted trees and shrubs mature.

WR-4 (Mercer Slough I-90), WR-6 (BNSF Matrix), WR-9 (Allied Waste), WR-10 (East of 140th Avenue NE), WR-11 (West of 140th Avenue NE), and WR-7 (Kelsey Creek Ponded) all scored low for functions in all three categories. WR-4, WR-9, WR-7, WR-10 and WR-11 were rated low because their small size and heavily urbanized and disturbed surroundings limit their ability to perform functions. WR-9 and WR-6 received the lowest function ratings of all wetlands surveyed. Hydrologic function for both wetlands was rated 2 due to their isolation from other natural areas and position in the landscape. In addition, both sites have been heavily disturbed by past human activities. WR-9 is surrounded by heavy industrial activities and retail buildings. The soil the wetland is located on is fill material from the construction of the surrounding buildings. Soil in the southern arm of WR-6 was a mix of upland soils and fill material. A heavily used, unpaved parking lot is situated upslope and adjacent to the site, between the southern upland arm and the northern wetland arm of the property.

4.0 Environmental Consequences

This section describes the expected short- and long-term impacts of the East Link Project on aquatic resources (Section 4.1); vegetation, wildlife habitat, and wildlife resources, including Washington PHS and threatened and endangered species and species of concern (Section 4.2); and wetland resources (Section 4.3). The discussion of project impacts assumes that the BMPs described in Appendix A would be implemented and perform as expected to avoid and minimize certain impacts during construction. For potential mitigation measures, see Chapter 5.

During the Final EIS process, Sound Transit will prepare a Biological Assessment for ESA consultation. Sound Transit expects that the Biological Assessment's effects determination for ESA-listed species to be a "may affect and is not likely to adversely affect" listed species and that there will be no effects to Essential Fish Habitat under Magnuson-Stevens Fishery Conservation and Management Act (MSA).

4.1 Aquatic Resources

The potential mitigation measures proposed in Chapter 5 would compensate for unavoidable adverse impacts. Sound Transit considered the following potential impacts:

- Direct fish mortality
- Permanent loss of physical habitat
- Permanent degradation of physical habitat, such as shading, chronic sedimentation, removal of boulders or LWD from the channel, and loss of riparian vegetation
- Temporary loss of physical habitat (dewatering)
- Temporary degradation of habitat (sedimentation, removal of riparian vegetation, disturbance to stream banks)
- Altered hydrology (higher peak flows = increased scour/deposition downstream; decreased percolation from impervious surfaces = lower base flows)
- Permanent degradation of water quality (increased temperature, increased turbidity, increased loading of heavy metals and hydrocarbons)
- Temporary degradation of water quality (turbidity, temperature)
- Fish passage barriers
- Facilitation of urban development
- Electric current field in Lake Washington

Not all of these types of potential impacts would occur from the East Link Project. Impacts that are not discussed in this section are not expected to occur.

The analysis focuses on salmonids because it is the group of species of greatest concern in Pacific Northwest freshwater environments. Because the habitat requirements and mode of potential impacts are so similar for the salmonid species present, the analysis is generic and lumped for all salmonid species. Species-specific impacts are identified where appropriate. The federally listed threatened and endangered aquatic species present in the study area are all salmonids and covered under in the lumped analysis. The discussion herein is thus limited to the risk of impact to each species based on the proximity of their known habitat in the project vicinity to sources of potential impacts from the project. A discussion of impacts relative to the Magnuson-Stevens Fishery Conservation and Management Act are similarly lumped into the generic analysis and is not discussed separately.

4.1.1 Impacts Common to Most or All Action Alternatives

Table 4-1 summarizes potential short-term and long-term impacts, by segment and alternative, common to most or all the action alternatives. The impacts disclosed below do not take into account the possible avoidance or reduction of impacts as a result of implementing appropriate BMPs during design, construction, and operation of the project.

4.1.1.1 Short-Term Construction Impacts

Sedimentation

Any earthwork conducted within a watershed has the potential to cause sedimentation that would adversely affect the streams in the watershed downstream of the work. The most obvious situation in which sedimentation cold occur is where earthwork construction occurs in or next to a stream channel. However, any earthwork in a watershed may contribute to the already serious sedimentation problems that exist in the streams in the project vicinity. The reason for this is that most stormwater in urban settings is collected in a system of pipes or ditches and conveyed directly to the nearest stream. An exception to this is in newer developments, where stormwater detention facilities trap much of the sediment carried by upstream sources defore discharging into streams. But even in these developments, some of the finer particulates may be discharged to streams as the ponds fill with stormwater and overflow. The closer the earthwork is to a stream, the higher the risk of sediment delivery into the stream. In addition, earthwork that occurs during the wet season has a higher risk of delivering sediment to streams.

The types of adverse impacts from excessive sediment in streams is well documented, and the range of adverse impacts on salmonid ecosystems is wide. For example, excessive sediment may preclude salmonid spawning or sucessful egg incubation, or it may lower egg suvival. The production and diversity of macrobenthic invertebrates, the primary food source of juvenile salmon and resident trout, is reduced as sediment loading increases. Shelter for juvenile salmonids is decreased as the voids between rocks are filled with sediment. Pools may become full of sediment if loading is high.

Alternatives with more earthwork, such as the at-grade alternatives, which require more road widening, have higher sedimentation risks. The exception to this is tunneling alternatives, where the earthwork is sheltered and isolated from rainfall and stormwater runnoff. Although tunneling alternatives have the lowest risk from sedimentation, they are not without sedimentatio impacts. Tunnels must be dewatered to remove groundwater seepage. This water can be treated to remove most of the particulates, but some may still be present after treatment. After treatment, the water is either discharged, ultimately ending up in streams through stormwater systems, or it is injected back into the ground. The elevated alternatives where there is minimal road widening and where most of the earthwork is borings for the support columns have an intermediate level of risk for sedimentation.

BMPs are designed to avoid or minimize sediment delivery to streams. The degree to which they are effective depends on correct installation but also on unpredictable circumstances. For instance, conventional BMPs may fail when subjected to extreme rainfall or rain-on-snow events. Examples of BMPs are delineated construction limits and pH monitoring during construction.

Pollutant Spills

Anywhere heavy equipment is fueled or hydraulic systems are used, fuel or hydraulic fluid can be spilled. Even though a spill prevention plan would be implemented, there is still a small risk that some of this material could be carried by stormwater and enter a stream. Because stormwater throughout a watershed ends up in a stream, stormwater entering a storm drain far from a stream is eventually carried to it. BMPs are designed to aviod or minimize construction-related pollutants from entering streams. However, despite precautions, there would still be a small risk.

4.1.1.2 Long-Term Operational Impacts

Overall, the project would increase the amount of impervious surface area in the study area. Impervious surfaces can increase stormwater runoff rates, volumes, and pollutant loads. These, in turn, can cause higher flows and degraded water quality in storm sewers and streams. Project impervious areas include new tracks and guideways, stations, park-and-ride lots, maintenance facilities, and roads. Relocated roads to accommodate the project were also counted as project-associated impervious area. In general, elevated alternatives would result in

TABLE 4-1
Summary of Short-Term Construction and Long-Term Operational Impacts

Segment/ Alternative/ Connection	Water Body Affected	Type of Construction Activities and Locations	Short-Term Construction Impacts	Long-Term Operational Impacts
Segment A				
A1, I-90	Lake Washington	Bridge joint replacement, track installation, possible in-water work for bridge upgrades.	Potential toxic material spill from heavy equipment.	None
Segment B				
B1, Bellevue Way	Mercer Slough	At-grade track installation and the widening of Bellevue Way SE between I-90 and 12th Street intersection.	Potential water quality degradation from runoff of sediment and pollutants.	None
B2A, 112th SE At-Grade	Mercer Slough	Elevated and at-grade track construction along Bellevue Way and at grade construction just south of 112th Avenue SE.	Potential water quality degradation from runoff of sediment and pollutants.	Worsened stream buffer encroachment along Mercer Slough for about 350 feet.
B2E, 112th SE Elevated	Mercer Slough	Elevated track construction along Bellevue Way and112th Avenue SE.	Potential water quality degradation from runoff of sediment and pollutants.	Worsened stream buffer encroachment along Mercer Slough for about 350 feet.
B3, 112th SE Bypass	Mercer Slough	Elevated and at-grade track construction along Bellevue Way and 112th Avenue SE.	Potential water quality degradation from runoff of sediment and pollutants.	Worsened stream buffer encroachment along Mercer Slough for about 350 feet.
B7, BNSF	Mercer Slough and Kelsey Creek	Elevated and at-grade track construction between113th Avenue SE and SE 8th Street.	Potential water quality degradation from runoff of sediment and pollutants.	Shading from the bridge over Mercer Slough.
Segment C				
C1T, Bellevue Way Tunnel	Sturtevant Creek	Elevated construction across Sturtevant Creek (piped section) and over the top of Sturtevant Creek near the outlet of Lake Bellevue.	Potential water quality degradation from runoff of sediment and pollutants. May need minor (300-foot length) stream relocation at Lake Bellevue.	400 feet of channel function would be lost due to culvert lengthening downstream of Lake Bellevue. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.
C2T, 106th NE Tunnel, from B2A, 112th SE At-Grade	Sturtevant Creek	Elevated construction across Sturtevant Creek (piped section) and over the top of Sturtevant Creek near the outlet of Lake Bellevue.	Potential water quality degradation from runoff of sediment and pollutants. May need minor (300-foot length) stream relocation at Lake Bellevue.	400 feet of channel function would be lost due to culvert lengthening downstream of Lake Bellevue.
C2T, 106th NE Tunnel, from B2E, 112th SE Elevated	Sturtevant Creek	Elevated construction across Sturtevant Creek (piped section) and over the top of Sturtevant Creek near the outlet of Lake Bellevue.	Potential water quality degradation from runoff of sediment and pollutants. May need minor (300-foot length) stream relocation at Lake Bellevue.	400 feet of channel function would be lost due to culvert lengthening downstream of Lake Bellevue. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.

TABLE 4-1
Summary of Short-Term Construction and Long-Term Operational Impacts

Segment/ Alternative/ Connection	Water Body Affected	Type of Construction Activities and Locations	Short-Term Construction Impacts	Long-Term Operational Impacts
C2T, 106th NE Tunnel, from I-405 (B3, 112th SE Bypass; and B7, BNSF)	Sturtevant Creek	Elevated track construction over the top of Sturtevant Creek adjacent to the Hilton Hotel and Lake Bellevue and over piped section.	Potential water quality degradation from runoff of sediment and pollutants. Major reconstruction of the stream channel for about 400 feet (from B3) or 740 feet (from B7). May need minor stream relocation downstream of Lake Bellevue (300 feet).	Shading impacts and loss of riparian vegetation nutrient and LWD inputs in the reach adjacent to the Hilton Hotel. Improvements to habitat are likely from reconstruction. 400 feet of channel function would be lost from culvert lengthening downstream of Lake Bellevue. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.
C3T, 108th NE Tunnel, from B2A, 112th SE At-Grade	Sturtevant Creek	Tunneling	Negligible	None
C3T, 108th NE Tunnel, from B2E, 112th SE Elevated	Sturtevant Creek	Tunneling	Negligible	None
C3T, 108th NE Tunnel, from I-405 (B3, 112th SE Bypass; and B7, BNSF)	Sturtevant Creek	Elevated track construction over the top of Sturtevant Creek near Hilton Hotel	Potential water quality degradation from runoff of sediment and pollutants. Major reconstruction of the stream channel for about 400 feet (from B3) or 740 feet (from B7).	Shading impacts and loss of riparian vegetation nutrient and LWD inputs in the reach adjacent to the Hilton Hotel. Some improvements to habitat are likely from reconstruction. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.
C4A, Couplet, from B2A, 112th SE At-Grade	Sturtevant Creek	Street widening and elevated track construction within watershed	Potential water quality degradation from runoff of sediment and pollutants.	None
C4A, Couplet, from B2E, 112th SE Elevated	Sturtevant Creek	Street widening and elevated track construction within watershed	Potential water quality degradation from runoff of sediment and pollutants.	None
C4A, Couplet, from I-405 (B3, 112th SE Bypass; and B7, BNSF)	Sturtevant Creek	Elevated track construction over the top of Sturtevant Creek near Hilton Hotel	Potential water quality degradation from runoff of sediment and pollutants. Major reconstruction of the stream channel for about 400 feet (from B3, 112th SE Bypass) or 740 feet (from B7, BNSF).	Shading impacts and loss of riparian vegetation nutrient and LWD inputs in the reach adjacent to the Hilton Hotel. Some improvements to habitat are likely from reconstruction. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.

TABLE 4-1
Summary of Short-Term Construction and Long-Term Operational Impacts

Segment/ Alternative/ Connection	Water Body Affected	Type of Construction Activities and Locations	Short-Term Construction Impacts	Long-Term Operational Impacts
C7E, 112th SE Elevated, from B2A, 112th SE At-Grade	Sturtevant Creek	Street widening and elevated track construction within watershed.	Potential water quality degradation from runoff of sediment and pollutants.	None
C7E, 112th NE Elevated, from B2E, 112th SE Elevated	Sturtevant Creek	Street widening and elevated track construction within watershed.	Potential water quality degradation from runoff of sediment and pollutants.	None
C7E, 112th NE Elevated, from I-405 (B3, 112th SE Bypass; and B7, BNSF)	Sturtevant Creek	Elevated track construction over the top of Sturtevant Creek.	Potential water quality degradation from runoff of sediment and pollutants. Major reconstruction of the stream channel for about 400 feet (from B3, 112th SE Bypass) or 740 feet (from B7, BNSF).	Shading impacts and loss of riparian vegetation nutrient and LWD inputs in the reach adjacent to the Hilton Hotel. Some improvements to habitat are likely from reconstruction. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.
C8E, 110th NE Elevated, from I-405 (B3, 112th SE Bypass; and B7, BNSF)	Sturtevant Creek	Elevated track construction over the top of Sturtevant Creek.	Potential water quality degradation from runoff of sediment and pollutants. Major reconstruction of the stream channel for about 400 feet (from B3, 112th SE Bypass) or 740 feet (from B7, BNSF).	Shading impacts and loss of riparian vegetation nutrient and LWD inputs in the reach adjacent to the Hilton Hotel. Some improvements to habitat are likely from reconstruction. Elevated stream crossing with possibility for support columns in riparian buffer or in stream channel.
Segment D				
D2A, NE 16th At-Grade – NE 12th and via BNSF	West tributary of Kelsey Creek, Goff Creek, Unnamed tributary, Valley Creek	Elevated and at-grade earthwork in watersheds; elevated crossings at West Tributary; crossing a piped section of Goff Creek; realignment or culverting the unnamed tributary; culvert lengthening of Valley Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts and loss of riparian vegetation nutrient and LWD inputs on West Tributary. Loss of all stream function and habitat for 30 feet on Valley Creek. 30 feet of new culvert on the unnamed tributary (loss of habitat).
D2E, NE 16th Elevated – NE 12th and via BNSF	West Tributary of Kelsey Creek, Goff Creek, Unnamed tributary, Valley Creek	Elevated structure earthwork in watersheds; elevated crossings at West Tributary; crossing a piped section of Goff Creek, the unnamed tributary, and Valley Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts on West Tributary, the unnamed tributary, and Valley Creek.
D3, NE 20th – NE 12th and via BNSF	West Tributary of Kelsey Creek, Goff Creek, Unnamed tributary, Valley Creek	Elevated and at-grade earthwork in watersheds; elevated crossing at West Tributary; at-grade crossing a piped section of Goff Creek; realignment or culverting the unnamed tributary; culvert lengthening of Valley Creek and a retained cut crossing over a piped section of Sears Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts and loss of riparian vegetation nutrient and LWD inputs on West Tributary. Loss of all stream function and habitat for 30 feet on Valley Creek. About 30 to 60 feet of new culvert on the unnamed tributary (loss of habitat). Fish passage would be preserved in the possible replacement culvert on Sears Creek.

TABLE 4-1
Summary of Short-Term Construction and Long-Term Operational Impacts

Segment/ Alternative/ Connection	Water Body Affected	Type of Construction Activities and Locations	Short-Term Construction Impacts	Long-Term Operational Impacts
D5, SR 520 – NE 12th and via BNSF	West Tributary of Kelsey Creek, Goff Creek, and Valley Creek	Elevated structure earthwork in watersheds; elevated crossings at West Tributary, Goff Creek, and Valley Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts of about 75 feet on West Tributary, and about 10 feet on Goff Creek, and Valley Creek.
Segment E				
E1, Redmond Way	Sammamish River, Bear Creek	Elevated and at-grade construction in watersheds; elevated crossings at the Sammamish River and Bear Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts at Sammamish River and Bear Creek crossings. Possible culvert replacement that feeds wetland mitigation site from Bear Creek high flows.
E2, Marymoor	Sammamish River, Bear Creek	Elevated and at-grade construction in watersheds; elevated crossings at the Sammamish River and Bear Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts at Sammamish River and Bear Creek crossings. Possible culvert replacement that feeds wetland mitigation site from Bear Creek high flows.
E4, Leary Way	Sammamish River, Bear Creek	Elevated and at-grade construction in watersheds; elevated crossings at the Sammamish River and Bear Creek.	Potential water quality degradation from runoff of sediment and pollutants.	Shading impacts at Sammamish River and Bear Creek crossings. Possible culvert replacement that feeds wetland mitigation site from Bear Creek high flows.
Maintenance Facilities				
MF1, 116th	West Tributary	Earthwork in watershed.	Potential water quality degradation from runoff of sediment and pollutants.	Few, but potential impacts from hazardous materials spills from facility. New PGIS[a] inputs.
MF2, BNSF	West Tributary	Earthwork in watershed.	Potential water quality degradation from runoff of sediment and pollutants.	Few, but potential impacts from hazardous materials spills from facility. New PGIS[a] inputs.
MF3, SR 520	Goff Creek	Either two short new culverts or removal of one long culvert and channel relocation	Potential water quality degradation from runoff of sediment and pollutants. Loss of habitat.	Loss of 230 feet of new channel function depending on design choice. Low, but potential impacts from hazardous materials spills from facility. New PGIS[a] inputs.
MF5, SE Redmond	Bear Creek	Earthwork in watershed	Potential water quality degradation from runoff of sediment and pollutants.	Few, but potential impacts from hazardous materials spills from facility. New PGIS[a] inputs.

[a] PGIS = pollutant-generating impervious surface

less new impervious area than at-grade alternatives because they would be typically narrower and require less road relocation. Tunnel alternatives do not add impervious area. Project-related parking lots and road realignments are subject to motor vehicle traffic and are considered to be pollution-generating impervious surfaces (PGIS). The guideway and stations would not be subject to motor vehicle traffic or other sources of potential pollution (except at crossing locations) and are therefore classified as non-PGIS.

Stormwater from project-related PGIS would be treated to at least basic treatment levels (i.e., removal of at least 80 percent of suspended solids). Roadways relocated as a result of at-grade rail alignments would be treated even though the pollutant loading would not be increased due to the light rail system. Stormwater runoff from the maintenance facility would be treated to enhanced treatment levels to remove heavy metals that are toxic to fish and aquatic invertebrates. Basic and enhanced treatment would reduce heavy metal and hydrocarbon contaminants in stormwater but would not eliminate all of it. None of the alternatives would substantially degrade water quality from existing conditions.

Sound Transit's preliminary engineering for the East Link Project includes development of a conceptual layout for major stormwater facilities to comply with the Ecology's Stormwater Manual. These facilities include stormwater ponds and underground vaults. Additional measures to reduce stormwater runoff, such as low-impact development or other on-site measures, would be considered at a more advanced phase of project development. Peak stream flows would not increase because the stormwater systems built for the project would be designed to simulate predevelopment hydrology. Impervious surfaces, however, preclude normal infiltration of precipitation into the ground. There is no practical means for compensating for this. Less precipitation entering the groundwater aquifers may decrease dry-season base flows by decreasing water inputs to streams from groundwater sources such as springs. Dry-season base flows have been identified as one of the most important natural limiting factors controlling salmonid production in lowland Puget Sound streams.

The less impervious surface an alternative has, the less effect it would be likely to have on base flows in a given watershed. Alternatives with more tunnels or elevated tracks would have less impact on base flows. Alternatives with more road widening and realignment from at-grade tracks would have more impact. Comparisons of impervious surface areas between alternatives are made in the Water Resources chapter of the EIS, Section 4.9.3.2. The worst-case alternative effect would, however, have only a small impact at a basin-wide level due to the proportion of the watershed affected by the project relative to the existing impervious surfaces within the watershed.

Permanent impacts also occur when stream channels area either enclosed within new culverts or shaded by overhead tracks (i.e., riparian function impacts). It is assumed that shading impacts cover an area represented by the surface area of an overhead structure 30 feet wide extending over riparian vegetation.

4.1.2 Specific Impacts of Alternatives in Each Segment

4.1.2.1 Fish and Aquatic Species and Habitats

Short-Term Construction Impacts

Only additional potential impacts are discussed below. The following discussion of potential impacts is segment and alternative specifc. Potential impacts common to most or all project alternatives (which are covered above) are not listed or discussed below.

Segment A

In Segment A, light rail would be installed on existing road and interstate highway surfaces. The only water body potentially affected would be Lake Washington. There would be a small risk of a fuel spill while refueling heavy equipment that is not mobile enough to refuel off site, such as a large crane, and concrete dust entering Lake Washington from modifying the bridge to accommodate the rail. BMPs such as containment booms and other measure should provide adequate protection. Sound Transit may need to implement special seismic upgrades to the I-90 floating bridge and I-90 East Channel bridge during the construction period. This may include in-water work in Lake Washington to reinforce the structures, which would need to be conducted during the in-water work window from July 16 to April 30. Construction activities in this segment would have a very low risk of impacts on ESA-listed fish. This should not impede the construction schedule.

Segment B

Bellevue Way Alternative (B1): This alternative would have the greatest degree of surface earthwork of the South Bellevue (Segment B) alternatives and thus the highest risk of sedimentation. This potential effect is moderated, however, because no construction occurs close to Mercer Slough.

112th SE At-Grade (B2A) and 112th SE Bypass (B3) Alternatives: These alternatives would be about half elevated and half at grade, thus posing less sedimentation risk than the Bellevue Way Alternative (B1) but more than the others. The section with the highest risk would be the area close to Mercer Slough along 112th Avenue SE. Appropriate BMPs would be implemented to reduce this risk.

112th SE Elevated Alternative (B2E): This alternative would be nearly an entirely elevated structure. As a result, it would have far less earthwork than the other Segment B alternatives and thus less associated risk from sedimentation.

BNSF Alternative (B7): This alternative would have an intermediate amount of earthwork relative to the other alternatives. The alternative would cross over the mouth of Mercer Slough as an elevated structure. Assuming the slough would be crossed with a free-spanning structure with the support column borings located outside of the ordinary high water mark (OHWM), impacts would be minimal on aquatic ecosystems. Construction would, however, be close to the water and would damage riparian vegetation as well as still posing a risk of sediment transport into Mercer Slough. A temporary work trestle would likely be constructed in Mercer Slough Park to accommodate construction, and a 100-foot-wide corridor would be cleared of vegetation. Impacts are expected to be largely avoided through implementation of appropriate BMPs to isolate the work area. The elevated alignment would cross a portion of Kelsey Creek contained within a culvert, but no impacts to the creek are expected. Also, because several streams would be crossed during construction of the BNSF Alternative (B7), western toad habitat could be affected.

Segment C

There are two areas where direct construction impacts may occur in Segment C: in the reach of Sturtevant Creek just below Lake Bellevue and in the reach of Sturtevant Creek adjacent to the Hilton Hotel, just downstream from I-405. Under the Bellevue Way Tunnel (C1T) and 106th NE Tunnel (C2T) alternatives, from the NE 6th Street crossing, the route would closely parallel the BNSF railroad tracks just downstream from Lake Bellevue; the elevated track may need to occupy the existing footprint of Sturtevant Creek for a distance of about 700 to 1,000 feet. Of this, about 300 feet of the creek would need to be relocated around the support columns at this location, causing temporary disturbance, loss of habitat function, and risk of sediment inputs to the creek. This would be compensated for by replacing the channel with improved habitat value in the areas where the channel would be relocated. The Hospital Station would be placed over the remaining impacted creek for a distance of approximately 400 to 700 feet. In that location, the creek would need to be contained in a pipe, causing a direct loss of habitat. Some sediment may enter the creek during construction. The present condition of this channel is that of an open, featurelesss ditch running along the railroad tracks. This is the only aquatic impact for C1T.

The alternative design options connecting from 112th SE Bypass [B3] and BNSF [B7] to the 106th NE Tunnel [C2T], 108th NE Tunnel [C3T], Couplet [C4A], 112th NE Elevated [C7E], and 110th NE Elevated [C8E] alternatives would be aligned over or very close to Sturtevant Creek, paralleling it as an elevated structure in the reach adjacent to the Hilton Hotel. It may be possible to avoid touching the creek and to place the piers ouside of the channel, and an effort would be made to do so. If the channel needs to realigned, there would be direct but temporary impacts on the best habitat in Sturtevant Creek accessible to anadromous salmonids. The reach potentially affected is approximately 900 feet long for the connection from the BNSF Alternative (B7) and 1,330 feet for the connection from from the 112th SE Bypass Alternative (B3).

Segment D

None of the connecting options from Segment C differentiate between the alternatives and are thus not discussed below. Construction over streams may affect suitable western toad habitat. These streams includes Kelsey Creek and West Tributary of Kelsey Creek (D2A, D2E, D3, D5), Goff Creek (D5), Valley Creek (D2A, D2E, D5), and Sears Creek (D3).

NE 16th At-Grade (D2A) and NE 20th (D3) Alternatives: These alternatives would cross the West Tributary of Kelsey Creek as an elevated structure. They would cross Goff Creek where Goff Creek is in a piped system. The unknown tributary to Kelsey Creek would be crossed at-grade obliquely between NE 16th and NE 20th streets.

The channel is essentially a roadside ditch lined with grasses and some intermittent culverts. The channel would likely be placed in an approximately 0.2-mile-long continuous culvert, the exact length of which would be determined during final design. Habitat value is very poor in this small intermittent stream and thus impacts from habitat loss would be negligible.

Under the NE 20th Alternative (D3), Valley Creek would be crossed at-grade and would require adding approximately 30 feet of length to the existing culvert under NE 20th Street; there would be a corresponding permanent loss of aquatic and riparian habitat. Valley Creek has anadromous salmonid access to this point and above. The reach potentially affected was rated as good during the habitat survey. The route would also cross Sears Creek, where the creek is in a long culvert under NE 20th Street. This may involve replacing the culvert but would not impact fish passability.

NE 16th Elevated Alternative (D2E): This alternative would be the same as the NE 16th At-Grade (D2A) and NE 20th (D3) alternatives until it crossed the unknown tributary to Kelsey Creek in an elevated structure. It also would cross Valley Creek in an elevated structure near SR 520.

SR 520 Alternative (D5): This alternative would cross the same streams as the NE 16th Elevated Alternative (D2E); however, it would cross the West Tributary to Kelsey Creek at a different location located farther up the reach.

Segment E

Construction over streams may temporarily affect western toad habitat along crossings at Bear Creek (E1, E2, E4) and the Sammamish River (E1, E2, E4).

Redmond Way Alternative (E1): The Redmond Way Alternative (E1) would cross the Sammamish River on a new bridge. The river is narrow enough to be spanned with the support columns ouside of the OHWM. Bear Creek would be crossed on a new bridge that would be wider than the existing railroad bridge. No in-water work would be necessary at either crossing. However, there may be adjustments or culvert replacement for an overflow culvert from Bear Creek to a wetland mitigation site at the SR 520/Redmond Way interchange. This work would be conducted at low flows and within in-water work windows to avoid impacting ESA species.

Marymoor Alternative (E2): The Marymoor Alternative (E2) would cross the Sammamish River on a new bridge next to the Leary Way Bridge. The river is narrow enough to be spanned with the support columns outside of the OHWM. The Bear Creek crossing would have the same potential impacts as the Redmond Way Alternative (E1).

Leary Way Alternative (E4): The Leary Way Alternative (E4) would cross the Sammamish River on a new bridge next to the SR 520 bridge. The river is narrow enough to be spanned with the support columns outside of the OHWM. The Bear Creek crossing would have the same potential impacts as the Redmond Way Alternative (E1).

Maintenance Facility

116th Maintenance Facility (MF1): MF1 would be sited in a commercial district well away from the nearest water body. The risk of sedimentation impacts would be low because the receiving water (i.e., the upper reaches of the West Tributary of Kelsey Creek) is a series of beaver ponds that would detain and deposit sediment inputs. No riparian vegetation would be disturbed.

BNSF Maintenance Facility (MF2): Construction impacts from the MF2 would be similar to those described for MF1.

SR 520 Maintenance Facility (MF3): The footprint of this facility would surround approximately 366 feet of the existing Goff Creek channel. If Goff Creek is left in its present alignment, a 56-foot-long culvert would be removed and replaced with a 19-foot-long culvert. In addition, a 43-foot-long culvert would be replaced with a 46-foot-long culvert. The result would be an increase in fish habitat of 34 feet of channel. If Goff Creek is rerouted around the west perimeter of the facility, then the 56- and 43-foot-long culverts would be removed with no new replacement culverts. There would be a net gain of 230 linear feet of stream channel in this senario. There would be some risk of sediment delivery into the channel as a result of in-stream work. No riparian vegetation other than mowed grass and English ivy is present in this reach

SE Redmond Maintenance Facility (MF5): This facility would be placed on the opposite side of SR 520 from Bear Creek. Stormwater from the facility drains to the Sammamish River some distance away, minimizing sediment delivery to the river. Bear Creek would be unaffected.

Long-Term Operational Impacts

Segment A

Because electrically powered light rail systems do not generate any pollutants, stormwater—from both water volume and water quality perspectives—is not an issue. Operation of rail could discharge stray electrical current into Lake Washington and create electric current fields around the bridge, in addition to fields that would be already possibly created from the bridge's existing cathodic corrosion protection system. Sound Transit estimates that stray current intensity would be one to three orders of magnitude below physiological or behavioral response thresholds for even the most sensitive Lake Washington fish species (Appendix G). No long-term operational impacts are expected.

Segment B

Bellevue Way Alternative (B1): This alternative should have no long-term operational impacts on aquatic resources.

112th SE At-Grade (B2A) and 112th SE Bypass (B3) Alternatives: The 112th SE At-Grade (B2A) and 112th SE Bypass (B3) alternatives would increase the existing encroachment of 112th Avenue NE into the Bellevue's 150-foot CAO stream buffer zone of Mercer Slough for about 350 feet, between Bellevue Way and SE 8th Street. This area is already cleared of trees, however. The increase in encroachment would be only 8 feet and the potential increase in pollutants reaching Mercer Slough would be correspondingly small.

112th SE Elevated Alternative (B2E): The elevated track section along 112th Avenue SE may cast shade on the riparian vegetation bordering Mercer Slough for a length of about 350 feet. Because of the relative aspect of Mercer Slough to the sun and the position of the hill slope to the west, however, it would likely have only a minor impact for a very short period during the late afternoon during the growing season.

BNSF Alternative (B7): Some shading impacts would occur from the bridge over the mouth of Mercer Slough on the slough and on adjacent riparian vegetation, degrading shoreline edge habitat and lowering LWD input potential for the width of the bridge structure.

Segment C

Bellevue Way Tunnel (C1T) and 106th NE Tunnel (C2T) alternatives from 112th SE At-Grade and Elevated (B2A and B2E) Design Options: If the reach of Sturtevant Creek north of 8th Street needs to be realigned to the accommodate the raised section of tracks in that location, the long-term impacts would be positive. The replacement stream channel would provide better habitat than now exists. However, salmonid presence in this reach is uncertain because the reach is above several fish-passage blocks. Habitat function would be lost in the 400-foot-long piped section of the creek under the Hospital Station.

106th NE Tunnel (C2T), 108th NE Tunnel (C3T), Couplet (C4A), 112th NE Elevated (C7E), and 110th NE Elevated (C8E) alternatives from I-405 Design Options (from 112th SE Bypass [B3] and BNSF [B7] alternatives): If the Sturtevant Creek channel is realigned in the reach adjacent to the Hilton Hotel, the habitat value could be improved with a new constructed channel. In the long term, habitat could be improved in terms of channel morphology (i.e., pool frquency, in-stream structure, riparian vegetation, and substrate type). However, this may be compromised somewhat by the impacts of the elevated structure shading on riparian vegetation and the channel. Biological productivity and LWD recruitment may be diminished.

108th NE Tunnel Alternative (C3T), Couplet (C4A), 112th NE Elevated (C7E), and 110th NE Elevated (C8E) alternatives from 112th At-Grade and Elevated (B2A and B2E) Design Options: These alternatives would cause no additional impacts beyond those common to all alternatives.

Segment D

NE 16th At-Grade (D2A) and NE 16th Elevated (D2E) alternatives: The elevated tracks over the West Tributary to Kelsey Creek would have shading impacts on the riparian community bordering the creek. Some loss of LWD recruitment may occur but would have little impact because this section of stream is not accessible to salmonids and is still, ponded water. Shading impacts on the creek itself should be minimal because the creek in this location is ponded by beaver activity and has a mud bottom with limited primary productivity potential. Long-term impacts should be negligible from habitat loss on the unnamed tributary because it is so small and intermittent, with no salmonid use. The elevated crossing over Valley Creek would have shading impacts on a patch of blackberries, which impart little riparian function other than shade.

NE 20th Alternative (D3): In addition to the impacts described above, D3 would affect Valley Creek. Valley Creek would lose all aquatic and riparian functions for the 30 linear feet of channel enclosed in the lengthened culvert at 20th Street. This reach of Valley Creek was rated as good habitat.

SR 520 Alternative (D5): The elevated tracks over the West Tributary to Kelsey Creek would have approximately 75 feet of shading impacts on the riparian community bordering the creek. Some loss of LWD recruitment may occur but would have little impact because this section of stream is not accessible to salmonids and is deep, still, ponded water. Shading impacts on the creek itself should be minimal because the creek in that location is ponded by beaver activity and has a mud bottom with limited primary productivity potential. Shading may cause a 10-foot section of Goff Creek to experience lowered biolgical productivity if the elevated track is located far enough to the south to shade it. The elevated crossing over Valley Creek may also have shading impacts on a patch of blackberries, which impart little riparian function other than shade.

Segment E

Redmond Way Alternative (E1): At the Sammamish River crossing, the impacts of shading on riaprain vegetation would have competing impacts. Shading of the channel and riparian vegetation would lower biological productivity and LWD recruitment potential (i.e., less tree growth). Shading would also help to lower river temperature, which is a major limiting factor for the river. Shading would lower biological productivity and riparian function at the Bear Creek crossing. The affected area is 9,900 square feet on Sammamish River and 4,500 square feet on Bear Creek.

Marymoor Alternative (E2): The Marymoor Alternative (E2) would have the same impacts as the Redmond Way Alternative (E1), except that less riparian vegetation (4,500 square feet) would be affected on the Sammamish River crossing.

Leary Way Alternative (E4): The Leary Way Alternative (E4) would have the same impacts as the Redmond Way Alternative (E1), except that less riparian vegetation (7,500 square feet) would be affected on the Sammamish River crossing.

Maintenance Facilities

116th Maintenance Facility (MF1): This maintenance facility would cause negligible long-term impacts from pollutant loading in the West Tributary to Kelsey Creek.

BNSF Maintenance Facility (MF2): Impacts would be the same as for MF1.

SR 520 Maintenance Facility (MF3): This maintenance facility would create either 36 or 230 feet of new fish habitat due to culvert length shortening or complete removal, or it could result in the removal of about 230 feet of fish habitat if the facility is constructed over Goff Creek. Pollutant loading impacts would be negligible in Goff Creek.

SE Redmond Maintenance Facility (MF5): This maintenance facility would cause negligible long-term impacts from minor pollutant loading in the Sammamish River.

4.1.2.2 High-Value Habitats and Species

High-value habitats in Washington include all lakes, ponds, streams, and rivers. Special-status species include all salmonids, the focus of the analysis described above.

Short-Term Construction Impacts

Same as described above.

Long-Term Operational Impacts

Same as described above.

4.1.2.3 Federal-Listed Threatened and Endangered Species

The ESA offers protection for three species of fish known to be present in the project vicinity: Puget Sound steelhead, Puget Sound Chinook salmon, and bull trout. NMFS and WDFW have established in-water construction work windows for water bodies that must be adhered to for protection of ESA species. Table 4-2 shows applicable in-water work windows for the resources in the project vicinity.

TABLE 4-2
Construction Work Windows for Listed Species

Water Body	Applicable Alternative	ESA Work Window
Lake Washington	Segment A Alternative	July 1 – April 30
Kelsey Creek watershed and Bear Creek	All Segment C Alternatives	July 1 – August 31
Sammamish River and lower Bear Creek	All Segment D Alternatives	July 16 – July 31 and November 16 – March 15

Although a detailed construction schedule has not been developed yet, the allowable construction work windows should not affect the overall project schedule. The potential impacts apply to the degree that the species or their habitats are found in proximity to project activities. The following text describes the likelihood of exposure and risk of project activities and structures to protected species by project segment.

Segment A
Chinook salmon, steelhead, and bull trout could be exposed to construction acivities. However, construction activities in this segment would have a very low risk of impacts on these fish. In addition, work-window restrictions would minimize exposure to construction activites.

Segment B
Construction acivities in this segment would have a low risk of impact to Chinook salmon because the segment contains no spawning or primary rearing habitat and because there would be no in-water work.

Segment C
Chinook salmon, steelhead, and bull trout are not present in this segment.

Segment D
Potential impacts to Chinook salmon occurring in West Tributary Kelsey Creek would be isolated somewhat from downstream habitats by long stretches of ponded water. Potential impacts that might occur in Goff Creek would be far enough upstream from areas of Chinook salmon use that impacts would be diminished before reaching Chinook salmon habitat. Kelsey Creek, the most important Chinook salmon habitat in this segment, is at least 0.25 mile downstream of the closest project construction.

Segment E
Risks to both Chinook salmon and steelhead would be low in the Sammaish River because it is only a migratory corridor and the crossings are elevated structures that would not involve in-water work. The Bear Creek crossing would be the most sensitive project element because it is close to Chinook salmon and steelhead rearing habitat.

4.2 Upland Vegetation and Wildlife

4.2.1 Short-Term Construction and Related Impacts

Project construction would require clearing and removal of vegetation from within the construction area. Affected areas (and associated species) within the construction area that would be permanently altered by project facilities are addressed under long-term impacts in Section 4.2.2. As described in Section 1.4.1.1, the duration of short-term impacts would vary depending on the vegetation type and associated habitat functions that would be affected. These variations are noted in the following discussion. Impacts associated with disturbance and displacement of wildlife are also described in this section. Alternatives that would result in some level of temporary wildlife displacement are listed in Table 4-3. Alternatives not listed in Table 4-3 would have few or no displacement-related impacts. Impacts on cities and county critical areas are noted only in terms of the effects on high-value habitats that support multiple special-status species. These high-value habitats are described in Section 2.2.2.4.

4.2.1.1 Impacts Common to All or Most Action Alternatives

Impacts that would occur under all or most of the action alternatives are those related to noxious weeds and resulting from construction noise and human activity. These impacts would occur in all areas where construction occurs.

Noxious Weeds

Noxious weeds and exotic plants rapidly colonize disturbed sites such as construction areas. They prevent native species from being re-established following ground disturbance, spread into undisturbed areas where they habitat value on additional lands, and provide very poor wildlife habitat or forage. Some BMPs (included in Appendix A) are intended to avoid, reduce, and control new infestations of noxious weeds through a variety of actions. Consistent and successful application of these measures would reduce potential habitat degradation. However, it is likely that some especially aggressive weeds such as Himalayan blackberry would become established in some areas disturbed during construction. This aggressive species prevents the re-establishment of native riparian species along streams and substantially reduces wildlife habitat value. Use of chemicals to control noxious weeds usually also kills non-target beneficial native plants, contributing to habitat loss.

Impacts of Noise and Human Activity on Wildlife

Both noise and human activity have been demonstrated to displace wildlife from occupied habitats, interfere with the ability to hear territorial songs in birds, interfere with mating and alarm calls in amphibians and ground squirrels, and interfere with raptor foraging activities. There are numerous studies documenting wildlife avoidance of roads and facilities and wildlife disturbance from human activity at varying distances (Madsen, 1985; Van der Zande, et al., 1980; Fyfe and Olendorff, 1976).

However, most of these and similar studies have considered the impacts of new construction or facilities and human activities in areas where none or few of these facilities or human activities previously existed. This is not the case in the East Link Project vicinity, where both roads and regular human activity are common features of most of the landscape. Wildlife that use habitats adjacent to the project alternatives are more or less accustomed to some level of human activity and noise. Impacts would be related to changes in noise levels and the types of human activities.

Measured constant day-time noise levels along I-90 and I-405 average about 70 to 72 A-weighted decibels (dBA) Leq ("equivalent" continuous sound level) at a distance of 100 feet from the roads. Noise levels along the I-90 bridge are projected to be 72 dBA Leq at 50 feet from the roadway, with maximum noise levels between 80 and 87 dBA Lmax (maximum noise level) when heavy trucks, such as dump tucks and long-haul tractor trailers, pass by. This is typical for major interstate highways. Measured average noise levels along Bellevue Way SE are between 65 and 69 dBA Leq for front-line residences (less than 50 feet from the road) and between 60 and 64 dBA Leq for second-line homes (about 100 feet from the road). Some species undoubtedly already avoid noisier areas such those found as along I-90 and I-405. The potential short-term adverse impacts on wildlife from increased noise and human activity during construction would be less than what would occur if the East Link Project were located in a rural area. However, some displacement of wildlife from otherwise useable habitat could occur. The degree of displacement would generally be proportional to the change in noise levels over background conditions, the distance of the construction activity from occupied habitats, the frequency, duration, and types of noise and human activity, and changes in the types of human activity during construction.

4.2.1.2 Specific Impacts of Alternatives by Segment

Vegetation and Wildlife

Project construction would require clearing and removal of vegetation from within the construction limits. The short-term construction disturbance would include the area beyond what would be required to accommodate the permanent facility. In particularly sensitive areas, an area that could be needed to construct the alternative was approximated—this was done for all Segment B and E alternatives. The estimated extent of the impacts on vegetation is listed in Table 4-3 in the next section, as most of the impact would occur to high-value habitats. Alternatives that are not listed would not affect these vegetation types.

Within the construction limits, animals of all types occupying areas that would be cleared would lose breeding, foraging, and roosting habitat. Less mobile species and those that retreat to burrows would likely be killed during this initial site work. More mobile species would likely flee to adjacent areas where they may not survive, depending on the availability of nearby suitable and unoccupied habitat. Suitable habitat for these species may be reestablished within the construction limits over time, but increased noise and human presence combined with increased soil compaction may render some areas unsuitable for future re-occupancy by the affected species.

TABLE 4-3
Alternatives with Temporary Wildlife Displacement Expected During Construction

Alternative	Basis for Determination
Alternatives with Relatively Higher Expected Levels of Wildlife Displacement	
B1, Bellevue Way B2A, 112th SE At-Grade B2E, 112th SE Elevated B3, 112th SE Bypass	Location along relatively quieter Bellevue Way and adjacent to Mercer Slough would result in greater increase in noise over existing conditions compared to other Segment B alternatives.
B2E, 112th SE Elevated B3, 112th SE Bypass, along SE 8th Street Elevated portion of B7, BNSF	Elevated structures adjacent to Mercer Slough Nature Park would create more noise near high-value wildlife area.
Alternatives with Intermediate Expected Levels of Wildlife Displacement	
B7, BNSF, at-grade along BNSF right-of-way	Farther from Mercer Slough Nature Park than other Segment B alternatives and proximity to noisy I-405 reduces potential impacts compared to alternatives on the west side of the park.
D5, SR 520	Passes through several relatively large patches of coniferous and deciduous forest.
E1, Redmond Way	Passes through several relatively large patches of coniferous forest.
Alternatives with Relatively Lower Expected Levels of Wildlife Displacement	
Elevated portion of: D2A, NE 16th At-Grade D2E, NE 16h Elevated D3, NE 20th	Short distance near west tributary of Kelsey Creek.
E2, Marymoor E4, Leary Way	Passes through a few relatively large patches of coniferous forest.
E2, Marymoor	Borders on Marymoor Park with large grassy areas and popular trees.
Alternatives with very Low Expected Wildlife Displacement	
All Segment C Alternatives	Highly urbanized corridors.

Affected Habitats and Species with Special Status

Affected Habitats

High value habitats that would be temporarily impacted within the construction limits and their locations include the following:

- Wetland and open water including Mercer Slough (BNSF Alternative [B7]) (See Section 4.3 for wetland impacts discussion)
- Riparian areas associated with Mercer Slough (BNSF Alternative [B7])
- Urban Natural Open Space including Urban—mostly vegetated—deciduous forest (all Segment B alternatives).

The estimated area of upland vegetation communities that would be directly affected during clearing for construction in Segment B varies from about 0.1 acre (112th SE Elevated Alterative [B2E]) to about 2.4 acres (BNSF Alternative [B7]). The BNSF Alternative would affect more riparian forest and deciduous forest area than the other alternatives. Riparian forest is the highest value upland wildlife habitat type in the study area, followed by the deciduous and coniferous forest types. Wetlands, along with riparian forest, are the highest value wildlife habitat type in the project vicinity. While wetlands impacts are addressed in Section 4.3 of this report, it is interesting to note that the BNSF Alternative would also affect more wetland area (2.7 acres) than the other alternatives. Table 4-4 includes an estimate of impacts upland habitats.

The loss of these habitats would persist for varying lengths of time. It was assumed that areas supporting native upland or wetland vegetation and streambanks would be restored to their former condition following construction. While short-term by definition, functional impacts on riparian and forested communities would persist for many years because of the time required for trees to grow enough to provide pre-construction functions.

TABLE 4-4
Short-Term Vegetation Impacts

Alternative	Area of Affected Vegetation (acres)								
	High Value Habitat [a]					Marginal Habitat			
	Riparian Forest	Urban Mostly Vegetated Coniferous Forest	Urban Mostly Vegetated–Deciduous Forest	Urban Mostly Vegetated - Mixed	Subtotal	Urban Moderately Vegetated	Blackberry	Urban Sparsely Vegetated	Grand Total
B1, Bellevue Way	0.0	0.0	0.3	0.0	**0.3**	0.0	0.1	0.0	**0.4**
B2A, 112th SE At-Grade	0.0	0.0	0.7	0.0	**0.7**	0.0	0.2	0.0	**1.0**
B2E, 112th SE Elevated	0.0	0.0	0.1	0.0	**0.1**	0.0	0.1	0.0	**0.2**
B3, 112th SE Bypass	0.0	0.0	0.7	0.0	**0.7**	0.0	0.2	0.0	**0.9**
B7, BNSF	0.9	0.0	1.5	0.0	**2.4**	0.0	0.2	0.2	**2.8**
E2, Marymoor	0.0	0.0	0.0	0.0	**0.0**	0.5	0.0	0.0	**0.5**

[a] Effects on high-value habitats would require adherence to the Bellevue and Redmond CAOs.

Subtotals were added before rounding and therefore reflect true impacted area.

Federal and State Threatened and Endangered, and Candidate Species, and Species of Concern

Marbled Murrelet

During the nonbreeding season, marbled murrelets are rare and infrequent visitors to Lake Washington. They have been observed on the lake in the past but have not been documented to use the lake since the early 1990s. However, because of the declining trend in the murrelet population, the USFWS has set a threshold of no adverse impacts for any project in relation to marbled murrelets. This includes harm or harassment to a murrelet from construction activities. Maximum construction noise levels are projected to be as high as 89.8-dBA Lmax at a distance of 50 feet from the construction site. These noise levels are far below the injury and disturbance thresholds for murrelets established by WSDOT. Therefore, no impacts are expected.

Bald Eagle

None of the five bald eagle nests are located closer than 0.3 mile (about 1,580 feet) from any of the alternatives (see Table 3-8), and the shortest line-of-sight distance from a nest to a construction area would be 0.4 mile (about 2,110 feet). These distances are substantially greater than the recommended minimum of 660 feet. Therefore, according to the USFWS (2007) bald eagle management guidance, potential impacts on nesting bald eagles during project construction would be minimized because disturbance levels would be lower than those specified in the guidelines.

Depending on screening vegetation, prevailing winds, topography, and the sensitivity of the nesting eagles to human activities, WDFW (2001) recommends possible expansion of the conditioned zone, or secondary zone, up to 2,640 feet from the edge of the protected zone, for a total distance of 3,640 feet. The shortest line-of sight distance from a nest to a construction area would be 2,112 feet under the I-90 Alternative (A1) (see Table 3-8). The line-of sight distances from the other nests to the nearest construction area would be about 2,650, 3,080 feet, and greater than 1 mile (two nests), respectively. Given the general location of these bald eagle nests in an urban area with relatively high levels of human activity, it is very unlikely that construction activities would directly or indirectly affect any of the existing bald eagle nest sites.

There are no known communal roosts within a half mile of any of the alternatives.

The change and increase in human activity from passing construction vehicles and people on foot outside of vehicles could displace eagles farther from the I-90 construction area. A study of bald eagles found that 50 percent of wintering eagles in open areas flushed at 500 feet from the source of human activity but that 98 percent will tolerate human activities at 1,000 feet (Stalmaster and Newman, 1979). Therefore, any increase in displacement in the vicinity of the I-90 Alternative (A1) along I-90 would likely occur within 1,000 feet of the construction area. Given the large areas available for foraging, it is unlikely that this would result in impacts on bald eagle foraging and perching.

Bald eagles are suspected of foraging for salmon along Bear Creek during the fall and winter. Although specific foraging locations are not known, construction of the Redmond Way (E1), Marymoor (E2), and Leary Way (E4) alternatives across Bear Creek could temporarily displace bald eagles from the construction area.

Peregrine Falcon

Peregrine falcons still using the one successful nest on the I-90 East Channel bridge may abandon the eyries during construction. There is no way to estimate whether these birds would nest elsewhere during construction or whether they would reoccupy these eyries after construction is complete.

Olive-sided flycatcher

The olive-sided flycatcher breeds in coniferous forests and may be present along the study area in Segments B and E, although none were recorded before or during surveys. There would be no short-term impacts because only narrow strips of conifer forest stands would be impacted by construction.

Willow flycatcher

These birds typically breed in deciduous thickets, especially in willow thickets. Willow flycatcher nest sites are often close to water. There could be impacts to willow flycatcher habitat due to minor loss of scrub/shrub riparian habitat that could occur at Mercer Slough under the 112th SE At-Grade and Elevated (B2A & B2E), 112th SE Bypass (B3), and BNSF (B7) alternatives.

State Candidate Species

Several other priority species are known to occur in the project vicinity. Aquatic species were addressed in Section 4.1.2.1 of this report. Table 4-5 lists these species and potential construction impacts on the species or their habitat. Stream crossings are specifically called out as an impact due to the loss of riparian habitat to occur as well as changes in other stream characteristics such as shading.

TABLE 4-5
Potential Short-Term Impacts on State Candidate Species Likely or Known to Occur in Project Vicinity

Species[a]	Preferred Habitat	Potential Project Impacts[b]
Pileated Woodpecker	Requires wooded forests with a component of dead and dying trees and snags for foraging and nesting. Prefers deciduous forests but would use conifer forests with some deciduous tree component. Found at Marymoor Park. One bird observed in WR-5.	Signs of pileated woodpecker activity were observed in some larger forest stands. Some habitat loss may occur. Any loss would persist for many years (B1, B2A, B2E, B3, B7).
Western Grebe	Nests in colonies numbering up to several hundred birds on large inland lakes or in coastal marshes of the western United States.	This species could be displaced from some foraging area near I-90 during construction (A1).
Merlin	Seen during the nesting season at Marymoor Park. Unlikely to nest in the study area.	Impacts on this species would be very unlikely. Foraging areas would not be affected.
Purple Martin	Nests in structures over water bodies. Forages over open water or wet areas for insects. Nesting observed at Marymoor Park in 2003, but no activity since.	There are no purple martin nests close enough to any of the alternatives to be affected by construction.

[a] Includes only those species not discussed in text.

[b] Alternative Designations:
A1 = I-90
B1 = Bellevue Way
B2A = 112th SE At-Grade
B2E = 112th SE Elevated
B3 = 112th SE Bypass
B7 = BNSF
D2A = NE 16th At-Grade
D2E = NE 16th Elevated
D3 = NE 20th
D5 = SR 520
E1 = Redmond Way
E2 = Marymoor
E4 = Leary Way

4.2.2 Long-Term Impacts

Long-term impacts are those that cause permanent displacement by the project alternatives, stations, maintenance facilities, traction power substations, and road widening. These impacts would occur during the early stages of construction within each segment and would be permanent.

4.2.2.1 Impacts Common to Most or All Action Alternatives

Many amphibian annual life cycles require seasonal migration among habitats with different ecological properties. These species' populations depend on dispersal connections and landscape links (Gibbs, 1998). Simple linear structures such as roads and at-grade tracks can act as physical and psychological barriers for amphibian movement (Mader, 1984; Gibbs, 1998). Areas where such movements may occur are between Mercer Slough Nature Park and forest remnants to the east and west of the park and between Bear Creek and Marymoor Park. However, the project vicinity already includes many roads that function as partial or complete physical barriers to seasonal amphibian movements between areas of suitable habitats. Few, if any, amphibians are likely to successfully cross the BNSF Railway and I-405 to the east of Mercer Slough Nature Park or Bellevue Way to reach the coniferous patch west of the nature park.

Impacts of Noise and Human Activity on Wildlife

The East Link project vicinity is predominantly urbanized, and the open spaces and open waters include high volumes of human activity with noise from adjacent roadways. East Link operations along elevated track sections adjacent to Mercer Slough (i.e., 112th SE Elevated Alternative [B2E], 112th SE Bypass Alternatvie [B3] along SE 8th Street, and elevated portion of BNSF Alternative [B7]) may result in noise impacts on wildlife above existing noise impacts from adjacent roadways. Noise from at-grade sections would not be expected to cause additional wildlife disturbance or displacement.

4.2.2.2 Specific Impacts of Alternatives by Segment

Vegetation and Wildlife

Table 4-6 provides estimates of the impacts of the project on vegetation communities in each of the segments.

The BNSF (B7) and SR 520 (D5) alternatives would impact the most area of riparian forest; however, none would impact more than 0.6 acre. The Bellevue Way (B1), BNSF (B7), and Redmond Way (E1), alternatives would impact the most high-value coniferous forest, whereas BNSF (B7) is the only alternatives that impacts nearly 1 acre of high-value decidous forest vegetation type. There would be relatively few impacts on vegetation communities in Segment C. Alternatives in Segment D impacts are between 2.1 to 7.4 acres of lost vegetation, but most of this was mapped as urban sparsely vegetated, which has little to no wildlife habitat value.

Animals of all types that lose breeding, foraging, and roosting habitat within the project vicinity would be permanently lost unless they were able to occupy suitable unoccupied habitat nearby.

Affected Habitats and Species

High-Value Habitats

The loss of high-value habitats within the project vicinity would persist because lands would be occupied by project facilities. High-value habitats that would be permanently affected by the project, and their locations, include the following:

- Wetlands (see the Section 4.3) (all Segment B, D, and E alternatives)
- In-stream habitats (discussed in detail in the Section 3.3).
- Riparian areas associated with Mercer Slough (BNSF Alternative [B7]) and along several streams in Segment D (NE 16th At-Grade [D2A], NE 20th [D2E], SR 520 [D5] alternatives)
- Urban natural open space, including urban mostly vegetated—coniferous forest (all Segment B alternatives, small areas along several alternatives in Segments C and D, and all Segment E alternatives) and urban mostly vegetated – deciduous forest (all Segment B alternatives, areas along several alternatives in Segment D, and all Segment E alternatives).

TABLE 4-6
Long-Term Vegetation Impacts within Project Vicinity

Alternative and Connection[a]	Area of Affected Upland Vegetation (acres)								
	High Value Habitat[b]					Marginal Habitat			
	Riparian Forest	Urban Mostly Vegetated – Coniferous Forest	Urban Mostly Vegetated – Deciduous Forest	Urban Mostly Vegetated	Subtotal	Urban Moderately Vegetated	Blackberry	Urban Sparsely Vegetated	Grand Total
Segment A									
A1	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
Segment B									
B1	0.0	1.2	0.5	0.0	**1.7**	0.7	0.0	0.0	**4.0**
B2A	0.0	0.2	0.5	0.0	**0.7**	0.3	0.1	0.1	**1.9**
B2E	0.0	0.2	0.2	0.0	**0.4**	0.1	0.2	0.1	**1.2**
B3	0.0	0.2	0.5	0.0	**0.7**	0.3	0.1	0.1	**1.9**
B7	0.6	1.5	0.9	0.0	**3.1**	0.0	0.1	0.1	**6.1**
Segment C									
C2T-B2A	0.0	0.2	0.0	0.0	**0.2**	0.0	0.0	0.0	**0.3**
C2T-B2E	0.0	0.4	0.0	0.0	**0.4**	0.0	0.0	0.0	**0.7**
C2T-B3	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.8	**0.8**
C2T-B7	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	1.3	**1.3**
C3T-B2A	0.0	0.2	0.0	0.0	**0.2**	0.2	0.0	0.0	**0.6**
C3T-B2E	0.0	0.5	0.0	0.0	**0.5**	0.2	0.0	0.0	**1.2**
C3T-B3	0.0	0.0	0.0	0.0	**0.0**	0.2	0.0	1.0	**1.3**
C3T-B7	0.0	0.0	0.0	0.0	**0.0**	0.2	0.0	1.3	**1.5**
C4A-B2A	0.0	0.2	0.0	0.0	**0.2**	0.1	0.0	0.0	**0.5**
C4A-B2E	0.0	0.2	0.0	0.0	**0.2**	0.1	0.0	0.0	**0.5**
C4A-B3	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.4	**0.4**
C4A-B7	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.6	**0.6**
C7E-B2A	0.0	0.2	0.0	0.0	**0.2**	0.1	0.0	0.1	**0.5**
C7E-B2E	0.0	0.2	0.0	0.0	**0.2**	0.1	0.0	0.1	**0.5**
C7E-B3	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.4	**0.5**
C7E-B7	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.6	**0.7**
C8E-B2A	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
C8E-B2E	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
C8E-B3	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.3	**0.4**
C8E-B7	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.5	**0.6**
Segment D									
D2A-12th	0.3	0.0	0.3	0.0	**0.6**	0.0	0.0	2.5	**3.8**
D2A-6th	0.3	0.0	0.2	0.0	**0.6**	0.0	0.0	2.4	**3.6**
D2E-12th	0.2	0.0	0.3	0.0	**0.5**	0.0	0.0	2.5	**3.6**
D2E-6th	0.2	0.0	0.2	0.0	**0.5**	0.0	0.0	2.4	**3.4**
D3-12th	0.0	0.0	0.1	0.0	**0.1**	0.5	0.0	1.7	**2.3**

TABLE 4-6
Long-Term Vegetation Impacts within Project Vicinity

Alternative and Connection[a]	Area of Affected Upland Vegetation (acres)								
	High Value Habitat[b]					Marginal Habitat			Grand Total
	Riparian Forest	Urban Mostly Vegetated – Coniferous Forest	Urban Mostly Vegetated – Deciduous Forest	Urban Mostly Vegetated	Subtotal	Urban Moderately Vegetated	Blackberry	Urban Sparsely Vegetated	
D3-6th	0.0	0.0	0.0	0.0	**0.0**	0.5	0.0	1.6	**2.1**
D5-12th	0.6	0.3	0.4	0.0	**1.3**	2.3	0.1	2.4	**7.4**
D5-6th	0.6	0.3	0.4	0.0	**1.2**	2.2	0.1	2.3	**7.2**
Segment E									
E1	0.0	1.5	0.6	0.0	**2.1**	1.0	0.0	0.5	**5.7**
E2	0.0	0.6	0.5	0.0	**1.2**	1.1	0.0	0.5	**3.9**
E4	0.0	0.5	0.7	0.0	**1.2**	1.1	0.1	0.9	**4.4**
Maintenance Facilities									
MF1, 116th-D2/D3	0.0	0.0	0.1	0.0	**0.1**	0.0	0.0	0.0	**0.2**
MF1, 116th-D5	0.0	0.0	0.0	0.0	**0.0**	0.1	0.0	0.0	**0.1**
MF2, BNSF-D2/D3	0.0	0.0	0.1	0.0	**0.1**	0.0	0.0	0.0	**0.2**
MF2, BNSFD5	0.0	0.0	0.4	0.0	**0.4**	0.0	0.0	0.0	**0.7**
MF3, SR 520 – all Seg D	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**
MF5 – SE Redmond – E1, E2, E4	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	**0.0**

Note: Alternatives that are not listed would not affect these vegetation types.

[a] Alternative Designations:

A1 = I-90	B7 = BNSF	C7E = 112th NE Elevated	D5 = SR 520
B1 = Bellevue Way	C1T = Bellevue Way Tunnel	C8E = 110th NE Elevated	D5 = SR 520
B2A = 112th SE At-Grade	C2T = 106th NE Tunnel	D2A = NE 16th At-Grade	E1 = Redmond Way
B2E = 112th SE Elevated	C3T = 108th NE Tunnel	D2E = NE 16th Elevated	E2 = Marymoor
B3 = 112th SE Bypass	C4A = Couplet	D3 = NE 20th	E4 = Leary Way

[b] These are high-value habitats and therefore effects on these areas would require adherence to the Bellevue and Redmond CAOs.

Federal and State Threatened and Endangered, and Candidate Species, and Species of Concern

Marbled Murrelet

Project operations are not expected to affect marbled murrelets because of the project's location along the existing I-90 bridge and because marbled murrelets are rare in the study area (one sighting in the past 50 years on Lake Washington). Furthermore, the maximum operating noise levels are projected to be far below the injury and disturbance thresholds for murrelets established by the USFWS. Therefore, no operational impacts are expected.

Bald Eagle

Because of local bald eagle acclimation and distances to eagle nests, no impacts on bald eagles would be expected from operation of this project.

Peregrine Falcon

Because there is an existing successful nest on I-90 that experiences vehicular noise, no impacts to peregrine pair or nest would be expected from operation of this project.

Olive-Sided Flycatcher
Because the potential habitat areas suitable for the olive-sided flycatcher are already adjacent to noisy arterial roadways and the project would not introduce more human activities near these habitats, no impacts on the olive-sided flycatcher are expected.

Willow Flycatcher
Because the potential habitat areas suitable for the willow flycatcher are already near or being crossed by noisy arterial roadways and the project would not introduce more human activities near these habitats, no impacts on the willow flycatcher are expected.

Other State Species
Loss of high value habitat and foraging may affect some priority species.

4.3 Wetland Resources

Construction of the East Link Project could have long-term and short-term direct and indirect impacts on wetlands in the project vicinity. The following sections outline the range of potential impacts that could occur for each segment and alternative. Actual impacts would depend on the final design, construction methods, BMPs implemented during construction, and success of post-construction wetland restoration. No wetland resources were identified in Segments A or C, so these segments are not discussed in the text or shown on exhibits. Tables of potential short-term and long-term impacts by alternative and by wetland and wetland buffers affected are included in Appendix F, Attachment 2.

4.3.1 Short-Term Construction-Related Impacts

4.3.1.1 Types of Impacts Common to All Project Alternatives

It is assumed that construction-related areas would be only temporarily affected and that they would be restored to pre-project conditions after construction. However, the duration of short-term impacts can vary depending on the wetland type that is affected. For instance, short-term impacts on emergent wetland functions could persist for months to a few years after construction because of the time required for restored areas to perform their pre-construction functions. Functional impacts resulting from loss of a forested wetland area would persist for more years because of the time required for trees to grow enough to provide pre-construction functions.

Short-term impacts as a result of construction activities can be either direct and quantifiable or indirect and qualitative. Potential short-term *direct* impacts include the following:

- Vegetation clearing and temporary site grading and filling for access.
- Soil compaction during construction activities that contributes to a decrease in soil permeability, infiltration, water-storage capacity, and vegetation regrowth.

Short-term *indirect* impacts on the qualitative function of wetlands that could potentially occur inside and directly adjacent to the construction limits include the following:

- Accidental spills of fuel oils, chemicals, and/or concrete leachate used during construction that impact aquatic species.
- Noise and human activity associated with construction activities that temporarily displace wildlife.
- Some increase in sediment loading and turbidity from grading and filling activities that could allow sediment-laden runoff into wetlands and affect water quality.
- Short-term changes in wetland hydrology due to soil compaction or access road construction.
- Introduction of invasive species as a result of disturbance.

4.3.1.2 Specific Impacts of the Alternatives in Each Segment

Table 4-7 shows quantitative short-term direct impacts on wetlands and wetland buffers for each segment and project alternative. There would be no short-term direct or indirect impacts on Segments A, C, or D. These impacts would in addition to the permanent impacts resulting from the project.

Segment B Short-Term Direct Impacts

Segment B would have the greatest amount of both buffer and wetland impacts and impacts on the highest category wetlands. Short-term direct impacts could occur on up to 2.7 acres of wetlands and up to 1.8 acres of wetland buffer depending upon the chosen alternative in this segment. All wetlands are Category 1 with associated buffers and most are palustrine wetlands, primarily PEM, PSS, and PFO. As shown in Table 4-7, the BNSF Alternative (B7) has the potential for the largest wetland impacts (2.7 acres, see Table 4.-7), and the Bellevue Way (B1), 112th At-Grade (B2A), 112th Elevated (B2E), and 112th Bypass (B3) alternatives have the most potential wetland buffer impacts. However, B2A, B2E, and B3 would primarily affect wetland buffers along 112th Avenue NE that consist of highly disturbed vegetation dominated by Himalayan blackberry.

Segment B Short-Term Indirect Impacts

WR-4 and WR-5 are outlying wetlands hydrologically dependant on Mercer Slough and could be indirectly affected by construction of the BNSF Alternative (B7) if the hydrology to these wetlands is affected. Similarly, construction of the 112th SE Bypass Alternative (B3) could indirectly affect WR-3 if construction activities hydrologically disconnect the northwest portion of this wetland from Mercer Slough.

Segment E Short-Term Direct Impacts

There are no direct short-term impacts on wetlands associated with the Segment E alternatives. However, there is the potential for direct short-term impacts on wetland buffers, as shown in Table 4-7. Of the alternatives with wetland buffer impacts, the Marymoor Alternative (E2) has the potential for the largest wetland buffer impacts (i.e., 0.4 acre). The Marymoor Alternative (E2) would affect the buffers for the second highest rated sites in the study area, WR-12 and WR-13, rated Category 2.

Segment E Short-Term Indirect Impacts

Indirect impacts as described in Section 4.2.1 may occur with implementation of the Segment E alternatives. Short-term indirect impacts on wetland WR-12 may occur from changes in the flow of water to the riparian wetlands within and bordering Bear Creek. The level of impacts may be reduced by working in the dry season and implementing sediment-control BMPs.

4.3.2 Long-Term Impacts

4.3.2.1 Types of Impacts Common to All Alternatives

Long-term, direct impacts are those that occur inside the project limits where the permanent alternatives (i.e., at-grade alternatives, columns for elevated alternatives, elevated structures), stations, maintenance facilities, park-and-ride lots, traction power substations, and road widening would occur. It is assumed that these areas would be permanently affected and all wetlands or buffers within these areas would be lost. For elevated sections of the alternatives, the entire footprint under the elevated structure is assumed to be affected long-term at this design stage, even though only the support columns for the elevated sections would remain as a permanent footprint. At this design stage, the location and number of support columns is not known. It is expected, therefore, that most of the long-term impacts associated with elevated sections of the alternatives can be avoided or minimized during final design and during construction. Depending on the combination of alternatives selected, the range of impact could vary from permanently filling or altering from 0.005 to 1.8 acres of wetland prior to compensatory mitigation.

Long-term indirect and qualitative impacts may also occur as a result of construction and operation activities. Potential long-term *indirect* impacts for each of the project alternatives include the following:

- Shading of areas of wetlands cast beyond the elevated structure footprint.
- Trackway and paved area runoff to surface waters or wetlands that degrade water quality.
- Accidental fuel, oil, or chemical spills during light rail operation and maintenance.

4.3.2.2 Specific Impacts of the Alternatives in Each Segment

Table 4-8 shows potential long-term direct impacts on wetlands and wetland buffers for each segment, project alternative, and connection option. There are no long-term direct or indirect wetland impacts on Segments A or C. Appendix F, Attachment 2, contains tables of the quantitative impact information by alternative.

Segment B Long-Term Direct Impacts

Segment B would have the greatest amount of direct impacts on wetlands and wetland buffers, as well as the greatest amount of impacts on the highest category wetlands, Category 1. The BNSF Alternative (B7) would have the largest wetland impact (i.e., 1.8 acres, Category 1), while the Bellevue Way (B1) and the 112th SE At-Grade (B2A) alternatives would avoid all direct impacts on identified wetland resources. The 112th SE Elevated (B2E), 112th SE Bypass (B3), and BNSF (B7) alternatives have the potential to impact small portions of existing wetland mitigation sites associated with Mercer Slough. The Bellevue Way (B1), 112th SE At-Grade (B2A), 112th SE Elevated (B2E), and 112th SE Bypass (B3) alternatives would have the greatest wetland buffer impacts (i.e., 2.0 to 3.7 acres, Category 1).

Segment B Long-Term Indirect Impacts

The elevated sections of the 112th SE At-Grade (B2A), 112th SE Elevated (B2E), 112th SE Bypass (B3), and BNSF (B7) alternatives could have long-term shading impacts on wetland resources where they pass through Mercer Slough wetlands. The effect of shading on wetland resources would depend on the degree to which the elevated sections prevent sunshine from reaching the wetland resources on a daily basis. Where no other structures abut the proposed elevated sections and prevent angular sun ray penetration (as is the case with the 112th SE At-Grade [B2A], 112th SE Elevated [B2E], 112th SE Bypass [B3] alternatives), it is expected that shading would only be partial and during mid-day. For B7 along I-90 the shading impact may be greater due to the effect the existing I-90 roadway already has on southerly sun exposure. Shading impacts may also help or hinder the spread of non-native and invasive species in the wetland.

Segment D Long-Term Direct Impacts

Alternatives and connection options for all but the NE 20th Street Alternative (D3) would all directly affect 0.3 to 0.4 acre of Category 3 wetlands and also would affect 0.3 to 0.4 acre of Category 3 wetland buffer. D3 and connections would have minor direct wetland and wetland buffer impacts.

Table 4-9 shows the potential long-term direct wetland and wetland buffer impacts associated with the three maintenance facility locations in Segment D. All proposed locations would have impacts on the Category 3 WR-6 wetland, with the 116th Maintenance Facility (MF1) connecting to the SR 520 Alternative (D5) and the BNSF Maintenance Facility (MF2) connecting to the SR 520 Alternative (D5) having the greatest potential direct and indirect impacts.

Segment D Long-Term Indirect Impacts

Long-term indirect impacts on wetlands in Segment D may occur by disturbing upland areas that drain into the wetlands. The potential for this to occur is greatest at WR-6, WR-10, and WR-11, because all three sites receive water from surrounding upland and impervious surface areas. By altering the drainage of these upland areas, or by increasing the amount of impervious surface, the water-flow patterns into the area may change and could subsequently affect the characteristics of the wetlands, including vegetation communities and the types and levels of functions the wetlands provide.

Segment E Long-Term Direct Impacts

The Marymoor Alternative (E2) has the potential to affect up to 0.3 acre of Category 2 wetland and 0.5 acre of wetland buffer. The rest of the Segment E alternatives would have minimal to no direct wetland or wetland buffer impacts.

The Redmond Way (E1) and Marymoor (E2) alternatives have the potential to cause long-term impacts on the mitigation wetland at Marymoor Park (WR-13) and to the wetland and riparian buffer at the railroad crossing at Bear Creek (WR-12). Approximately 0.3 acre of the northern portion of the mitigation wetland would be lost due to the construction of the at-grade sections of the Marymoor Alternative (E2) through the wetland.

Segment E Long-Term Indirect Impacts

The elevated sections of the Marymoor (E2) and Leary Way (E4) alternatives could have long-term shading impacts on wetland and riparian vegetation. The effect of shading on wetland resources would depend on the degree to which the elevated sections prevent sunshine from reaching the wetland resources on a daily basis. As no other structures abut the proposed elevated sections and prevent angular sun ray penetration, it is expected that shading would only be partial and during mid-day. E2 may also indirectly affect WR-13. The amount of indirect impacts on the central and southern portions of this mitigation wetland (WR-13) would depend on the

location and placement of staging equipment and the use of siltation fencing and other BMPs to control construction-related sedimentation.

TABLE 4-7
Short-Term Direct Impacts on Wetlands and Wetland Buffers by Project Alternative[a]

Project Alternative	Category	Wetland Area Affected (acres)	Wetland Buffer Area Affected (acres)
B1, Bellevue Way	1	0.1	1.8
B2A, 112th SE At-Grade	1	0.3	1.7
B2E, 112th SE Elevated	1	0.1	1.1
B3, 112th SE Bypass	1	0.2	1.7
B7, BNSF	1	2.7	0.7
E1, Redmond Way	2	0	0.1
E2, Marymoor	2	0.3	0.4
E4, Leary Way	2	0	0.1

[a] Alternatives not listed do not have direct short-term wetland or wetland buffer impacts.

TABLE 4-8
Long-Term Direct Impacts on Wetlands and Wetland Buffers by Project Alternative and Connection Option[a]

Alternative and Connection	Category	Wetland Area Affected (acres)	Wetland Buffer Area Affected (acres)
B1, Bellevue Way	1	0	2.0
B2A, 112th SE At-Grade	1	0	3.5
B2E, 112th SE Elevated	1	0.002/(0.005 mitigation site)	3
B3, 112th SE Bypass	1	0.004/(0.005 mitigation site)	3.7
B7, BNSF	1	1.8/(0.3 of mitigation site)	0.8
D2A, NE 16th At-Grade, Connecting from NE 12th	3	0.4	0.3
D2A, NE 16th At-Grade, Connecting from NE 6th	3	0.4	0.3
D2E, NE 16th Elevated, Connecting from NE12th	3	0.3	0.3
D2E, NE 16th Elevated, Connecting from NE 6th	3	0.3	0.3
D3, NE 20th, Connecting from NE 12th	3	0.1	0.1
D3, NE 20th, Connecting from NE6th	3	0.1	0.1
D5, SR 520, Connecting from NE 12th	3	0.4	0.4
D5, SR 520, Connecting from NE 6th	3	0.4	0.4
E1, Redmond Way	2	0/(0.1 of mitigation site)	0.1
E2, Marymoor	2	0.1/(0.3 of mitigation site)	0.5
E4, Leary Way	2	0/(0.2 of mitigation site)	0.1

[a] Alternatives not listed do not have direct short-term wetland or wetland buffer impacts.

TABLE 4-9
Long-Term Direct Impacts on Wetlands by Maintenance Facility Placement

Maintenance Facility	Wetland Locator - Wetland Name	Category	Wetland Affected Area (acres)	Wetland Buffer Affected Area (acres)
MF1, 116th, connecting from NE 16th At-Grade/Elevated (D2A/E) and NE 20th (D3)/SR 520 (D5)	WR-6—BNSF Matrix	3	0.1	0.4
MF2, BNSF, connecting from SR 520 (D5)	WR-6—BNSF Matrix	3	0.2	0.8

5.0 Potential Mitigation Measures

Appendix A (Best Management Practices for Sensitive Natural Resources) identifies the typical regulatory requirements for avoidance and minimization of impacts on ecosystem resources during design and construction. Sound Transit may also take additional measures to avoid and minimize impacts on sensitive natural resources as needed. The Biological Assessment prepared for ESA consultation may also outline conservation measures and proposed aquatic habitat improvements that would become conditions of federal approvals for the project. Based on this analysis, and the mitigation measures proposed herein, Sound Transit expects that the determination for ESA-listed species would be "may affect and is not likely to adversely effect" listed species and there would not be effects on Essential Fish Habitat under the Magnuson-Stevens Fishery Conservation and Management Act.

To the extent that impacts cannot be avoided or minimized through BMPs, Sound Transit would implement the following compensatory mitigation measures:

5.1 Aquatic Resources Compensatory Mitigation Measures

- Where realignment of streams is required, Sound Transit would reconstruct new channels with improved habitat features to improve salmonid spawning and rearing functions, adding large woody debris and replacing or improving streamside riparian habitat functions. Specific requirements and details of these measures would be established during final design and project permitting.
- Habitat function in Sturtevant Creek would be lost in the 400- to 700-foot-long section that would be culverted under the Hospital Station. This would be compensated for by improving equivalent habitat along another segment of Sturtevant Creek that currently does support salmonidis or by improving equivalent habitat elsewhere in the Kelsey Creek basin. This would be determined during during final design and project permitting.
- For alternatives with culvert lengthening (i.e., Goff Creek and Valley Creek), habitat improvements could be made in the form of large woody debris placements. For maximum benefit to fisheries, habitat improvements could be done in either Valley Creek or Kelsey Creek. A final approach would be developed during final design and project permitting. Also, the extension of a culvert on Goff Creek for the SR 520 Maintenance Facility (MF3) may be avoided by realigning the stream or reducing the length of culvert.
- Riparian plantings to mitigate impacts in riparian areas from shading by elevated tracks or bridges would be possible in a number of locations, such as in Mercer Slough, West Tributary to Kelsey Creek, Valley Creek, Bear Creek, and the Sammamish River. The Sammamish River would receive the most benefit from this mitigation.
- Sound Transit would consult with the tribes to avoid impacting tribal fishing events for construction work in Lake Washington. No other mitigation is proposed for aquatic species during construction.

5.2 Upland Vegetation and Wildlife Resources Compensatory Mitigation Measures

- Areas disturbed in the construction staging areas would be revegetated within 1 year following construction.
- Sound Transit would update its survey of bird nests during final design. If a bald eagle nest isfound within a half mile of the proposed construction limits, a bald eagle management plan would be prepared. Under the Mirgratory Bird Treaty Act (MBTA), nesting migratory bird nests cannot be destroyed during the breeding season. If nests are found, then, at a minimum, Sound Transit would relocate sensitive nests before beginning construction and Sound Transit would consult with the USFWS on methods to implement during construction to avoid impacts on migratory birds, consistent with the MBTA and the Bald and Golden Eagle Act.

- High-value habitat regulated by local agency regulations that are affected by the project would be mitigated with habitat replacement or enhancement. The type of habitat to be established would depend on the affected species. The type of habitat to be replaced and mitgation ratios would be determined through discussions with local permitting agencies during final design and project permitting.
- Sound Transit would adhere to local ordinances regarding tree replacement ratios.

5.3 Wetland Resources Compensatory Mitigation Measures

Compensatory mitigation for unavoidable adverse impacts to wetlands would be provided according to the replacement ratios for affected wetlands shown, based on local jurisdictions' requirements. (Sound Transit is committed to achieving no net loss of wetland function and area on a project-wide basis.) To the extent possible, compensatory mitigation sites would be identified close to impacts and compensate for lost values in-kind. Sound Transit determined there are several opportunities for wetland mitigation to occur in the study area that are expected to meet required mitigation ratios. The specific compensatory mitigation for the selected alternative would be determined during final design and project permitting.

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Appendix A

Best Management Practices for Sensitive Natural Resources

Appendix A

Best Management Practices for Sensitive Natural Resources

The following list of measures is a compilation of best management practices (BMPs) that can be used to avoid and minimize short-and long-term impacts of the East Link project. These BMPs are either required by state or federal agencies to obtain permits required for the project or may be required to comply with typical permit conditions. They are based on Sound Transit's knowledge of permit requirements and experience with conducting environmental compliance and permitting for numerous other projects in the Puget Sound area.

Construction-Related BMPs

General BMPs for All Sensitive Areas

The project would delineate construction limits for vegetated and habitat areas that may be disturbed during construction. The intent is to prevent unintended effects to riparian vegetation, wetlands, woodlands, and other sensitive sites outside of the construction limits. The construction limits would be clearly marked with high-visibility construction fencing prior to any ground-disturbing or construction-related activities. There would be no direct site disturbance outside of the construction limit.

Soil or rock stockpiles, excavated materials, or excess soil materials would be prevented from eroding into sensitive habitats, including water channels, wetlands, and riparian areas outside of the construction limits by high water or storm runoff. Sound Transit or its construction contractor would develop a Temporary Erosion and Sediment Control (TESC) plan that would be implemented during construction. This TESC plan would address potential erosion during construction. The contractor would implement the plan before discharging or allowing runoff from the site. Monitoring requirements specified in the TESC would provide feedback to make sure that the erosion control practices are operating properly and effectively.

Fish and Aquatic Habitat Protection

All work would comply with the terms and conditions set forth in the Hydraulic Project Approval (HPA) issued for the project by the Washington Department of Fish and Wildlife (WDFW). The HPA program is the vehicle through which WDFW regulates activities that affect the bed or flow of waters of the state for the protection of fish life. An HPA is required for construction or structural work associated with any bridge structure or culvert construction within or below the ordinary high water mark (OHWM) of waters of the state.

Seasonal restrictions (i.e., work windows) applied to work conducted below the OHWM would be as required by an HPA issued by WDFW and by the Section 404 permit issued by the U.S. Army Corps of Engineers (USACE).

In accordance with typical requirements of a HPA, when large woody debris must be moved to allow the reasonable use of an over-water or in-water facility, the large woody debris would be returned to the water downstream, where it would continue to provide aquatic habitat function.

All newly installed culverts would be in compliance with Washington Administrative Code (WAC) 220-110-070 (http: //wdfw.wa.gov/hab/ engineer/w2201170.htm) regarding fish passage requirements. Any affected streambeds, stream banks adjacent to culverts, and at the stream relocation reach, would be permanently restored following in-water work with plantings of native or approved woody and herbaceous species within one year of completion of each phase of construction. Bank protection would follow the guidelines set forth in WDFW's Integrated Streambank Protection Guidelines (http://wdfw.wa.gov/hab/ahg/ispgdoc.htm).

Water Quality

The Federal Clean Water Act (CWA) (1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the

goals of the CWA is the National Pollutant Discharge Elimination System (NPDES) permit program, which is administered by the U.S. Environmental Protection Agency (EPA). EPA has delegated responsibility to administer the NPDES permit program to the State of Washington on the basis of Chapter 90.48 of the Revised Code of Washington (RCW), which defines the Washington State Department of Ecology (Ecology) authority and obligations in administering the wastewater discharge permit program.

Ecology's construction stormwater general permit is required for certain construction activities. The goal of the permit is to reduce or eliminate stormwater pollution and other impacts to surface waters from construction sites.

The project must complete a Notice of Intent (NOI) for coverage under the permit. The project must also develop a Stormwater Pollution Prevention Plan (SWPPP) that implements BMPs for identifying, reducing, eliminating, or preventing sediment and erosion problems on site.

Any materials placed below the OHWM (e.g., cobble or boulders for energy dissipation at culvert ends, streambed gravel or other substrates) would have a sufficiently low sediment fraction so as not to violate Section 401 permit conditions when flow is restored to the work site. To the fullest extent practicable, culverts would be installed, modified, and/or replaced in isolation from stream flow (if there is flow during the work window) by means of a temporary bypass flume, diversion culvert, or by temporarily pumping flow around the in-water work zone. Any temporary dewatering of the in-water work zone would be preceded by work area isolation and fish removal/relocation (as necessary). Fish handling would be conducted by a trained and qualified biologist. Turbid water produced during the course of in-water work would be prevented from discharging to fish-bearing waters or wetlands. Turbid wastewater may be routed to temporary or permanent detention facilities, or to upland areas that provide adequate rates of infiltration.

In accordance with conditions of a typical HPA, heavy equipment used during the course of in-water work would operate from above the OHWM wherever possible. Use of equipment below the OHWM would be limited to that necessary to gain position for work. Drive mechanisms would not enter or operate below the OHWM, except under the terms of the HPA issued by WDFW.

Uncured concrete and/or concrete byproducts would be prevented from coming in contact with streams or water conveyed directly to streams during construction. Any water having direct contact with uncured concrete would be contained and treated or removed from the site (as appropriate) to prevent discharge to streams or wetlands.

Installation of permanent footings and all drilled or pile-driven shafts (and excavated spread footings) below the OHWM (e.g., for culvert end-walls) would be conducted in a manner consistent with Section 404 and other permits issued for the project by the USACE and other parties (as applicable). When constructing drilled shafts, the contractor would ensure that all drilling equipment, drill recovery and recycling pits, and any waste or spoil produced are properly contained to prevent discharge of drill wastes or fluids to any surface water or wetlands.

In accordance with typical Section 401 permit requirements, turbidity would be monitored if in-water work occurs when water is flowing in the streams. Equipment (excluding track-mounted equipment, large cranes, and other relatively immobile equipment) would be refueled and maintenance activities conducted at a distance from the nearest wetlands, ditches, and flowing or standing water approved by regulatory permits. Appropriate spill prevention measures and fuel containment systems would be designed and implemented to completely contain a potential spill as specified in the Spill Prevention and Control Countermeasure (SPCC) plan. If flooding of the work area is expected to occur within 24 hours, all equipment and material would be evacuated from near-stream construction sites. An exception would be for efforts to avoid or minimize resource damage. All equipment that is used for in-stream or in-wetland work would be cleaned prior to operations below the OHWM. Wash-water would not be discharged directly into any water body without pretreatment.

Weed Control

Weeds would be treated and monitored for a period of at least 3 years on property disturbed during construction. Chemicals to be used and application methods would be approved by the King County Noxious Weed Control Board and the Washington State Noxious Weed Control Board.

Design and Operation BMPs

The project would install permanent storm water runoff treatment and flow control facilities where needed according to the requirements of the 2002 Ecology Manual or the most recently adopted manual.

The project would incorporate storm water conveyance and management facilities that promote infiltration where applicable.

The project would select, design, and install runoff treatment BMPs that are best suited to the site conditions and best capable of achieving the required levels of treatment (subject to negotiation with the local jurisdiction and/or Ecology). These would or may include natural or engineered dispersion BMPs; biofiltration BMPs such as vegetated filter strips, biofiltration swales, or ecology embankments; wet-pool BMPs; and infiltration BMPs.

The project would not reroute existing drainage configurations to the extent that storm water from one basin or subbasins is conveyed and discharged to another.

The project would implement integrated pest management techniques, in accordance with current Ecology water quality agreements to minimize the effect on aquatic and terrestrial environments.

Appendix B

Wildlife Function Field Data Form

Sound Transit East Link Wildlife Functions Field Data Form
(Adapted from WSDOT's BPJ Characterization)

Project:
_____ Date: _____
Site ID:
_____ Biologist: _____

Function	Likely or Not Likely to Provide (State Your Rationale), Yes/No, or Number
F. General Habitat Suitability	
1. Area is not fragmented by development.	
2. Upland surrounding area is undeveloped.	
3. Area has connectivity with other habitat types.	
4. Diversity of plant species is high.	
5. Evidence of wildlife use, e.g., tracks, scat, gnawed stumps present.	
6. Distance to disturbance source and type.	
H. Habitat for Amphibians	
1. Cover (i.e., woody debris, rocks, and leaf litter) present.	
2. Woody debris present within area.	
3. Proximity to wetland habitats – distance and type.	
4. Lands within 1 km (0.6 mi) of area are > or = 40% undeveloped.	
5. Wetlands and/or an intermittent or perennial stream within 1 km (0.6 mi) of area.	
6. Presence of movement barrier between above wetland or stream and site being evaluated	
I. Habitat for Mammals	
1. Permanent water present within the area.	
2. Presence of emergent vegetation in areas of permanent water.	
3. Areas containing dense shrubs and/or trees are present.	
4. Interspersion between different strata of vegetation.	
5. Presence of slopes / banks suitable for denning.	
6. Evidence of wildlife use, e.g., dens, tracks, scat, gnawed stumps, etc.	
J. Habitat for Birds	
1. Forested and scrub-shrub classes present within the area.	
2. Average tree height.	
3. Average DBH.	

Function	Likely or Not Likely to Provide (State Your Rationale), Yes/No, or Number
4. Largest DBH and percent of trees in this class.	
5. Relative tree species diversity (L, M, H).	
6. Snags present in area .	
7. Cavities present in trees.	
8. Tree % canopy estimate.	
9. Shrub % canopy estimate.	
10. Adjacent area contains relatively undisturbed grassland or wetland shrub and/or forest habitats.	
11. Lands within 1 km (0.6 mi) of the area are greater than or = 40% undeveloped.	
L. Native Plant Richness	
1. Dominant and co-dominant plants are native.	
2. Area has three or more strata of vegetation.	
3. Area has mature trees (conifer, deciduous?).	
4. Number of species of trees.	
5. Area has well developed shrub layer.	
6. Number of species of shrubs.	
N. Uniqueness and Heritage	
1. Area contains documented occurrence of a state or federally listed threatened or endangered species.	
2. Area contains documented critical habitat, high quality ecosystems, or priority species respectively designated by the USFWS, the WDNR's NHP, or WDFW's Priority Habitats and Species Program.	
3. Area has biological, geological, or other features that are determined rare by the local jurisdiction.	
4. Area has been determined significant by the local jurisdiction because it provides functions scarce for the area	

Appendix C

Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Species with Federal Endangered Species Act Status							
Marbled Murrelet	*Brachyramphus marmoratus*	Bird	FT	ST		X	Requires conifer forests with trees >28-inch diameter at breast high (dbh) with platforms for nesting. Spends the winter in marine waters offshore. Rare and infrequent visitors to Lake Washington during the nonbreeding season.
Taylor's Checkerspot	*Euphydryas editha taylori*	Butterfly	FCo	SoC		X	Parent species Edith's checkerspot (*Euphydryas editha*) listed as occurring in King County. *E. editha taylori* likely does not occur in study area due to a lack of grasslands. *Plantago* only host plant likely growing in study area. Grasslands in Puget Sound lowlands, San Juan's, and Olympic Coast. Larval host plants: paintbrush (*Castilleja*), beardtongues (*Penstemon*), lousewort (*Pedicularis*), owl's clover (*Orthocarpus*), Chinese houses (*Collinsia*), and plantain (*Plantago*).
Federal Species of Concern—No Endangered Species Act Status							
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Bat	FCo	SC		X	Areas with a mosaic of woodland/grassland and/or shrubland, esp. coniferous mosaics. Found in Pierce County, Fort Lewis.
Yuma Myotis	*Myotis yumanensis*	Bat	FCo	NONE		X	Closely associated with water. Moist woodlands, forests, desert scrub. Forages over water and in open, uncluttered habitats. Mapped in Puget Sound.
Western Toad	*Bufo boreas*	Amphibian	FCo	SC	X		Found in a variety of habitats, including slow-moving rivers and streams, and near ponds and lakes. Large population declines in the Northwest. Listed as occurring in the Lake Washington Basin.
Additional Washington Listed Species, and Species of Concern							
Monarch	*Danaus plexippus*	Butterfly	None	SoC	Known in the study area		Listed as occurring in King County. Variety of open habitats: fields, meadows, weedy areas, marshes, and along roadsides. Larval and adult food plants are milkweeds.

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Bald Eagle	*Haliaeetus leucocephalus*	Bird	FCo	SM	Known in the study area		Nests in wooded areas with larger trees within a half mile of large bodies of water. Highly territorial of nesting tree. May have more than one nest tree per territory, as well as roost and perch trees. Several known territories in Segments A, B, and E.
Peregrine Falcon	*Falco peregrinus*	Bird	FCo	SM	Known in the study area		Two historical and recent eyries in Segment A. Nests in sheltered cliff areas naturally, has adapted to using bridges and buildings for nesting sites.
Pileated Woodpecker	*Dryocopus pileatus*	Bird	None	SC	Known in the study area		Requires wooded forests with a component of dead and dying trees and snags for foraging and nesting. Prefers deciduous forests. Will occur in conifer forests with some deciduous tree component. Found at Marymoor Park. One bird observed in WR-5.
Purple Martin	*Progne subis*	Bird	None	SC	Known in the study area		Nests in structures over waterbodies, including natural cavities, pilings, and man-made housing structures. Forages over open water or wet areas for insects while in flight. Nesting observed at Marymoor Park in 2003, but no activity since. Population believed to be in decline throughout its range.
Common Loon	*Gavia immer*	Bird	None	SS		X	Population has declined due to acid rain, pollution, industrial contamination of waterbodies and lead poisoning. Artificial floating nesting platforms have reduced the negative impact of fluctuating water levels from human activities to nests.
Western Grebe	*Aechmophorus occidentalis*	Bird	None	SC	Known in the study area		Nests in colonies numbering up to several hundred birds on large inland lakes or in coastal marshes of the western United States. Birds breeding in the northern extent of their range migrate to the western coastal ocean to spend the winter.
Merlin	*Falco columbarius*	Bird	None	SC	X		Seen during the nesting season at Marymoor Park.

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Vaux's Swift	*Chaetura vauxi*	Bird	None	SC		X	Nests and forages in groups with 30 or more birds. Nest is a cup shaped nest placed in a dark, confined cavity. Breeds in mountains and foothills, usually >700 meters in elevation. Forages over wooded areas and more open habitats, including towns.
Olive-sided Flycatcher	*Contopus borealis*	Bird	FCo	SM	X		Breeds in coniferous forests in North America. Population is declining due to loss of winter habitat in Central America and the Andes region of South America.
Willow Flycatcher	*Empidonax traillii*	Bird	FCo	SM	Known in the study area		Breeds in deciduous thickets, especially in willow thickets. Nest site often close to water.

[a] **Federal Status:**

FT=Federal Threatened

FC=Federal Candidate

FCo=Federal Species of Concern (no formal ESA status)

[b] **State of Washington Status:**

The Washington Species of Concern list is published by the Wildlife Management Program and includes only native Washington fish and wildlife species that are listed as Endangered, Threatened, or Sensitive, or as Candidates for these designations. Endangered, Threatened, and Sensitive species are legally established in Washington Administrative Codes.

SE=State Endangered

ST=State Threatened

SC=State Candidate

SS=State Sensitive

SoC=State Species of Concern

SM=State Monitor Species (this is the “lowest level” of species classification afforded to fish and wildlife species in the state of Washington. State Monitor Species are not considered Species of Concern, but are monitored for status and distribution in a particular area.

Appendix D

WDFW-Recommended Management Buffer Distances for Bald Eagles

WDFW-Recommended Management Buffer Distances for Bald Eagles

This information is summarized from the Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species Management Recommendations for Bald Eagles (WDFW, 2001).

Nest Area

When developing site management plans, WDFW recommends buffering bald eagle nests with a two-zone management system that mimics a strategy designed by the U.S. Fish and Wildlife Service (USFWS, 1981). The following guidelines for these zones are based on the research cited in WDFW's Priority Habitat and Species Management Recommendations for bald eagles (WDFW, 2001):

- Protected Zone (Primary Zone). This zone protects and screens the nest tree and should extend at least 400 feet from the nest tree. Its size and shape will vary with site conditions such as topography, prevailing winds, and screening vegetation, as well as on the eagles' tolerance to human activities. In areas where vegetation and/or topography do not provide adequate screening within 400 feet of the nest, consider increasing the size of the protected zone. Retain all existing large trees and existing forest structure within the protected zone.
- Conditioned Zone (Secondary Zone). The conditioned zone further screens and protects nest sites in the protected zone and should extend from 330 to 800 feet beyond the edge of the protected zone. Alternate nest locations, perch trees, and feeding sites should be included in this zone and will influence its size and shape (Stallmaster, 1987). Depending on screening vegetation, prevailing winds, topography, and the sensitivity of the nesting eagles to human activities, this zone may need to be expanded up to 2,640 feet from the edge of the protected zone. Avoid constructing roads or trails within sight of the nest that would facilitate human or predator access to the nest. Construction activities (e.g., homes, roads, and power lines) that take place out of sight of the nest should be postponed until after the young eagles have fledged, as should forest practice activities.

Roosting Habitat (Communal Roosts)

Activities that produce noise or visual effects within 400 feet of the edges of communal roost trees or staging trees should be conducted outside of the critical roosting period (November 15 to March 15). This corresponds to the time when most eagles begin to arrive in eastern and western Washington, with numbers peaking in December and January and declining rapidly by mid-March (Fielder and Starkey, 1980; Garrett, et al., 1988; Stalmaster, 1989). There are no known communal roosts in the project vicinity.

Perching and Foraging Habitat

Perches along shorelines near winter roosts or in nesting territories are important to foraging eagles. Tree structure, and the distance between habitat alterations and shorelines should be considered when managing for bald eagle wintering habitat.

Perch Structure and Location

In Washington, protect known bald eagle perch trees and potential foraging perches greater than 20 inches dbh and within 246 feet of the top of a bank or shoreline. Chandler, et al., (1995) recommends protecting patches of shoreline forest, and specifically protecting live and dead trees over 8 inches dbh for future habitat.

Human Disturbance

Bald eagles often feed on the ground, in open areas where food resources are concentrated. They should be allowed a distance of at least 1,500 feet from human activity and permanent structures. Buffer zones of 800 to 1,000 feet) have been recommended in perching areas where little screening cover is present (Stalmaster and Newman, 1978). Stalmaster and Newman (1979) found that 50 percent of wintering eagles in open areas flushed at 500 feet, but 98 percent would tolerate human activities at 1,000 feet. Activities that disturb eagles while feeding, especially during winter, can cause them to expend more energy, which increases their susceptibility to disease and poor health (Stalmaster, 1987).

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Appendix E

Management Recommendations for Locally Important Species Found in the East Link Project Area

Management Recommendations for Locally Important Species Found in the East Link Project Area

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DATE: February 14, 2008

Introduction

Title 21A of the Growth Management Act (GMA) requires counties and cities in Washington to designate and protect critical areas, in accordance with RCW 36.70A.170. The GMA requires local jurisdictions to designate and protect critical areas, using the best available science (BAS) in developing policies and regulations to protect critical area functions and values. The purpose of the GMA is to avoid the possibility of uncoordinated and unplanned growth as the population in the state continues to rise and development increases. The GMA is intended to protect the public's health and safety by requiring county and city governments to create local based plans and regulations that are centered on land use and natural resource issues as guided by the state legislature. Critical areas are one of the two primary natural resource areas addressed in the GMA planning process. Critical areas include wetlands, critical recharge areas for potable water aquifers, frequently flooded areas, geologically hazard areas, and Fish and Wildlife habitat conservation areas.

Fish and Wildlife Habitat Conservation Areas

Fish and Wildlife habitat conservation areas are the primary way the Washington Department of Fish and Wildlife (WDFW) works to conserve wildlife habitat in Washington State. While WDFW is charged with protecting and maintaining fish and wildlife populations, WDFW has little authority over the habitats used by fish and wildlife species. Protection is primarily achieved through the voluntary actions of landowners and through existing state regulations, including the State Environmental Policy Act (SEPA), the Growth Management Act, the Forest Practices Act (FPA), and the Shoreline Management Act (SMA). WDFW primarily serves an advisory role, by reviewing proposals for development and offering guidelines for species management on private property. WDFW has written management guidelines for all state and priority listed species. Priority species include species and wildlife congregations that are priorities for conservation due to their population status, sensitivity to disturbance, economic, recreational or tribal importance. These species may or may not be listed as an endangered, threatened, sensitive, or candidate species by the state or federal government. The management recommendations are generalized guidelines and are not enforceable regulations. They are based on the needs of fish and wildlife species, and are not based on land use objectives.

Fish and Wildlife Habitat Conservation Areas are lands that are managed for perpetuating species in suitable habitats within their natural range, and to prevent the creation of isolated subpopulations. As set forth in the WAC guidelines, Fish and Wildlife Habitat Conservation Areas include:

a. Areas with which federal and state endangered, threatened, and sensitive species, and state candidate species, have a primary association;

b. Habitats and species of local importance;

c. Commercial and recreational shellfish areas;

d. Kelp and eel grass beds; herring and smelt spawning areas;

e. Naturally occurring ponds under 20 acres and their submerged aquatic beds that

f. Provide fish or wildlife habitat;

g. Waters of the state;

h. Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal

i. Entity; or

j. State natural area preserves and natural resource conservation areas.

In order to meet the requirements established by the GMA, King County and the Cities of Bellevue, Mercer Island and Redmond created Critical Areas Ordinances to ensure the management and protection of lands used by listed and locally important species. Species of Local Importance include native species that are in danger of becoming federally or state listed or extirpated if current population trends continue. The long-term preservation of the species is dependent on the protection it receives. Without the additional protection, the species or habitat is likely to decline in the future. Localized populations that are vulnerable or in decline, or species or habitats that offer some special value may also be considered locally important. Fish and Wildlife Habitat Conservation Areas also include areas associated with state priority species, and areas critical for habitat connectivity. These wildlife habitats are classified and rated by a variety of internal (site specific) and external (contextual) habitat conditions.

King County Comprehensive Plan

The King County code protects critical areas as well as their buffers in order to protect the health and safety of the County's residents and its environment. In October of 2006, King County adopted ordinances 15605-15607, amending the 2004 Updated Comprehensive Plan. Chapter 4 of the King County Comprehensive Plan establishes recommendations for protecting listed and locally important wildlife and their breeding habitats. Protection is given to species of local importance using regulations, incentive programs, land purchases, networking of wildlife corridors, and development clustering. Species considered to be locally important in King County are shown in Table 1. In addition, King County is required to protect designated wildlife corridors, riparian corridors, and the breeding sites of two species of raptors and herons. These four species and their breeding habitats are shown in Table 2.

TABLE 1
King County Designated Locally Important Species

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Locally Important Species listed by King County (King County Comprehensive Code Chapter 4)					
Trumpeter Swan	*Cygnus buccinator*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Trumpeter Swans spend the winter from November to April in the open fields and estuaries of Skagit and Whatcom Counties. Recently, their range has expanded to Grays Harbor and other areas of western Washington. There are currently no trumpeter swans breeding in Washington
Tundra Swan	*Cygnus columbianus*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Tundra Swans are common in fresh- and saltwater habitats throughout the lowlands of northwestern Washington from November to April. Almost 2,000 winter in Skagit County.
Snow Goose	*Chen caerulescens*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Typically observed in large flocks. Up to 55,000 winter in western Washington. Most gather in the Skagit River Delta from mid-October to early May.
Band-tailed Pigeon	*Patagioenas fasciata*	Bird	Known in the study area		Found in low- and mid-elevation conifer and mixed conifer/deciduous forests. Requires a component of mature conifers. Band-tailed Pigeons prefer forest edges, especially open sites bordered by tall conifers.
Harlequin Duck	*Histrionicus histrionicus*	Bird		May Occur	In western Washington, harlequins historically bred in the Olympic and Cascade mountains. Wintering areas include northern Puget Sound, northern Hood Canal, the Strait of Juan de Fuca, San Juan Islands, and the Pacific coast. In winter they are common in marine waters along rocky shorelines and jetties. They are more common in northern Puget Sound then in southern portions of the Sound.
Western Bluebird	*Sialia Mexicana*	Bird		Known in the study	Rare visitor to Marymoor Park. Seen fewer then 10x at Marymoor Park. In western Washington, Mountain Bluebirds

TABLE 1
King County Designated Locally Important Species

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
				area	are uncommon in the Fort Lewis area, and rare in forest clearings in King, Pierce, Thurston, and Mason Counties.
Brant Goose	*Branta bernicla nigricans*	Bird	No	No	Found in estuaries, beaches, bays and spits where they feed and rest before their migration north to Arctic breeding grounds. Ninety-five percent of their diet is composed on eelgrass (*Zostera marina* and *Zostera japonica*) which grow on inter-tidal mudflats.
Black-crowned Night Heron	*Nycticorax nycticorax*	Bird	No	No	Black-crowned Night-herons have been known to breed in western Washington's eastern Puget Trough lowlands. Frequently nest on island and in large trees in small colonies. Usually found in fresh and saltwater wetlands. In spring and fall, they can be found in wetlands flanking large river basins.
Blue Grouse	*Dendragapus obscurus*	Bird	No	No	In Washington, blue grouse are found in three distinct areas east of the Cascades. Blue grouse are found in mountainous areas wherever open coniferous forests are present. They are closely associated with true fir (*Abies* spp.) and Douglas fir *(Pseudotsuga menziesii*) forests.
Mountain Quail	*Oreortyx pictus*	Bird	No	No	Found on mountain slopes and foothills, in areas with dense cover supporting scattered open areas. Often found in dense thickets created by fires or clear cuts.
Mountain Goat	*Oreamnos americanus*	Mammal	No	No	Found in the Cascade Mountain range.
Columbian Black-tailed Deer	*Odocoileus hemionus columbianus*	Mammal	None	Locally Important	Found along the Pacific Coast from Alaska to northern California.
Elk	*Cervus elaphus*	Mammal	No	No	Found in the mountain ranges and shrub lands of the Olympic and Cascade mountains.
Marten	*Martes americana*	Mammal	No	No	Strongly associated with mature conifer forests. Historically found throughout the mountains of Washington, Oregon and California.
Mink	*Mustela vison*	Mammal	Known in the study area		Rare visitor to Marymoor Park. Seen fewer then 10x at Marymoor Park.

In addition, King County wrote local guidelines for ten terrestrial species most often encountered during proposal reviews in the County (Table 3). Section 198 of the King County Comprehensive Plan requires the county to protect the active breeding sites of these species, as well as the immediate area surrounding each site to prevent any disturbance to breeding activities. All ten species are either listed by the State as an endangered, threatened, sensitive, candidate or monitor species, or are listed as a locally important species by King County. The species include the bald eagle (*Haliaeetus leucocephalus)*, great blue heron (*Ardea herodias*), osprey (*Pandion haliaetus)*, peregrine falcon (*Falco peregrinus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*) , Townsend's big eared bat (*Corynorhinus townsendii)*, Vaux's swift (*Chaetura vauxi)*, red-tailed hawk (*Buteo jamaicensis)*, and goshawk (*Accipiter gentilis*).

For all other species included in the King County Comprehensive Plan, the County is required to establish protective standards if a breeding site is discovered during a project review. The protective standards are based on management guidelines and recommendations established by WDFW. Most of the species listed in the King County Comprehensive Plan do not occur in the East Link project area, as they are not found in urban or commercially developed areas. In some cases however, their breeding habitat is still protected, even though the species itself is not actively breeding or occurring at the location.

TABLE 2
Wildlife Breeding Habitats Designated as having Local Importance in King County

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Species Whose Breeding Habitats are Included in King County's Fish and Wildlife Habitat Conservation Areas (King County Comprehensive Code Chapter 4)					
Great Blue Heron	*Ardea Herodias*	Bird	Known in the study area		Nests in small to medium sized colonies ranging from 3 to 30 nests. Colonies usually in secluded deciduous forests, but can adapt to some levels of disturbance gradually, over time. Will use conifer forests occasionally. Colonies often <1mile away from wetlands or large water bodies. Listed due to its sensitivity to disturbances and dependence on wetlands, wet meadows, and water bodies.
Black-crowned Night Heron	*Nycticorax nycticorax*	Bird	No	No	Black-crowned Night-herons have been known to breed in western Washington's eastern Puget Trough lowlands. Usually nest on island and in large trees in small colonies. Often found in fresh and saltwater wetlands. In spring and fall, they can be found in wetlands flanking large river basins.
Red-tailed Hawk	*Buteo jamaicensis*	Bird	Known in the study area		Found in areas with a mix of forests and open spaces, including agricultural land, grasslands, wetlands and meadows. Small mammals, especially rodents, are their

TABLE 2
Wildlife Breeding Habitats Designated as having Local Importance in King County

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					primary prey.
Osprey	*Pandion haliaetus*	Bird	Known in the study area		Nests in exposed trees or platforms that provide a clear, unobstructed view of surrounding area. Nests close to large bodies of water. Territorial. Several known active nests and territories in Segments B, C, and E.

TABLE 3
King County Designated Wildlife Habitat Conservation Area Breeding Areas

Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
Bald Eagle	Haliaeetus leucocephalus	400-foot radius from active nest	• No alterations within 800 feet from March 15 through April 30 (incubation and first three weeks of brooding). • Maintain a 400 foot radius around nest trees. • Prohibit use of land-clearing machinery within 800 feet from January 1 through August 31.
Great Blue Heron	Ardea herodias	820-foot radius from the rookery. WDFW can increase radius up to an additional 164 feet if population of rookery is declining	• No clearing or grading disturbance from January 1 through July 31 within 924 feet around existing rookeries. • Maintain 820 foot radius around existing rookeries that are known to be stable; buffer may be increased by 164 feet if population of rookery is declining.
Marbeled Murrelet	Bracyrhampus marmuratus	One-half mile radius around an active nest	• Protect area within 0.5 mile of nest trees.
Northern Spotted Owl	Strix Occidentalis	3,700-foot radius from an active nest	• Protect 3,700 foot radius from nest tree.
Goshawk	Accipter gentilis	1,500-foot radius around an active nest located outside of the Urban Growth Area (UGA)	• Maintain 1,500 foot radius around active nest sites located outside the urban growth area.
Osprey	Pandion haliaetus	230-foot radius around an active nest	• No disturbance within 660 feet from April 1 through September 30. • Maintain 230 foot radius around active nest.
Peregrine Falcon	Falco peregrinus	Extending 1,000 feet of an eyrie on a cliff face,	• No human activity along the nest cliff rim, immediately below nest cliffs, or on the cliff face within 1,000 feet at any time of

TABLE 3
King County Designated Wildlife Habitat Conservation Area Breeding Areas

Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
		the area immediately above the eyrie on the rim of the cliff, and the area immediately below the cliff	year. • No surface-disturbing activities that would produce loud noises (e.g. blasting, operation of chainsaws and heavy machinery) from March 1 through June 30 within .5 miles of nest. • Route power lines 1,000 feet from eyries.
Red-tailed Hawk	Buteo jamaicensis	325-foot radius from an active nest located outside of the UGA	• Maintain an area with a radius of 325 feet from an active nest located outside the urban growth area. • Clearing and grading is not allowed within 660 feet of an active nest located outside of the urban growth area from March 1-July 31
Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
Vaux's Swift	Chaetura vauxi	300-foot radius around an active nest located outside of the UGA	• Maintain a 300 foot radius around active nest sites outside the urban growth area. • No clearing or construction activities within 400 feet of active or potential nest trees from April 1 through October 31, unless potential nest tree is proved to contain no nests.
Townsend's Big-eared Bat	Corynorhinus townsendii	June 1-Oct 1 – 450-foot radius around from entrance to a cave or mine located outside of the UGA, within an active nursery colony Nov. 1-March 31 – 450-foot radius around the entrance to a cave or mine located outside the UGA serving as a winter hibernacula	• Maintain a minimum 450' radius in all directions from the entrance of a cave or mine of an active and alternate nursery sites located outside of the urban growth area from June 1-October 1 • Establish 450 foot radius around the entrance to the cave or mine serving as winter hibernacula November 1 - March 31 outside of the urban growth boundary • A building, bridge or tunnel, or other structure used solely for day or night roosting shall not be altered from March 1-November 30 • The entrance to a cave or mine that is protected because of bat presence is protected from human entry May 1 – September 15 • Gate entrance to cave or mine that is protected because of bat presence must be designed to allow bats to enter and exit.

Specifically, King County is required to protect:

1. habitat for all federally and state listed endangered, threatened, and sensitive species, and state candidate species
2. habitat used by locally important species

3. designated WDFW wildlife corridors
4. riparian corridors
5. locally important salmonid habitats
6. commercial and recreational shellfish beds
7. kelp and eelgrass beds
8. herring, sand lance and smelt spawning areas
9. habitat used by nesting red-tailed hawks
10. habitat for raptors and herons of local importance: osprey, great blue heron and black-crowned heron, and
11. habitat used by locally important marine species: freshwater mussels, geoduck clam, Pacific oyster, Dungeness crab, Pandalid shrimp, red urchins, white sturgeon, Pacific herring, channel catfish, longfin smelt, surfsmelt, Pacific cod, Pacific whiting, black rockfish, copper rockfish, quillback rockfish, yelloweye rockfish, lingcod, Pacific sand lance, English sole and rock sole.

Bellevue Ordinance #5680

Bellevue updated its Land Use Code in 2001 to incorporate critical area regulations. Under LUC 20.25H.025, any habitat associated with a species of local importance is designated a critical area. Furthermore, if a habitat associated with a species of local importance is impacted by a proposed development, the proposal shall implement the WDFW wildlife management plan designed for that species. If the habitat does not include a critical area or critical area buffer, but is occupied by a locally important species, then only the guidelines in the wildlife management plan need to be followed. Updating the Land Use Code also led to the creation of a Critical Areas Overlay District. This district excludes downtown Bellevue, as it focuses on the recognition of natural, sensitive and hazard areas and imposes regulations on the use and development of these properties. Locally important species in Bellevue are show in Table 4.

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Locally Important Species listed by the City of Bellevue (LUC 20.25H.150)					
Great Blue Heron	*Ardea herodias*	Bird	Known in the study area		Nests in small to medium sized colonies ranging from 3 to 30 nests. Colonies usually in secluded deciduous forests, but can adapt to some levels of disturbance gradually, over time. Will use conifer forests occasionally. Colonies often <1mile away from wetland or large water bodies. Listed due to its sensitivity to

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					disturbances and dependence on wetlands, wet meadows, and water bodies.
Red-tailed Hawk	*Buteo jamaicensis*	Bird	Known in the study area		Found in areas with a mix of forests and open spaces, including agricultural land, grasslands, wetlands and meadows. Small mammals, especially rodents, are their primary prey.
Bald Eagle	*Haliaeetus leucocephalus*	Bird	Known in the study area		Nests in wooded areas with larger trees within a half mile of large bodies of water. Highly territorial of nesting tree. May have more than one nest tree per territory, as well as roost and perch trees. Several known territories in Segments A, B, and E.
Peregrine Falcon	*Falco peregrinus*	Bird	Known in the study area		Two historical and recent eyries in Segment A. Nests in sheltered cliff areas naturally, has adapted to using bridges and buildings for nesting sites.
Osprey	*Pandion haliaetus*	Bird	Known in the study area		Nests in exposed trees or platforms that provide a clear, unobstructed view of surrounding area. Nests close to large bodies of water. Territorial. Several known active nests and territories in Segments B, C, and E.
Pileated Woodpecker	*Dryocopus pileatus*	Bird	Known in the study area		Requires wooded forests with a component of dead and dying trees and snags for foraging and nesting. Prefers deciduous forests. Will occur in conifer forests with some deciduous tree component. Found at Marymoor Park. One bird observed in WR-5.
Purple Martin	*Progne subis*	Bird	Known in the study area		Nests in structures over water bodies, including natural cavities, pilings, and man-made housing structures. Forages over open water or wet areas for insects while in flight. Nesting observed at Marymoor Park in 2003, but no activity since. Population believed to be in decline throughout its range.
Common Loon	*Gavia immer*	Bird		Known in the study area	Population has declined due to acid rain, pollution, industrial contamination of water bodies and lead poisoning. Artificial floating nesting platforms have reduced the negative impact of fluctuating water levels from human activities to nests.
Western Grebe	*Aechmophorus occidentalis*	Bird	Known in the study area		Nests in colonies numbering up to several hundred birds on large inland lakes or in coastal marshes of the western United States. Birds breeding in the northern extent of their range migrate to the western coastal ocean to

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					spend the winter.
Merlin	*Falco columbarius*	Bird	Known in the study area		Seen during the nesting season at Marymoor Park.
Great Egret	*Ardea alba*	Bird	Known in the study area		Feeds in low watered areas and fields, on fish, amphibians, and insects. Breeds in colonies close to large lakes with emergent vegetation beds, or in large wetland areas.
Green Heron	*Butorides virescens*	Bird	Known in the study area		Breeds in small wetlands on a platform built nest that is either in a tree or shrub, close to the water. Feeds on small fish, insects, and amphibians. Nests at Marymoor Park.
			Likely Present	Possibly Present	
Vaux's Swift	*Chaetura vauxi*	Bird		Known in the study area	Nests and forages in groups with 30 or more birds. Nest is a cup shaped nest placed in a dark, confined cavity. Breeds in mountains and foothills, usually >700 meters in elevation. Forages over wooded areas and more open habitats, including towns.
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Bat		May Occur	Areas with a mosaic of woodland/grassland and/or shrub land, esp. coniferous mosaics. Found in Pierce County, Fort Lewis.
Western Toad	*Bufo boreas*	Amphibian	May Occur		Found in a variety of habitats, including slow-moving rivers and streams, and near ponds and lakes. Large population declines in the Northwest. Listed as occurring in the Lake Washington Basin.

City of Mercer Island Locally Important Species

The City of Mercer Island Comprehensive Land Use Plan includes Ordinance No. 05C-12, which details their critical areas regulations. In order to streamline their critical areas regulations, the City of Mercer Island adopted WDFW's Priority Habitat and Species program in its entirety in 1998. The City of Mercer Island relies solely on the United State Fish and Wildlife Service (USFWS) and WDFW for species listings. WDFW management guidelines and recommendations for state listed species are followed. In addition, the City of Mercer Island's City Council has not designated any species as having local importance.

City of Redmond Locally Important Species

The City of Redmond's Critical Areas Ordinance (Ordinance #2259) applies species protection to State Species of Concern, Priority Species designated by WDFW, and locally important species. Only one species, the great blue heron, is currently listed as a locally important species in Redmond. The red-tailed hawk was listed as a locally important species until 2004.

Redmond's critical areas ordinance established a set of recommendations for development within the urban growth boundaries of the city. These recommendations focus on using incentive programs, density transfers and existing state regulations to minimize impacts to natural areas. This is accomplished by clustering developments and, when possible, avoiding development in critical areas or their buffers. The primary framework of habitat management in the City of Redmond is the creation of habitat reserves and linking these reserves together using wildlife corridors. Following guidelines established in NE-79 and NE-90, the City of Redmond recommends using reserves and corridors to reduce the effects of habitat fragmentation. Section NE-84 also calls for protecting habitats having a primary association with state and federally listed species and candidate species, and species of local importance.

Conclusion

Locally important wildlife species do occur in the East Link project area. WDFW has been contacted in regards to any mitigation or conservation measures they may require for the East Link project. Any conservation measures will follow the management guidelines established by WDFW for those specific species. These guidelines and recommendations may be enforceable if they fall under the guidance of state regulations such as SEPA. In addition, WDFW or King County may also require management guidelines to lessen the impact to locally important species as detailed in their critical areas ordinances.

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Appendix F

Wetland Functional Scores and Impact Data

Attachment 1
Wetland Functional Scoring Tables

TABLE F1-1
Hydrologic Functions and Score for Each Wetland in Study Area

Locator	Wetland Name	Flood Reduction and Storm water Control	Erosion and Shoreline Protection	Hydrology Total
WR-1, WR-2	Bellevue Way North and South of Park and Ride	20	20	20 (MOD)
WR-3	Sturtevant Creek	6	6	6 (LOW)
WR-4	Mercer Slough I-90	3	3	3 (LOW)
WR-5	118th Ave SE	4	4	4 (LOW)
WR-6	BNSF Matrix	2	2	2(LOW)
WR-7	Kelsey Creek Ponded	18	18	18 (MOD)
WR-8	Kelsey Creek Riparian	10	10	10 (LOW)
WR-9	Allied Waste	2	2	2 (LOW)
WR-10	East of 140th Ave	6	6	6 (LOW)
WR-11	West of 140th Ave	12	12	12 (LOW)
WR-12	Bear Creek	18	18	18 (MOD)
WR-13	Marymoor Park Mitigation Wetland	8	8	8 (LOW)

TABLE F1-2
Habitat and Water Quality Functions and Score for Each Wetland in Study Area

Locator	Wetland Name	Potential to Provide Habitat Structure and Support	Proximity to Other Habitats	Opportunity to Provide Habitat	Habitat Function Total	Water Quality Improvements	Water Quality Total
WR-1, WR-2	Bellevue Way North and South of Park and Ride	14	1	7	22 (MOD)	32	32 (HIGH)
WR-3	Sturtevant Creek	8	0	7	15 (LOW)	16	16 (MOD)
WR-4	Mercer Slough I-90	8	3	1	12 (LOW)	14	14 (LOW)
WR-5	118th Ave SE	8	4	1	13 (LOW)	16	16(MOD)
WR-6	BNSF Matrix	8	0	4	12 (LOW)	14	14 (LOW)
WR-7	Kelsey Creek Ponded	10	3	3	16(LOW)	10	10 (LOW)
WR-8	Kelsey Creek Riparian	9	3	1	13 (LOW)	16	16 (MOD)
WR-9	Allied Waste	5	1	1	7 (LOW)	6	6 (LOW)
WR-10	East of 140th Ave	5	3	0	8 (LOW)	18	18 (MOD)
WR-11	West of 140th Ave	8	3	1	12 (LOW)	16	16 (MOD)
WR-12	Bear Creek	13	7	1	21 (MOD)	16	16 (MOD)
WR-13	Marymoor Park Mitigation Wetland	10	8	2	20 (MOD)	20	20 (MOD)

TABLE F1-3
Special Criteria Function and Value for Each Wetland in Study Area

Locator	Wetland Name	Special Criteria: Cultural Educational and Socioeconomic	Inside a Protected Area	Bog Estuary Forested	Natural Heritage Site	Undisturbed Area >1acre with <10% Non-native Plants
WR-1, WR-2	Bellevue Way North and South of Park and Ride	Yes	Yes	Bog	No	No
WR-3	Sturtevant Creek	No	No	No	No	No
WR-4	Mercer Slough I-90	No	No	No	No	No
WR-5	118th Ave SE	No	No	No	No	No
WR-6	BNSF Matrix	No	No	No	No	No
WR-7	Kelsey Creek Ponded	No	No	No	No	No
WR-8	Kelsey Creek Riparian	No	No	No	No	No
WR-9	Allied Waste	No	No	No	No	No
WR-10	East of 140th Ave	No	No	No	No	No
WR-11	West of 140th Ave	No	No	No	No	No
WR-12	Bear Creek	No	No	No	No	No
WR-13	Marymoor Park Mitigation Wetland	Yes	Yes	No	No	No

Attachment 2
Detailed Wetland and Wetland Buffer Impact Data

TABLE F2-1
Short-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Wetlands	
			Area Affected (square feet)	Area Affected (acres)
B1	WR-2—Bellevue Way North of Park and Ride	1	310.82	0.01
B1 Total			**310.82**	**0.01**
B2A	WR-1—Bellevue Way South of Park and Ride	1	9,833.81	0.23
B2A	WR-2—Bellevue Way North of Park and Ride	1	4,098.75	0.09
B2A Total				**0.32**
B2E	WR-2—Bellevue Way North of Park and Ride	1	310.82	0.01
B2E Total				**0.01**
B3	WR-1—Bellevue Way South of Park and Ride	1	8,255.03	0.19
B3	WR-2—Bellevue Way North of Park and Ride	1	1,786.00	0.04
B2E Total				**0.23**
B7	WR-1—Bellevue Way South of Park and Ride	1	117,224.34	2.7
B7 Total			117,224.34	2.7

TABLE F2-2
Short-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B1	WR1 and 2- Bellevue Way North/South of Park and Ride	1	77,547.73	1.78
B1 Total		**1**	**77,547.73**	**1.78**
B2A	WR1 and 2- Bellevue Way North/South of Park and Ride	1	74,156.87	1.7
B2A Total		**1**	**74,156.87**	**1.7**
B2E	WR1 and 2- Bellevue Way North/South of Park and Ride	1	49,351.58	1.13
B2E Total		**1**	**49,351.58**	**1.13**
B3	WR1 and 2- Bellevue Way North/South of Park and Ride	1	72,165.00	1.66
B2E Total		**1**	**72,165.00**	**1.66**

TABLE F2-2
Short-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B7	WR1 and 2- Bellevue Way North/South of Park and Ride	1	28,503.57	0.65
B7 Total		**1**	**28,503.57**	**0.65**
E1	WR-12 Bear Creek	2	3,749.98	0.09
E1 Total		2	**3,749.98**	**0.09**
E2	WR-13 – Marymoor Park Mitigation Wetland	2	12,693.77	0.29
E2	WR-12 Bear Creek	2	3,749.98	0.09
E2 Total		**2**	**16,443.75**	**0.38**
E4	WR-12 Bear Creek	2	3,749.99	0.09
E4 Total		**2**		**0.09**

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B2A	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B2A	WR-2—Bellevue Way North of Park and Ride	1	79.44	0
B2A Total			**175.08**	**0**
B2E	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B2E Total			**95.64**	**0**
B3	WR-3—Sturtevant Creek	1	18,083.10	0.42
B3	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B3	WR-2—Bellevue Way North of Park and Ride	1	79.18	0
B3 Total			**18,257.92**	**0.42**
B7	WR-1—Bellevue Way South of Park and Ride	1	15,401.57	0.35
B7	WR-1—Bellevue Way South of Park and Ride	1	11,808.24	0.27
B7	WR-1—Bellevue Way South of Park and Ride	1	18,345.21	0.42
B7	WR-1—Bellevue Way South of Park and Ride	1	2,322.82	0.05
B7	WR-1—Bellevue Way South of Park and Ride	1	9,495.06	0.22

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B7	WR-5—118th Ave SE	1	20,165.90	0.46
B7	WR-4—Mercer Slough I-90	1	497.79	0.01
B7 Total			**78,036.59**	**1.78**
D2A-12TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D2A-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D2A-12TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2A-12TH	WR-11—West of 140th Ave NE	3	9,811.90	0.23
D2A-12TH	WR-9—Allied Waste	4	20.17	0
D2A-12th Total for Cat 3		**3**	**17587.57**	**0.4**
D2A-12th Total for Cat 4		**4**	**20.17**	**0**
D2A-6TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D2A-6TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2A-6TH	WR-11—West of 140th Ave NE	3	9,811.90	0.23
D2A-6TH	WR-9—Allied Waste	4	20.17	0
D2A-6th Total for Cat 3		**3**	**15,661.39**	**0.36**
D2A-6th Total for Cat 4		**4**	**20.17**	**0**
D2E-12TH	WR-8—Kelsey Creek Riparian	3	2,365.15	0.05
D2E-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D2E-12TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2E-12TH	WR-11—West of 140th Ave NE	3	7,083.60	0.16
D2E-12TH	WR-9—Allied Waste	4	20.17	0
D2E-12th Total for Cat 3		**3**	**14,864.22**	**0.33**
D2E-12th Total for Cat 4		**4**	**20.17**	**0**
D2E-6TH	WR-8—Kelsey Creek Riparian	3	2,365.15	0.05
D2E-6TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2E-6TH	WR-11—West of 140th Ave NE	3	7,083.60	0.16
D2E-6TH	WR-9—Allied Waste	4	20.17	0
D2E-6th Total for Cat 3		**3**	**12,938.06**	**0.29**
D2E-6th Total for Cat 4		**4**	**20.17**	**0**
D3-12TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
D3-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D3-12th Total			**4,286.38**	**0.09**
D3-6TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D3-6th Total			**2,360.20**	**0.05**
D5-12TH	WR-8—Kelsey Creek Riparian	3	5,026.85	0.12
D5-12TH	WR-6—BNSF Matrix	3	2,117.26	0.05
D5-12TH	WR-10—East of 140th Ave NE	3	4,592.72	0.11
D5-12TH	WR-11—West of 140th Ave NE	3	7,053.12	0.16
D5-12TH	WR-9—Allied Waste	4	26.39	0
D5-12th Total for Cat 3		**3**	**18,816.34**	**0.44**
D5-12th Total for Cat 4		**4**	**26.39**	**0**
D5-6TH	WR-8—Kelsey Creek Riparian	3	5,026.85	0.12
D5-6TH	WR-10—East of 140th Ave NE	3	4,592.72	0.11
D5-6TH	WR-11—West of 140th Ave NE	3	7,053.12	0.16
D5-6TH	WR-10— East of 140th Ave NE	4	26.39	0
D5-6th Total for Cat 3		3	**16,699.08**	**0.39**
D5-6th Total for Cat 4		**4**	26.39	0
E2	WR-13—Marymoor Park Mitigation Wetland	2	3,541.29	0.08
E2 Total			**3,541.29**	**0.08**

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
B1	WR-1 WR-2 Bellevue Way North/South of Park and Ride	33,691.66	0.77
B1 Total		**33,691.66**	**0.77**
B2A	WR-1 WR-2 Bellevue Way North/South of Park and Ride	116,205.60	2.67
B2A Total		**116,205.60**	**2.67**
B2E	WR-1 WR-2 Bellevue Way North/South of Park and Ride	84,575.61	1.94

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
B2E Total		**84,575.61**	**1.94**
B3	WR-1 WR-2 Bellevue Way North/South of Park and Ride	116,451.94	2.67
B3	WR-3 Sturtevant Creek	4,933.10	0.11
B3 Total		**121,385.04**	**2.78**
B7	WR-1 WR-2 Bellevue Way North/South of Park and Ride	17,243.67	0.4
B7	WR-4 Mercer Slough I-90	5,703.18	0.13
B7	WR-3 Sturtevant Creek	3,756.90	0.09
B7	WR-5 118th Ave SE	10,559.49	0.24
B7 Total		**20,019.57**	**0.46**
D2A-12TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2A-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D2A-12TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2A-12TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D2A-12th Total		**14.970**	**0.34**
D2A-6TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2A-6TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2A-6TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D2A-6TH	WR-11 West of 140th Ave NE	3,379.02	0.08
D2A-6th Total		**12,757.64**	**0.29**
D2E-12TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2E-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D2E-12TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2E-12TH	WR-7 Kelsey Creek Ponded	557.03	0.01
D2E-12TH	WR-11 West of 140th Ave NE	2,283.80	0.05
D2E-12th Total		**13,878.85**	**0.31**
D2E-6TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2E-6TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2E-6TH	WR-7 Kelsey Creek Ponded	557.03	0.01
D2E-6TH	WR-11 West of 140th Ave NE	2,283.80	0.05
D2E-6th Total		**11,663.91**	**0.26**
D3-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D3-12TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D3-12th Total		**2,770.48**	**0.06**

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
D3-6TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D3-6th Total		**555.54**	**0.01**
D5-12TH	WR-10 East of 140th Ave. NE	7,021.97	0.16
D5-12TH	WR-11 BNSF Matrix	5,098.96	0.12
D5-12TH	WR-10 East of 140th Ave NE	6,833.79	0.16
D5-12TH	WR-8 Kelsey Creek Riparian	1,712.24	0.04
D5-12TH	WR-11 West of 140th Ave NE	2,286.16	0.05
D5-12th Total		**22,953.12**	**0.53**
D5-6TH	WR-10 East of 140th Ave. NE	7,021.97	0.16
D5-6TH	WR-10 East of 140th Ave NE	6,833.79	0.16
D5-6TH	WR-8 Kelsey Creek Riparian	1,712.24	0.04
D5-6TH	WR-11 West of 140th Ave NE	2,286.16	0.05
D5-6th Total		**17,854.16**	**0.41**
E1	WR-12 Railroad Crossing	599.79	0.01
E1 Total		**599.79**	**0.01**
E2	WR-13 Marymoor Park Mitigation Wetland	16,530.82	0.38
E2	WR-12 Bear Creek	3,286.11	0.08
E2 Total		**19816.93**	**0.46**
E4	WR-12 Bear Creek	3,286.11	0.08
E4 Total		**3,286.11**	**0.08**

Appendix G

Interstate 90 / Homer Hadley Bridge, Light Rail Transit Stray Current—Assessment of Potential Effects on Fish Memorandum

Herrera Environmental Consultants, Inc.

Memorandum

To	Marti Louther, James Irish, Sue Comis – Sound Transit
cc	Ed Wetzel - Universal Technical Resource Services, Inc
From	José Carrasquero, Eric Doyle - Herrera Environmental Consultants
Date	June 13, 2008
Subject	Interstate 90/Homer Hadley Bridge, light rail transit (LRT) stray current - Assessment of potential effects on fish

Sound Transit retained Herrera Environmental Consultants (Herrera) to conduct a preliminary investigation into the potential effects of changes in the stray electrical current field associated with the Interstate 90 Homer Hadley Bridge over Lake Washington (referred to hereafter as the I-90 bridge). Specifically, Sound Transit is proposing to build the East Link light rail transit (LRT) line on the I-90 bridge. Operation of the LRT system could discharge stray electrical current into Lake Washington. This weak direct (DC) current would leak into the environment through various conductive pathways along the bridge alignment, creating one or more small electrical current fields around the span. Possible current leakage pathways include the bridge's existing cathodic corrosion protection system, and the stray current mitigation system planned as part of LRT expansion. The intent of this assessment is to investigate if the change in stray electrical current conditions is of sufficient magnitude to pose potential adverse effects on aquatic species.

The findings of this assessment are summarized as follows:

1. The proposed LRT system will produce stray electrical current fields that are essentially negligible relative to existing conditions.

2. Expected field intensity produced by leakage from the LRT is difficult to calculate with precision, but will be very low in intensity, ranging from tenths to hundredths of a microvolt per centimeter direct current (µV/cm DC) (Wetzel 2008).

3. These values are one to two orders of magnitude below established physiological detection and behavioral response thresholds for even the most sensitive species of potential concern.

On this basis, it appears reasonable to conclude that any change in stray DC electrical current emissions resulting from LRT operation would be unlikely to result in adverse effects on fish species of potential concern in the Lake Washington system.

The assessment approach and the findings are described in the following sections.

Assessment Approach

The screening level assessment of potential stray current effects consisted of the following steps:

1. Confirm that fish species of potential concern may be present in the study area. (These include but are not limited to species listed under the Endangered Species Act [ESA]; species listed at the state level as species of concern; and game fish.)

2. Identify known biological response thresholds for these or sufficiently similar species in the available scientific literature.

3. Identify the strength, dimension, and configuration of the stray current field under existing and proposed conditions.

4. Compare the existing and proposed electrical field conditions to these known response thresholds and determine the likelihood of potential effects.

Fish Presence in the I-90 Bridge Vicinity

For the purpose of this assessment, fish species of potential concern include the following: resident and anadromous salmonids native to the Lake Washington basin (including ESA listed species); Pacific and river lamprey; longfin smelt; forage fish species; and other native and introduced game fish species. These species are referred to hereafter as Lake Washington species.

The potential presence of these species in the general vicinity was determined by consulting with two experts on Lake Washington fisheries investigations: Kurt Fresh, a research scientist with the NOAA Fisheries Northwest Fisheries Science Center; and Roger Tabor, a research scientist with the U.S. Fish and Wildlife Service. While both agreed that specific studies of fish habitat utilization in the immediate vicinity of the I-90 bridge are lacking, they confirmed that several Lake Washington species either utilize habitats in the vicinity of the bridge, or must pass under the structure when migrating between spawning and rearing habitats. As such, it is apparent that a number of Lake Washington species could occur within the area of potential effects.

Fish Response to Electrical Field Exposure: A General Review

To aid in interpreting the findings of this assessment, it is desirable to provide a general review how fish interact with and respond to electrical fields. Weak electrical fields are common in nature, and many organisms have evolved specialized means of detecting and orienting to these

fields. Organisms with this specialized capability are referred to as electroreceptive, meaning they have the ability to detect, orient to, or even produce and navigate by an electrical field. Not all fish species are electroreceptive, and for most species that are this ability is limited to short-range sensory awareness used to locate prey species or detect objects at close range. However, certain fish species, including the sharks, lampreys, and other specialized higher fish, have specialized electroreceptive organ systems that greatly increase sensitivity to weak electrical fields (Hopkins 1983, New 1999, Smith 1991, Gibbs 2004, Von Der Emde 2007, Alves-Gomes 2001).

Electroreceptivity confers a number of useful abilities. For example, electroreceptive predators like sharks and rays are able to detect the weak electrical signals produced by muscle activity in their prey (Kalmjin 1982). Some fish species, such as eels, are able to detect and orient to the weak electrical fields generated by ocean currents, using these fields as a means of navigation (McCleave and Power 1978). Certain fish species that live in highly turbid water environments where eyesight is useless have evolved the ability to produce weak electrical fields that are used like sonar systems to communicate, navigate, and detect predators and prey (Knudsen 1974). Species like lamprey have evolved specialized electroreceptive organ systems to detect prey organisms (Bodznick and Preston 1983). Because of their specialized ability to detect weak electrical fields, electroreceptive fish species are by nature more susceptible to weak electrical fields, like those produced by stray current from LRT systems. Weak fields can stimulate or confuse their sensory systems, potentially altering behavior and physiology in ways that are difficult to observe and detect.

Most of the fish species common to Lake Washington, such as the trout, salmon, perch, and bass, lack specialized electroreceptive organ systems. As such they are unable to detect very weak electrical fields and are thereby relatively insensitive to weak field exposure.

Electroreceptivity should not be confused with behavioral and physiological responses that all fish exhibit in the presence of strong electrical fields. All organisms are susceptible to the effects of electrical shocks, which essentially "short-circuit" physiological systems. Responses to strong electrical field exposure can range from attraction or avoidance, to altered feeding behavior, or even unconsciousness. A sufficiently large electrical exposure can cause seizure, injury, and even direct mortality. Responses to strong electrical field exposure can vary widely, based on the species and size of the fish exposed, site specific conditions, and the nature of the electrical field (Snyder 2003).

For example, the orientation of a fish's body relative to an electrical field is a determining factor in amount of voltage exposure a fish will receive. A fish swimming parallel to an electrical field (i.e., directly towards or away from the source) will experience a larger exposure than one swimming perpendicular to the field. This is because the longest body axis is oriented to the increasing field strength, creating the greatest electrical gradient from end to end and thereby a large voltage potential. The fish oriented perpendicular to field strength presents a minimal aspect to the field, creating much smaller electrical potential from one side of the body to the other, minimal voltage exposure, and little or no effect. Larger fish are inherently more sensitive to strong electrical fields because a bigger body has inherently greater potential voltage gradient.

Literature Review Methods

Available information on the relevant biological response thresholds of Lake Washington fish species or similar organisms was derived from available scientific literature. Literature sources were identified using the Google Scholar online search engine. The studies relied upon in this assessment express electrical field strength in units of Volts per meter (V/M), volts per centimeter (V/cm), or microvolts per centimeter (µV/cm). These metrics are commonly used to characterize the response of biological organisms to electrical field exposure.

The types of threshold responses reported in this assessment range from physiological detection of the electrical field (e.g., measured changes in cardiac response), to behavioral detection (e.g., attraction, avoidance, twitching), to marked physiological responses including paralysis and injury. When considering this information, it is important to note that electrical fields capable of causing paralysis or injury are many orders of magnitude stronger than what is expected from the I-90 stray current field. The intent of providing this information is to present a basis of comparison to the expected strength of the I-90 stray current field.

Physiological and Behavioral Response Thresholds for Electrical Field Exposure

The literature review identified several exposure response thresholds that are relevant to Lake Washington species. This information is summarized in Table 1. The range of response thresholds shown varies from the smallest observed physiological and behavioral detection limits, to electrical field strength sufficient to cause injury and incapacitation. The intent of providing this broad range of threshold values is to provide a broader context for interpreting the potential effects of the I-90 stray current field.

Stray Current Field Strength and Dimensions Under Existing and Proposed Conditions

The strength and dimensions of the stray current field under existing and proposed conditions was characterized for Sound Transit by Mr. Ed Wetzel of Universal Technical Resource Services, Inc (UTRS) (Wetzel 2008). Per request from Herrera staff, these values were provided in the same units commonly used to characterize biological effects (µV/cm). The maximum strength of the I-90 stray current field under existing and potential future conditions is shown in Table 2. These estimates represent the worst-case stray electrical current field strength and size expected to occur under each condition.

While the LRT system will produce a stray current field, the proposed system design and additional shielding mechanisms will limit the intensity of this field to very low levels. The cathodic protection system is expected to be the dominant source of electrical current emanating from the I-90 bridge. The positioning and orientation of the cathodic protection system and the intensity of the field it produces are not expected to vary measurably under proposed conditions with LRT operation.

Table 1. Electrical field strength associated with observed responses in various fish species.

Response Type	Species Type	Environment Type Where the Response was Observed	Electrical Field or Source Strength Associated with Observed Response	Source
Attraction/avoidance (attraction to the anode, avoidance or repulsion from the cathode)	Lamprey	Marine	1–10 µV/cm	Bodznick and Preston 1983
Twitch response to field exposure	Lamprey	Marine	10-60 µV/cm @ 0.05-0.5 Hz	Muraveiko 1984
Observed physiological detection limit (measurable change in heart rate or the electrical pattern of the heartbeat)	Atlantic salmon, American eel	Freshwater	7-70 µV/cm @ 60-75 Hz	McCleave et al. 1974
Theoretical limit above which chronic electrical field exposure could alter cellular biochemical systems.	n/a	General	90 µV/cm	Weaver et al. 1998
Attraction (anodic taxis)	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.13-0.19 V/cm pulsed DC @ 15 Hz 0.05-0.09 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.16-0.21 V/cm pulsed DC @ 15 Hz 0.09-0.20 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Twitch response to field exposure	Rainbow trout (31 to 48 cm fork length)	Freshwater (conductivity 103 µS/cm @ 11ºC)	0.19-0.43 V/cm pulsed DC @ 20 Hz 0.15-0.71 V/cm pulsed DC @ 30 Hz 0.11-0.97 V/cm pulsed DC @ 60 Hz	Taube 1992 (as cited in Snyder 2003)
	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.06-0.10 V/cm pulsed DC @ 15 Hz 0.03-0.05 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.08-0.13 V/cm pulsed DC @ 15 Hz 0.02-0.10 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Altered migratory behavior (changed orientation relative to electrical field)	American eel elvers (juveniles)	Marine	1 µA/cm^2 to 100 µA/cm^2	McCleave and Power 1978
Observed avoidance responses (electrofishing voltage used to direct fish out of an in-water work area)	Salmonids (adult and juvenile), other resident fish species	Freshwater (riverine ~1-6 ft. depth)	500 to 1,000 V pulsed DC @ 7.5 Hz	Johnson and Hoffman 2000
Observed avoidance responses (electrical fish barrier used to prevent access to an in-water work area)	Salmonids (adult and juvenile)	Freshwater (riverine ~1-6 ft. depth)	~0.5 to 100 V/M pulsed DC @ 2 Hz	Johnson and Hoffman 2000

Table 1 (continued). Electrical field strength associated with observed responses in various fish species.

Response Type	Species Type	Environment Type Where the Response was Observed	Electrical Field or Source Strength Associated with Observed Response	Source
Recommended voltage settings for electrofishing equipment to avoid fish injury (voltage requirements dependent on conductivity)	Salmonids (juvenile)	Freshwater	100 to 800 V pulsed DC @ ≤30Hz	WSDOT 2006
Electrofishing injury (electrofishing voltage settings associated with spinal and tissue injury)	Rainbow trout (juvenile)	Freshwater	300 V pulsed DC @ 30 Hz	McMichael et al. 1998
			1-9 V/cm within 100 cm of anode (produced by electrofishing at a setting of 350-400 V @ 60 Hz)	Dalbey et al. 1996
Stunning or unconsciousness	Rainbow trout (31 to 48 cm fork length)	Freshwater (conductivity 103 µS/cm @ 11ºC)	0.53-10.4 V/cm pulsed DC @ 20 Hz 0.92-6.5 V/cm pulsed DC @ 30 Hz 0.61-6.4 V/cm pulsed DC @ 60 Hz	Taube 1992 (as cited in Snyder 2003)
	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.54-0.70 V/cm pulsed DC @ 15 Hz 0.14-0.20 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Stunning or unconsciousness (continued)	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.25-0.36 V/cm pulsed DC @ 15 Hz 0.18-0.27 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Atlantic salmon (adult)	Marine	15-250 V/M @ 50 Hz AC (depending on duration of exposure)	Roth et al. 2003

µV/cm = microvolts per centimeter
V/cm = volts per centimeter
V/M = volts per meter
µS/cm = microsiemens per centimeter (measure of electrical conductivity)
DC = direct current
Hz = Hertz
V = volts
ºC = degrees Celcius
Fork length = the length of a fish from the tip of the nose to the indent, or fork, in the middle of the tail fin

Table 2. Stray electrical current field strength under the I-90 bridge, under existing and proposed conditions

Source	Parameter	Existing Conditions	Proposed LRT Conditions	Notes
Existing cathodic corrosion protection system	Electrical field intensity	Maximum: 26.2 µV/cm DC Typical: 13.1 µV/cm DC	Similar to existing conditions.	LRT operation will have little impact on the potential strength of the stray current field. Maximum rectifier output is the limit of the rectifier specifications. Most units are operating about half the rated output. Planned upgrades in rectifier and anode design will maintain current conditions, or possibly reduce field intensity.
	Maximum electrical field size around each cathode/anode	30 meters (horizontal) 21 meters (vertical)	30 meters (horizontal) 21 meters (vertical)	The electric field will be concentrated between the cathode (anchor cable) and the anode, which are spaced approximately 30 meters apart. Each anode is suspended 10 to 11 meters below the surface and is between 10 to 21 meters in length.
	Minimum horizontal distance between each field	10 meters (horizontal) Pontoons A & R; 5 meters pontoon J; 100 meters remaining pontoons.	10 meters (horizontal) Pontoons A & R; 5 meters pontoon J; 100 meters remaining pontoons.	
Stray electrical current from LRT system	Maximum electrical field intensity	n/a	Uncertain but will most likely range from 10^{-1} to 10^{-2} µV/cm DC	The proposed LRT system will produce a stray DC current field, but the design and additional shielding mechanisms will limit the intensity of this field to very low levels (essentially negligible in comparison to the existing cathodic corrosion protection system). The size and orientation of the potential stray DC current field is difficult to determine. Stray current could leak to the aquatic system through a number of pathways on the structure, including drainpipes, power lines, the cathodic protection system, and even the concrete structure itself when wet with rain. It is not practical to analyze each of these potential pathways for the purpose of this analysis. Given the limited intensity of the field however, its size and orientation would appear to be irrelevant with regards to potential effects.
	Field size and orientation	n/a	Unknown	

Source: Wetzel 2008.
AC = alternating current
DC = direct current
LRT = light rail transit

As shown in Table 2, operation of the LRT system on the I-90 bridge will not change the output of the cathodic corrosion protection system in any significant way, meaning that the existing electrical field intensity and orientation associated with this feature will remain unchanged under proposed conditions (Wetzel 2008).

The LRT system is expected to produce a stray electrical current field in and around the I-90 bridge. Because this current can discharge along any conduction pathway, the location and extent of this field is difficult to predict. However, much of the discharge is likely to occur from the stray current mitigation system. The intensity of this stray current field is expected to be on the order of 10^{-1} to 10^{-2} µV/cm DC (Wetzel 2008).

Comparison of Stray Current Field Intensity to Established Response Thresholds

Retrofitting of the I-90 bridge to support the LRT system could conceivably alter the electrical field associated with the structure through two pathways: 1) modification of the cathodic corrosion protection system; and 2) creation of a stray electrical current field leaking from the DC electrical system used to power the trains. As shown in Table 2, the size and intensity of the electrical field produced by the existing cathodic protection system is not expected to change under the proposed conditions. As there is no related change in stressor exposure for fish Lake Washington species, there is no further need to consider this particular issue.

The stray current field produced by the LRT system will result in a change in potential electrical exposure from the existing conditions. However, the range of electrical field intensity likely to occur from stray current leakage appears to be lower than levels necessary for sensory detection or physiological effects in Lake Washington species. The intensity of the stray current field will range between 10^{-1} to 10^{-2} µV/cm DC. These levels are one to three orders of magnitude lower than observed physiological response limits in Atlantic salmon and American eel (7-70 µV/cm DC) (McCleave et al. 1974). These species are representative of the likely sensitivity of the majority of Lake Washington species exposed to stray electrical current.

Lamprey are the most electroreceptive, and thereby the most potentially sensitive of the Lake Washington fish species to stray current field exposure. At least one and possibly two species of lamprey (Pacific and river lamprey) are known to occur in the Lake Washington basin (a third species, western brook lamprey, may also be present). Even in the case of lamprey however, the anticipated stray current field appears to be at least one to as much as two orders of magnitude below known physiological and behavioral response thresholds (Bodznick and Preston 1983; Muraveiko 1984).

In recent years, concerns have emerged regarding the potential health effects of long-term exposure to low intensity electro-magnetic fields. Theoretically, long-term exposure even at levels below behavioral response thresholds could lead to adverse effects that would otherwise go undetected. Considerable research effort has been devoted to this concern. For example, Weaver et al. (1998) examined the biochemical response profile of various cellular systems to electromagnetic field exposure in order to evaluate the potential for human health effects. They

developed a model to estimate the minimum threshold limits at which an electromagnetic field could potentially cause harmful changes in cellular level physiological systems. They determined that 90 µV/cm was the minimum field intensity necessary to alter physiological systems at the cellular level in species lacking specialized electroreceptive organ systems. Like the physiological and behavioral response thresholds discussed previously, the anticipated I-90 stray DC current field is well below this threshold.

Conclusions

The East Link project proposal to locate LRT on the I-90 bridge is likely to create a low intensity stray current field around the bridge structure. The size and intensity of this field cannot practically be determined with accuracy. However the best possible estimate indicates that stray current intensity will be one to three orders of magnitude below physiological or behavioral response thresholds for even the most sensitive Lake Washington fish species. Given these findings, the conclusion of this screening level assessment is that stray current from LRT operation is unlikely to lead to adverse effects on aquatic life, and there is no need to investigate the issue further.

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Appendix A

Best Management Practices for Sensitive Natural Resources

Appendix A

Best Management Practices for Sensitive Natural Resources

The following list of measures is a compilation of best management practices (BMPs) that can be used to avoid and minimize short-and long-term impacts of the East Link project. These BMPs are either required by state or federal agencies to obtain permits required for the project or may be required to comply with typical permit conditions. They are based on Sound Transit's knowledge of permit requirements and experience with conducting environmental compliance and permitting for numerous other projects in the Puget Sound area.

Construction-Related BMPs

General BMPs for All Sensitive Areas

The project would delineate construction limits for vegetated and habitat areas that may be disturbed during construction. The intent is to prevent unintended effects to riparian vegetation, wetlands, woodlands, and other sensitive sites outside of the construction limits. The construction limits would be clearly marked with high-visibility construction fencing prior to any ground-disturbing or construction-related activities. There would be no direct site disturbance outside of the construction limit.

Soil or rock stockpiles, excavated materials, or excess soil materials would be prevented from eroding into sensitive habitats, including water channels, wetlands, and riparian areas outside of the construction limits by high water or storm runoff. Sound Transit or its construction contractor would develop a Temporary Erosion and Sediment Control (TESC) plan that would be implemented during construction. This TESC plan would address potential erosion during construction. The contractor would implement the plan before discharging or allowing runoff from the site. Monitoring requirements specified in the TESC would provide feedback to make sure that the erosion control practices are operating properly and effectively.

Fish and Aquatic Habitat Protection

All work would comply with the terms and conditions set forth in the Hydraulic Project Approval (HPA) issued for the project by the Washington Department of Fish and Wildlife (WDFW). The HPA program is the vehicle through which WDFW regulates activities that affect the bed or flow of waters of the state for the protection of fish life. An HPA is required for construction or structural work associated with any bridge structure or culvert construction within or below the ordinary high water mark (OHWM) of waters of the state.

Seasonal restrictions (i.e., work windows) applied to work conducted below the OHWM would be as required by an HPA issued by WDFW and by the Section 404 permit issued by the U.S. Army Corps of Engineers (USACE).

In accordance with typical requirements of a HPA, when large woody debris must be moved to allow the reasonable use of an over-water or in-water facility, the large woody debris would be returned to the water downstream, where it would continue to provide aquatic habitat function.

All newly installed culverts would be in compliance with Washington Administrative Code (WAC) 220-110-070 (http: //wdfw.wa.gov/hab/ engineer/w2201170.htm) regarding fish passage requirements. Any affected streambeds, stream banks adjacent to culverts, and at the stream relocation reach, would be permanently restored following in-water work with plantings of native or approved woody and herbaceous species within one year of completion of each phase of construction. Bank protection would follow the guidelines set forth in WDFW's Integrated Streambank Protection Guidelines (http://wdfw.wa.gov/hab/ahg/ispgdoc.htm).

Water Quality

The Federal Clean Water Act (CWA) (1972, and later modifications, 1977, 1981, and 1987) established water quality goals for the navigable (surface) waters of the United States. One of the mechanisms for achieving the

goals of the CWA is the National Pollutant Discharge Elimination System (NPDES) permit program, which is administered by the U.S. Environmental Protection Agency (EPA). EPA has delegated responsibility to administer the NPDES permit program to the State of Washington on the basis of Chapter 90.48 of the Revised Code of Washington (RCW), which defines the Washington State Department of Ecology (Ecology) authority and obligations in administering the wastewater discharge permit program.

Ecology's construction stormwater general permit is required for certain construction activities. The goal of the permit is to reduce or eliminate stormwater pollution and other impacts to surface waters from construction sites.

The project must complete a Notice of Intent (NOI) for coverage under the permit. The project must also develop a Stormwater Pollution Prevention Plan (SWPPP) that implements BMPs for identifying, reducing, eliminating, or preventing sediment and erosion problems on site.

Any materials placed below the OHWM (e.g., cobble or boulders for energy dissipation at culvert ends, streambed gravel or other substrates) would have a sufficiently low sediment fraction so as not to violate Section 401 permit conditions when flow is restored to the work site. To the fullest extent practicable, culverts would be installed, modified, and/or replaced in isolation from stream flow (if there is flow during the work window) by means of a temporary bypass flume, diversion culvert, or by temporarily pumping flow around the in-water work zone. Any temporary dewatering of the in-water work zone would be preceded by work area isolation and fish removal/relocation (as necessary). Fish handling would be conducted by a trained and qualified biologist. Turbid water produced during the course of in-water work would be prevented from discharging to fish-bearing waters or wetlands. Turbid wastewater may be routed to temporary or permanent detention facilities, or to upland areas that provide adequate rates of infiltration.

In accordance with conditions of a typical HPA, heavy equipment used during the course of in-water work would operate from above the OHWM wherever possible. Use of equipment below the OHWM would be limited to that necessary to gain position for work. Drive mechanisms would not enter or operate below the OHWM, except under the terms of the HPA issued by WDFW.

Uncured concrete and/or concrete byproducts would be prevented from coming in contact with streams or water conveyed directly to streams during construction. Any water having direct contact with uncured concrete would be contained and treated or removed from the site (as appropriate) to prevent discharge to streams or wetlands.

Installation of permanent footings and all drilled or pile-driven shafts (and excavated spread footings) below the OHWM (e.g., for culvert end-walls) would be conducted in a manner consistent with Section 404 and other permits issued for the project by the USACE and other parties (as applicable). When constructing drilled shafts, the contractor would ensure that all drilling equipment, drill recovery and recycling pits, and any waste or spoil produced are properly contained to prevent discharge of drill wastes or fluids to any surface water or wetlands.

In accordance with typical Section 401 permit requirements, turbidity would be monitored if in-water work occurs when water is flowing in the streams. Equipment (excluding track-mounted equipment, large cranes, and other relatively immobile equipment) would be refueled and maintenance activities conducted at a distance from the nearest wetlands, ditches, and flowing or standing water approved by regulatory permits. Appropriate spill prevention measures and fuel containment systems would be designed and implemented to completely contain a potential spill as specified in the Spill Prevention and Control Countermeasure (SPCC) plan. If flooding of the work area is expected to occur within 24 hours, all equipment and material would be evacuated from near-stream construction sites. An exception would be for efforts to avoid or minimize resource damage. All equipment that is used for in-stream or in-wetland work would be cleaned prior to operations below the OHWM. Wash-water would not be discharged directly into any water body without pretreatment.

Weed Control

Weeds would be treated and monitored for a period of at least 3 years on property disturbed during construction. Chemicals to be used and application methods would be approved by the King County Noxious Weed Control Board and the Washington State Noxious Weed Control Board.

Design and Operation BMPs

The project would install permanent storm water runoff treatment and flow control facilities where needed according to the requirements of the 2002 Ecology Manual or the most recently adopted manual.

The project would incorporate storm water conveyance and management facilities that promote infiltration where applicable.

The project would select, design, and install runoff treatment BMPs that are best suited to the site conditions and best capable of achieving the required levels of treatment (subject to negotiation with the local jurisdiction and/or Ecology). These would or may include natural or engineered dispersion BMPs; biofiltration BMPs such as vegetated filter strips, biofiltration swales, or ecology embankments; wet-pool BMPs; and infiltration BMPs.

The project would not reroute existing drainage configurations to the extent that storm water from one basin or subbasins is conveyed and discharged to another.

The project would implement integrated pest management techniques, in accordance with current Ecology water quality agreements to minimize the effect on aquatic and terrestrial environments.

Appendix B

Wildlife Function Field Data Form

Sound Transit East Link Wildlife Functions Field Data Form
(Adapted from WSDOT's BPJ Characterization)

Project:
_____ Date: _____
Site ID:
_____ Biologist: _____

Function	Likely or Not Likely to Provide (State Your Rationale), Yes/No, or Number
F. General Habitat Suitability	
1. Area is not fragmented by development.	
2. Upland surrounding area is undeveloped.	
3. Area has connectivity with other habitat types.	
4. Diversity of plant species is high.	
5. Evidence of wildlife use, e.g., tracks, scat, gnawed stumps present.	
6. Distance to disturbance source and type.	
H. Habitat for Amphibians	
1. Cover (i.e., woody debris, rocks, and leaf litter) present.	
2. Woody debris present within area.	
3. Proximity to wetland habitats – distance and type.	
4. Lands within 1 km (0.6 mi) of area are > or = 40% undeveloped.	
5. Wetlands and/or an intermittent or perennial stream within 1 km (0.6 mi) of area.	
6. Presence of movement barrier between above wetland or stream and site being evaluated	
I. Habitat for Mammals	
1. Permanent water present within the area.	
2. Presence of emergent vegetation in areas of permanent water.	
3. Areas containing dense shrubs and/or trees are present.	
4. Interspersion between different strata of vegetation.	
5. Presence of slopes / banks suitable for denning.	
6. Evidence of wildlife use, e.g., dens, tracks, scat, gnawed stumps, etc.	
J. Habitat for Birds	
1. Forested and scrub-shrub classes present within the area.	
2. Average tree height.	
3. Average DBH.	

Function	Likely or Not Likely to Provide (State Your Rationale), Yes/No, or Number
4. Largest DBH and percent of trees in this class.	
5. Relative tree species diversity (L, M, H).	
6. Snags present in area .	
7. Cavities present in trees.	
8. Tree % canopy estimate.	
9. Shrub % canopy estimate.	
10. Adjacent area contains relatively undisturbed grassland or wetland shrub and/or forest habitats.	
11. Lands within 1 km (0.6 mi) of the area are greater than or = 40% undeveloped.	
L. Native Plant Richness	
1. Dominant and co-dominant plants are native.	
2. Area has three or more strata of vegetation.	
3. Area has mature trees (conifer, deciduous?).	
4. Number of species of trees.	
5. Area has well developed shrub layer.	
6. Number of species of shrubs.	
N. Uniqueness and Heritage	
1. Area contains documented occurrence of a state or federally listed threatened or endangered species.	
2. Area contains documented critical habitat, high quality ecosystems, or priority species respectively designated by the USFWS, the WDNR's NHP, or WDFW's Priority Habitats and Species Program.	
3. Area has biological, geological, or other features that are determined rare by the local jurisdiction.	
4. Area has been determined significant by the local jurisdiction because it provides functions scarce for the area	

Appendix C

Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Species with Federal Endangered Species Act Status							
Marbled Murrelet	*Brachyramphus marmoratus*	Bird	FT	ST		X	Requires conifer forests with trees >28-inch diameter at breast high (dbh) with platforms for nesting. Spends the winter in marine waters offshore. Rare and infrequent visitors to Lake Washington during the nonbreeding season.
Taylor's Checkerspot	*Euphydryas editha taylori*	Butterfly	FCo	SoC		X	Parent species Edith's checkerspot (*Euphydryas editha*) listed as occurring in King County. *E. editha taylori* likely does not occur in study area due to a lack of grasslands. *Plantago* only host plant likely growing in study area. Grasslands in Puget Sound lowlands, San Juan's, and Olympic Coast. Larval host plants: paintbrush (*Castilleja*), beardtongues (*Penstemon*), lousewort (*Pedicularis*), owl's clover (*Orthocarpus*), Chinese houses (*Collinsia*), and plantain (*Plantago*).
Federal Species of Concern—No Endangered Species Act Status							
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Bat	FCo	SC		X	Areas with a mosaic of woodland/grassland and/or shrubland, esp. coniferous mosaics. Found in Pierce County, Fort Lewis.
Yuma Myotis	*Myotis yumanensis*	Bat	FCo	NONE		X	Closely associated with water. Moist woodlands, forests, desert scrub. Forages over water and in open, uncluttered habitats. Mapped in Puget Sound.
Western Toad	*Bufo boreas*	Amphibian	FCo	SC	X		Found in a variety of habitats, including slow-moving rivers and streams, and near ponds and lakes. Large population declines in the Northwest. Listed as occurring in the Lake Washington Basin.
Additional Washington Listed Species, and Species of Concern							
Monarch	*Danaus plexippus*	Butterfly	None	SoC	Known in the study area		Listed as occurring in King County. Variety of open habitats: fields, meadows, weedy areas, marshes, and along roadsides. Larval and adult food plants are milkweeds.

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Bald Eagle	*Haliaeetus leucocephalus*	Bird	FCo	SM	Known in the study area		Nests in wooded areas with larger trees within a half mile of large bodies of water. Highly territorial of nesting tree. May have more than one nest tree per territory, as well as roost and perch trees. Several known territories in Segments A, B, and E.
Peregrine Falcon	*Falco peregrinus*	Bird	FCo	SM	Known in the study area		Two historical and recent eyries in Segment A. Nests in sheltered cliff areas naturally, has adapted to using bridges and buildings for nesting sites.
Pileated Woodpecker	*Dryocopus pileatus*	Bird	None	SC	Known in the study area		Requires wooded forests with a component of dead and dying trees and snags for foraging and nesting. Prefers deciduous forests. Will occur in conifer forests with some deciduous tree component. Found at Marymoor Park. One bird observed in WR-5.
Purple Martin	*Progne subis*	Bird	None	SC	Known in the study area		Nests in structures over waterbodies, including natural cavities, pilings, and man-made housing structures. Forages over open water or wet areas for insects while in flight. Nesting observed at Marymoor Park in 2003, but no activity since. Population believed to be in decline throughout its range.
Common Loon	*Gavia immer*	Bird	None	SS		X	Population has declined due to acid rain, pollution, industrial contamination of waterbodies and lead poisoning. Artificial floating nesting platforms have reduced the negative impact of fluctuating water levels from human activities to nests.
Western Grebe	*Aechmophorus occidentalis*	Bird	None	SC	Known in the study area		Nests in colonies numbering up to several hundred birds on large inland lakes or in coastal marshes of the western United States. Birds breeding in the northern extent of their range migrate to the western coastal ocean to spend the winter.
Merlin	*Falco columbarius*	Bird	None	SC	X		Seen during the nesting season at Marymoor Park.

TABLE C-1
Priority Species Found in Western Washington and Potential Occurrence in the East Link Affected Habitats

Common Name	Scientific Name	Family	Federal Status[a]	State Status[b]	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
					Likely Present	Possibly Present	
Vaux's Swift	*Chaetura vauxi*	Bird	None	SC		X	Nests and forages in groups with 30 or more birds. Nest is a cup shaped nest placed in a dark, confined cavity. Breeds in mountains and foothills, usually >700 meters in elevation. Forages over wooded areas and more open habitats, including towns.
Olive-sided Flycatcher	*Contopus borealis*	Bird	FCo	SM	X		Breeds in coniferous forests in North America. Population is declining due to loss of winter habitat in Central America and the Andes region of South America.
Willow Flycatcher	*Empidonax traillii*	Bird	FCo	SM	Known in the study area		Breeds in deciduous thickets, especially in willow thickets. Nest site often close to water.

[a] **Federal Status:**

FT=Federal Threatened

FC=Federal Candidate

FCo=Federal Species of Concern (no formal ESA status)

[b] **State of Washington Status:**

The Washington Species of Concern list is published by the Wildlife Management Program and includes only native Washington fish and wildlife species that are listed as Endangered, Threatened, or Sensitive, or as Candidates for these designations. Endangered, Threatened, and Sensitive species are legally established in Washington Administrative Codes.

SE=State Endangered

ST=State Threatened

SC=State Candidate

SS=State Sensitive

SoC=State Species of Concern

SM=State Monitor Species (this is the “lowest level” of species classification afforded to fish and wildlife species in the state of Washington. State Monitor Species are not considered Species of Concern, but are monitored for status and distribution in a particular area.

Appendix D

WDFW-Recommended Management Buffer Distances for Bald Eagles

WDFW-Recommended Management Buffer Distances for Bald Eagles

This information is summarized from the Washington Department of Fish and Wildlife (WDFW) Priority Habitat and Species Management Recommendations for Bald Eagles (WDFW, 2001).

Nest Area

When developing site management plans, WDFW recommends buffering bald eagle nests with a two-zone management system that mimics a strategy designed by the U.S. Fish and Wildlife Service (USFWS, 1981). The following guidelines for these zones are based on the research cited in WDFW's Priority Habitat and Species Management Recommendations for bald eagles (WDFW, 2001):

- Protected Zone (Primary Zone). This zone protects and screens the nest tree and should extend at least 400 feet from the nest tree. Its size and shape will vary with site conditions such as topography, prevailing winds, and screening vegetation, as well as on the eagles' tolerance to human activities. In areas where vegetation and/or topography do not provide adequate screening within 400 feet of the nest, consider increasing the size of the protected zone. Retain all existing large trees and existing forest structure within the protected zone.
- Conditioned Zone (Secondary Zone). The conditioned zone further screens and protects nest sites in the protected zone and should extend from 330 to 800 feet beyond the edge of the protected zone. Alternate nest locations, perch trees, and feeding sites should be included in this zone and will influence its size and shape (Stallmaster, 1987). Depending on screening vegetation, prevailing winds, topography, and the sensitivity of the nesting eagles to human activities, this zone may need to be expanded up to 2,640 feet from the edge of the protected zone. Avoid constructing roads or trails within sight of the nest that would facilitate human or predator access to the nest. Construction activities (e.g., homes, roads, and power lines) that take place out of sight of the nest should be postponed until after the young eagles have fledged, as should forest practice activities.

Roosting Habitat (Communal Roosts)

Activities that produce noise or visual effects within 400 feet of the edges of communal roost trees or staging trees should be conducted outside of the critical roosting period (November 15 to March 15). This corresponds to the time when most eagles begin to arrive in eastern and western Washington, with numbers peaking in December and January and declining rapidly by mid-March (Fielder and Starkey, 1980; Garrett, et al., 1988; Stalmaster, 1989). There are no known communal roosts in the project vicinity.

Perching and Foraging Habitat

Perches along shorelines near winter roosts or in nesting territories are important to foraging eagles. Tree structure, and the distance between habitat alterations and shorelines should be considered when managing for bald eagle wintering habitat.

Perch Structure and Location

In Washington, protect known bald eagle perch trees and potential foraging perches greater than 20 inches dbh and within 246 feet of the top of a bank or shoreline. Chandler, et al., (1995) recommends protecting patches of shoreline forest, and specifically protecting live and dead trees over 8 inches dbh for future habitat.

Human Disturbance

Bald eagles often feed on the ground, in open areas where food resources are concentrated. They should be allowed a distance of at least 1,500 feet from human activity and permanent structures. Buffer zones of 800 to 1,000 feet) have been recommended in perching areas where little screening cover is present (Stalmaster and Newman, 1978). Stalmaster and Newman (1979) found that 50 percent of wintering eagles in open areas flushed at 500 feet, but 98 percent would tolerate human activities at 1,000 feet. Activities that disturb eagles while feeding, especially during winter, can cause them to expend more energy, which increases their susceptibility to disease and poor health (Stalmaster, 1987).

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Management Recommendations for Locally Important Species Found in the East Link Project Area

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DATE: February 14, 2008

Introduction

Title 21A of the Growth Management Act (GMA) requires counties and cities in Washington to designate and protect critical areas, in accordance with RCW 36.70A.170. The GMA requires local jurisdictions to designate and protect critical areas, using the best available science (BAS) in developing policies and regulations to protect critical area functions and values. The purpose of the GMA is to avoid the possibility of uncoordinated and unplanned growth as the population in the state continues to rise and development increases. The GMA is intended to protect the public's health and safety by requiring county and city governments to create local based plans and regulations that are centered on land use and natural resource issues as guided by the state legislature. Critical areas are one of the two primary natural resource areas addressed in the GMA planning process. Critical areas include wetlands, critical recharge areas for potable water aquifers, frequently flooded areas, geologically hazard areas, and Fish and Wildlife habitat conservation areas.

Fish and Wildlife Habitat Conservation Areas

Fish and Wildlife habitat conservation areas are the primary way the Washington Department of Fish and Wildlife (WDFW) works to conserve wildlife habitat in Washington State. While WDFW is charged with protecting and maintaining fish and wildlife populations, WDFW has little authority over the habitats used by fish and wildlife species. Protection is primarily achieved through the voluntary actions of landowners and through existing state regulations, including the State Environmental Policy Act (SEPA), the Growth Management Act, the Forest Practices Act (FPA), and the Shoreline Management Act (SMA). WDFW primarily serves an advisory role, by reviewing proposals for development and offering guidelines for species management on private property. WDFW has written management guidelines for all state and priority listed species. Priority species include species and wildlife congregations that are priorities for conservation due to their population status, sensitivity to disturbance, economic, recreational or tribal importance. These species may or may not be listed as an endangered, threatened, sensitive, or candidate species by the state or federal government. The management recommendations are generalized guidelines and are not enforceable regulations. They are based on the needs of fish and wildlife species, and are not based on land use objectives.

Fish and Wildlife Habitat Conservation Areas are lands that are managed for perpetuating species in suitable habitats within their natural range, and to prevent the creation of isolated subpopulations. As set forth in the WAC guidelines, Fish and Wildlife Habitat Conservation Areas include:

a. Areas with which federal and state endangered, threatened, and sensitive species, and state candidate species, have a primary association;

b. Habitats and species of local importance;

c. Commercial and recreational shellfish areas;

d. Kelp and eel grass beds; herring and smelt spawning areas;

e. Naturally occurring ponds under 20 acres and their submerged aquatic beds that

f. Provide fish or wildlife habitat;

g. Waters of the state;

h. Lakes, ponds, streams, and rivers planted with game fish by a governmental or tribal

i. Entity; or

j. State natural area preserves and natural resource conservation areas.

In order to meet the requirements established by the GMA, King County and the Cities of Bellevue, Mercer Island and Redmond created Critical Areas Ordinances to ensure the management and protection of lands used by listed and locally important species. Species of Local Importance include native species that are in danger of becoming federally or state listed or extirpated if current population trends continue. The long-term preservation of the species is dependent on the protection it receives. Without the additional protection, the species or habitat is likely to decline in the future. Localized populations that are vulnerable or in decline, or species or habitats that offer some special value may also be considered locally important. Fish and Wildlife Habitat Conservation Areas also include areas associated with state priority species, and areas critical for habitat connectivity. These wildlife habitats are classified and rated by a variety of internal (site specific) and external (contextual) habitat conditions.

King County Comprehensive Plan

The King County code protects critical areas as well as their buffers in order to protect the health and safety of the County's residents and its environment. In October of 2006, King County adopted ordinances 15605-15607, amending the 2004 Updated Comprehensive Plan. Chapter 4 of the King County Comprehensive Plan establishes recommendations for protecting listed and locally important wildlife and their breeding habitats. Protection is given to species of local importance using regulations, incentive programs, land purchases, networking of wildlife corridors, and development clustering. Species considered to be locally important in King County are shown in Table 1. In addition, King County is required to protect designated wildlife corridors, riparian corridors, and the breeding sites of two species of raptors and herons. These four species and their breeding habitats are shown in Table 2.

TABLE 1
King County Designated Locally Important Species

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Locally Important Species listed by King County (King County Comprehensive Code Chapter 4)					
Trumpeter Swan	*Cygnus buccinator*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Trumpeter Swans spend the winter from November to April in the open fields and estuaries of Skagit and Whatcom Counties. Recently, their range has expanded to Grays Harbor and other areas of western Washington. There are currently no trumpeter swans breeding in Washington
Tundra Swan	*Cygnus columbianus*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Tundra Swans are common in fresh- and saltwater habitats throughout the lowlands of northwestern Washington from November to April. Almost 2,000 winter in Skagit County.
Snow Goose	*Chen caerulescens*	Bird		Known in the study area	Rare visitor to Marymoor Park during the winter. Seen fewer then 10x at Marymoor Park. Typically observed in large flocks. Up to 55,000 winter in western Washington. Most gather in the Skagit River Delta from mid-October to early May.
Band-tailed Pigeon	*Patagioenas fasciata*	Bird	Known in the study area		Found in low- and mid-elevation conifer and mixed conifer/deciduous forests. Requires a component of mature conifers. Band-tailed Pigeons prefer forest edges, especially open sites bordered by tall conifers.
Harlequin Duck	*Histrionicus histrionicus*	Bird		May Occur	In western Washington, harlequins historically bred in the Olympic and Cascade mountains. Wintering areas include northern Puget Sound, northern Hood Canal, the Strait of Juan de Fuca, San Juan Islands, and the Pacific coast. In winter they are common in marine waters along rocky shorelines and jetties. They are more common in northern Puget Sound then in southern portions of the Sound.
Western Bluebird	*Sialia Mexicana*	Bird		Known in the study	Rare visitor to Marymoor Park. Seen fewer then 10x at Marymoor Park. In western Washington, Mountain Bluebirds

TABLE 1
King County Designated Locally Important Species

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
				area	are uncommon in the Fort Lewis area, and rare in forest clearings in King, Pierce, Thurston, and Mason Counties.
Brant Goose	*Branta bernicla nigricans*	Bird	No	No	Found in estuaries, beaches, bays and spits where they feed and rest before their migration north to Arctic breeding grounds. Ninety-five percent of their diet is composed on eelgrass (*Zostera marina* and *Zostera japonica*) which grow on inter-tidal mudflats.
Black-crowned Night Heron	*Nycticorax nycticorax*	Bird	No	No	Black-crowned Night-herons have been known to breed in western Washington's eastern Puget Trough lowlands. Frequently nest on island and in large trees in small colonies. Usually found in fresh and saltwater wetlands. In spring and fall, they can be found in wetlands flanking large river basins.
Blue Grouse	*Dendragapus obscurus*	Bird	No	No	In Washington, blue grouse are found in three distinct areas east of the Cascades. Blue grouse are found in mountainous areas wherever open coniferous forests are present. They are closely associated with true fir (*Abies* spp.) and Douglas fir *(Pseudotsuga menziesii*) forests.
Mountain Quail	*Oreortyx pictus*	Bird	No	No	Found on mountain slopes and foothills, in areas with dense cover supporting scattered open areas. Often found in dense thickets created by fires or clear cuts.
Mountain Goat	*Oreamnos americanus*	Mammal	No	No	Found in the Cascade Mountain range.
Columbian Black-tailed Deer	*Odocoileus hemionus columbianus*	Mammal	None	Locally Important	Found along the Pacific Coast from Alaska to northern California.
Elk	*Cervus elaphus*	Mammal	No	No	Found in the mountain ranges and shrub lands of the Olympic and Cascade mountains.
Marten	*Martes americana*	Mammal	No	No	Strongly associated with mature conifer forests. Historically found throughout the mountains of Washington, Oregon and California.
Mink	*Mustela vison*	Mammal	Known in the study area		Rare visitor to Marymoor Park. Seen fewer then 10x at Marymoor Park.

In addition, King County wrote local guidelines for ten terrestrial species most often encountered during proposal reviews in the County (Table 3). Section 198 of the King County Comprehensive Plan requires the county to protect the active breeding sites of these species, as well as the immediate area surrounding each site to prevent any disturbance to breeding activities. All ten species are either listed by the State as an endangered, threatened, sensitive, candidate or monitor species, or are listed as a locally important species by King County. The species include the bald eagle (*Haliaeetus leucocephalus)*, great blue heron (*Ardea herodias*), osprey (*Pandion haliaetus)*, peregrine falcon (*Falco peregrinus*), northern spotted owl (*Strix occidentalis*), marbled murrelet (*Brachyramphus marmoratus*) , Townsend's big eared bat (*Corynorhinus townsendii)*, Vaux's swift (*Chaetura vauxi)*, red-tailed hawk (*Buteo jamaicensis)*, and goshawk (*Accipiter gentilis*).

For all other species included in the King County Comprehensive Plan, the County is required to establish protective standards if a breeding site is discovered during a project review. The protective standards are based on management guidelines and recommendations established by WDFW. Most of the species listed in the King County Comprehensive Plan do not occur in the East Link project area, as they are not found in urban or commercially developed areas. In some cases however, their breeding habitat is still protected, even though the species itself is not actively breeding or occurring at the location.

TABLE 2
Wildlife Breeding Habitats Designated as having Local Importance in King County

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Species Whose Breeding Habitats are Included in King County's Fish and Wildlife Habitat Conservation Areas (King County Comprehensive Code Chapter 4)					
Great Blue Heron	*Ardea Herodias*	Bird	Known in the study area		Nests in small to medium sized colonies ranging from 3 to 30 nests. Colonies usually in secluded deciduous forests, but can adapt to some levels of disturbance gradually, over time. Will use conifer forests occasionally. Colonies often <1mile away from wetlands or large water bodies. Listed due to its sensitivity to disturbances and dependence on wetlands, wet meadows, and water bodies.
Black-crowned Night Heron	*Nycticorax nycticorax*	Bird	No	No	Black-crowned Night-herons have been known to breed in western Washington's eastern Puget Trough lowlands. Usually nest on island and in large trees in small colonies. Often found in fresh and saltwater wetlands. In spring and fall, they can be found in wetlands flanking large river basins.
Red-tailed Hawk	*Buteo jamaicensis*	Bird	Known in the study area		Found in areas with a mix of forests and open spaces, including agricultural land, grasslands, wetlands and meadows. Small mammals, especially rodents, are their

TABLE 2
Wildlife Breeding Habitats Designated as having Local Importance in King County

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					primary prey.
Osprey	*Pandion haliaetus*	Bird	Known in the study area		Nests in exposed trees or platforms that provide a clear, unobstructed view of surrounding area. Nests close to large bodies of water. Territorial. Several known active nests and territories in Segments B, C, and E.

TABLE 3
King County Designated Wildlife Habitat Conservation Area Breeding Areas

Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
Bald Eagle	Haliaeetus leucocephalus	400-foot radius from active nest	• No alterations within 800 feet from March 15 through April 30 (incubation and first three weeks of brooding). • Maintain a 400 foot radius around nest trees. • Prohibit use of land-clearing machinery within 800 feet from January 1 through August 31.
Great Blue Heron	Ardea herodias	820-foot radius from the rookery. WDFW can increase radius up to an additional 164 feet if population of rookery is declining	• No clearing or grading disturbance from January 1 through July 31 within 924 feet around existing rookeries. • Maintain 820 foot radius around existing rookeries that are known to be stable; buffer may be increased by 164 feet if population of rookery is declining.
Marbeled Murrelet	Bracyrhampus marmuratus	One-half mile radius around an active nest	• Protect area within 0.5 mile of nest trees.
Northern Spotted Owl	Strix Occidentalis	3,700-foot radius from an active nest	• Protect 3,700 foot radius from nest tree.
Goshawk	Accipter gentilis	1,500-foot radius around an active nest located outside of the Urban Growth Area (UGA)	• Maintain 1,500 foot radius around active nest sites located outside the urban growth area.
Osprey	Pandion haliaetus	230-foot radius around an active nest	• No disturbance within 660 feet from April 1 through September 30. • Maintain 230 foot radius around active nest.
Peregrine Falcon	Falco peregrinus	Extending 1,000 feet of an eyrie on a cliff face,	• No human activity along the nest cliff rim, immediately below nest cliffs, or on the cliff face within 1,000 feet at any time of

TABLE 3
King County Designated Wildlife Habitat Conservation Area Breeding Areas

Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
		the area immediately above the eyrie on the rim of the cliff, and the area immediately below the cliff	year. • No surface-disturbing activities that would produce loud noises (e.g. blasting, operation of chainsaws and heavy machinery) from March 1 through June 30 within .5 miles of nest. • Route power lines 1,000 feet from eyries.
Red-tailed Hawk	Buteo jamaicensis	325-foot radius from an active nest located outside of the UGA	• Maintain an area with a radius of 325 feet from an active nest located outside the urban growth area. • Clearing and grading is not allowed within 660 feet of an active nest located outside of the urban growth area from March 1-July 31
Common Name	Scientific Name	Fish and Wildlife Habitat Conservation Area	Protective Nesting Habitat Recommendations when Active Nesting or Breeding is Determined for a Site:
Vaux's Swift	Chaetura vauxi	300-foot radius around an active nest located outside of the UGA	• Maintain a 300 foot radius around active nest sites outside the urban growth area. • No clearing or construction activities within 400 feet of active or potential nest trees from April 1 through October 31, unless potential nest tree is proved to contain no nests.
Townsend's Big-eared Bat	Corynorhinus townsendii	June 1-Oct 1 – 450-foot radius around from entrance to a cave or mine located outside of the UGA, within an active nursery colony Nov. 1-March 31 – 450-foot radius around the entrance to a cave or mine located outside the UGA serving as a winter hibernacula	• Maintain a minimum 450' radius in all directions from the entrance of a cave or mine of an active and alternate nursery sites located outside of the urban growth area from June 1-October 1 • Establish 450 foot radius around the entrance to the cave or mine serving as winter hibernacula November 1 - March 31 outside of the urban growth boundary • A building, bridge or tunnel, or other structure used solely for day or night roosting shall not be altered from March 1-November 30 • The entrance to a cave or mine that is protected because of bat presence is protected from human entry May 1 – September 15 • Gate entrance to cave or mine that is protected because of bat presence must be designed to allow bats to enter and exit.

Specifically, King County is required to protect:

1. habitat for all federally and state listed endangered, threatened, and sensitive species, and state candidate species
2. habitat used by locally important species

3. designated WDFW wildlife corridors
4. riparian corridors
5. locally important salmonid habitats
6. commercial and recreational shellfish beds
7. kelp and eelgrass beds
8. herring, sand lance and smelt spawning areas
9. habitat used by nesting red-tailed hawks
10. habitat for raptors and herons of local importance: osprey, great blue heron and black-crowned heron, and
11. habitat used by locally important marine species: freshwater mussels, geoduck clam, Pacific oyster, Dungeness crab, Pandalid shrimp, red urchins, white sturgeon, Pacific herring, channel catfish, longfin smelt, surfsmelt, Pacific cod, Pacific whiting, black rockfish, copper rockfish, quillback rockfish, yelloweye rockfish, lingcod, Pacific sand lance, English sole and rock sole.

Bellevue Ordinance #5680

Bellevue updated its Land Use Code in 2001 to incorporate critical area regulations. Under LUC 20.25H.025, any habitat associated with a species of local importance is designated a critical area. Furthermore, if a habitat associated with a species of local importance is impacted by a proposed development, the proposal shall implement the WDFW wildlife management plan designed for that species. If the habitat does not include a critical area or critical area buffer, but is occupied by a locally important species, then only the guidelines in the wildlife management plan need to be followed. Updating the Land Use Code also led to the creation of a Critical Areas Overlay District. This district excludes downtown Bellevue, as it focuses on the recognition of natural, sensitive and hazard areas and imposes regulations on the use and development of these properties. Locally important species in Bellevue are show in Table 4.

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
Locally Important Species listed by the City of Bellevue (LUC 20.25H.150)					
Great Blue Heron	*Ardea herodias*	Bird	Known in the study area		Nests in small to medium sized colonies ranging from 3 to 30 nests. Colonies usually in secluded deciduous forests, but can adapt to some levels of disturbance gradually, over time. Will use conifer forests occasionally. Colonies often <1mile away from wetland or large water bodies. Listed due to its sensitivity to

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					disturbances and dependence on wetlands, wet meadows, and water bodies.
Red-tailed Hawk	*Buteo jamaicensis*	Bird	Known in the study area		Found in areas with a mix of forests and open spaces, including agricultural land, grasslands, wetlands and meadows. Small mammals, especially rodents, are their primary prey.
Bald Eagle	*Haliaeetus leucocephalus*	Bird	Known in the study area		Nests in wooded areas with larger trees within a half mile of large bodies of water. Highly territorial of nesting tree. May have more than one nest tree per territory, as well as roost and perch trees. Several known territories in Segments A, B, and E.
Peregrine Falcon	*Falco peregrinus*	Bird	Known in the study area		Two historical and recent eyries in Segment A. Nests in sheltered cliff areas naturally, has adapted to using bridges and buildings for nesting sites.
Osprey	*Pandion haliaetus*	Bird	Known in the study area		Nests in exposed trees or platforms that provide a clear, unobstructed view of surrounding area. Nests close to large bodies of water. Territorial. Several known active nests and territories in Segments B, C, and E.
Pileated Woodpecker	*Dryocopus pileatus*	Bird	Known in the study area		Requires wooded forests with a component of dead and dying trees and snags for foraging and nesting. Prefers deciduous forests. Will occur in conifer forests with some deciduous tree component. Found at Marymoor Park. One bird observed in WR-5.
Purple Martin	*Progne subis*	Bird	Known in the study area		Nests in structures over water bodies, including natural cavities, pilings, and man-made housing structures. Forages over open water or wet areas for insects while in flight. Nesting observed at Marymoor Park in 2003, but no activity since. Population believed to be in decline throughout its range.
Common Loon	*Gavia immer*	Bird		Known in the study area	Population has declined due to acid rain, pollution, industrial contamination of water bodies and lead poisoning. Artificial floating nesting platforms have reduced the negative impact of fluctuating water levels from human activities to nests.
Western Grebe	*Aechmophorus occidentalis*	Bird	Known in the study area		Nests in colonies numbering up to several hundred birds on large inland lakes or in coastal marshes of the western United States. Birds breeding in the northern extent of their range migrate to the western coastal ocean to

TABLE 4
Designated Locally Important Wildlife in the City of Bellevue

Common Name	Scientific Name	Family	Expected Occurrence in Study Area		Preferred Habitat / Basis for Occurrence Determination
			Likely Present	Possibly Present	
					spend the winter.
Merlin	*Falco columbarius*	Bird	Known in the study area		Seen during the nesting season at Marymoor Park.
Great Egret	*Ardea alba*	Bird	Known in the study area		Feeds in low watered areas and fields, on fish, amphibians, and insects. Breeds in colonies close to large lakes with emergent vegetation beds, or in large wetland areas.
Green Heron	*Butorides virescens*	Bird	Known in the study area		Breeds in small wetlands on a platform built nest that is either in a tree or shrub, close to the water. Feeds on small fish, insects, and amphibians. Nests at Marymoor Park.
			Likely Present	Possibly Present	
Vaux's Swift	*Chaetura vauxi*	Bird		Known in the study area	Nests and forages in groups with 30 or more birds. Nest is a cup shaped nest placed in a dark, confined cavity. Breeds in mountains and foothills, usually >700 meters in elevation. Forages over wooded areas and more open habitats, including towns.
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Bat		May Occur	Areas with a mosaic of woodland/grassland and/or shrub land, esp. coniferous mosaics. Found in Pierce County, Fort Lewis.
Western Toad	*Bufo boreas*	Amphibian	May Occur		Found in a variety of habitats, including slow-moving rivers and streams, and near ponds and lakes. Large population declines in the Northwest. Listed as occurring in the Lake Washington Basin.

City of Mercer Island Locally Important Species

The City of Mercer Island Comprehensive Land Use Plan includes Ordinance No. 05C-12, which details their critical areas regulations. In order to streamline their critical areas regulations, the City of Mercer Island adopted WDFW's Priority Habitat and Species program in its entirety in 1998. The City of Mercer Island relies solely on the United State Fish and Wildlife Service (USFWS) and WDFW for species listings. WDFW management guidelines and recommendations for state listed species are followed. In addition, the City of Mercer Island's City Council has not designated any species as having local importance.

City of Redmond Locally Important Species

The City of Redmond's Critical Areas Ordinance (Ordinance #2259) applies species protection to State Species of Concern, Priority Species designated by WDFW, and locally important species. Only one species, the great blue heron, is currently listed as a locally important species in Redmond. The red-tailed hawk was listed as a locally important species until 2004.

Redmond's critical areas ordinance established a set of recommendations for development within the urban growth boundaries of the city. These recommendations focus on using incentive programs, density transfers and existing state regulations to minimize impacts to natural areas. This is accomplished by clustering developments and, when possible, avoiding development in critical areas or their buffers. The primary framework of habitat management in the City of Redmond is the creation of habitat reserves and linking these reserves together using wildlife corridors. Following guidelines established in NE-79 and NE-90, the City of Redmond recommends using reserves and corridors to reduce the effects of habitat fragmentation. Section NE-84 also calls for protecting habitats having a primary association with state and federally listed species and candidate species, and species of local importance.

Conclusion

Locally important wildlife species do occur in the East Link project area. WDFW has been contacted in regards to any mitigation or conservation measures they may require for the East Link project. Any conservation measures will follow the management guidelines established by WDFW for those specific species. These guidelines and recommendations may be enforceable if they fall under the guidance of state regulations such as SEPA. In addition, WDFW or King County may also require management guidelines to lessen the impact to locally important species as detailed in their critical areas ordinances.

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Appendix F

Wetland Functional Scores and Impact Data

Attachment 1

Wetland Functional Scoring Tables

TABLE F1-1
Hydrologic Functions and Score for Each Wetland in Study Area

Locator	Wetland Name	Flood Reduction and Storm water Control	Erosion and Shoreline Protection	Hydrology Total
WR-1, WR-2	Bellevue Way North and South of Park and Ride	20	20	20 (MOD)
WR-3	Sturtevant Creek	6	6	6 (LOW)
WR-4	Mercer Slough I-90	3	3	3 (LOW)
WR-5	118th Ave SE	4	4	4 (LOW)
WR-6	BNSF Matrix	2	2	2(LOW)
WR-7	Kelsey Creek Ponded	18	18	18 (MOD)
WR-8	Kelsey Creek Riparian	10	10	10 (LOW)
WR-9	Allied Waste	2	2	2 (LOW)
WR-10	East of 140th Ave	6	6	6 (LOW)
WR-11	West of 140th Ave	12	12	12 (LOW)
WR-12	Bear Creek	18	18	18 (MOD)
WR-13	Marymoor Park Mitigation Wetland	8	8	8 (LOW)

TABLE F1-2
Habitat and Water Quality Functions and Score for Each Wetland in Study Area

Locator	Wetland Name	Potential to Provide Habitat Structure and Support	Proximity to Other Habitats	Opportunity to Provide Habitat	Habitat Function Total	Water Quality Improvements	Water Quality Total
WR-1, WR-2	Bellevue Way North and South of Park and Ride	14	1	7	22 (MOD)	32	32 (HIGH)
WR-3	Sturtevant Creek	8	0	7	15 (LOW)	16	16 (MOD)
WR-4	Mercer Slough I-90	8	3	1	12 (LOW)	14	14 (LOW)
WR-5	118th Ave SE	8	4	1	13 (LOW)	16	16(MOD)
WR-6	BNSF Matrix	8	0	4	12 (LOW)	14	14 (LOW)
WR-7	Kelsey Creek Ponded	10	3	3	16(LOW)	10	10 (LOW)
WR-8	Kelsey Creek Riparian	9	3	1	13 (LOW)	16	16 (MOD)
WR-9	Allied Waste	5	1	1	7 (LOW)	6	6 (LOW)
WR-10	East of 140th Ave	5	3	0	8 (LOW)	18	18 (MOD)
WR-11	West of 140th Ave	8	3	1	12 (LOW)	16	16 (MOD)
WR-12	Bear Creek	13	7	1	21 (MOD)	16	16 (MOD)
WR-13	Marymoor Park Mitigation Wetland	10	8	2	20 (MOD)	20	20 (MOD)

TABLE F1-3
Special Criteria Function and Value for Each Wetland in Study Area

Locator	Wetland Name	Special Criteria: Cultural Educational and Socioeconomic	Inside a Protected Area	Bog Estuary Forested	Natural Heritage Site	Undisturbed Area >1acre with <10% Non-native Plants
WR-1, WR-2	Bellevue Way North and South of Park and Ride	Yes	Yes	Bog	No	No
WR-3	Sturtevant Creek	No	No	No	No	No
WR-4	Mercer Slough I-90	No	No	No	No	No
WR-5	118th Ave SE	No	No	No	No	No
WR-6	BNSF Matrix	No	No	No	No	No
WR-7	Kelsey Creek Ponded	No	No	No	No	No
WR-8	Kelsey Creek Riparian	No	No	No	No	No
WR-9	Allied Waste	No	No	No	No	No
WR-10	East of 140th Ave	No	No	No	No	No
WR-11	West of 140th Ave	No	No	No	No	No
WR-12	Bear Creek	No	No	No	No	No
WR-13	Marymoor Park Mitigation Wetland	Yes	Yes	No	No	No

Attachment 2

Detailed Wetland and Wetland Buffer Impact Data

TABLE F2-1
Short-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Wetlands	
			Area Affected (square feet)	Area Affected (acres)
B1	WR-2—Bellevue Way North of Park and Ride	1	310.82	0.01
B1 Total			**310.82**	**0.01**
B2A	WR-1—Bellevue Way South of Park and Ride	1	9,833.81	0.23
B2A	WR-2—Bellevue Way North of Park and Ride	1	4,098.75	0.09
B2A Total				**0.32**
B2E	WR-2—Bellevue Way North of Park and Ride	1	310.82	0.01
B2E Total				**0.01**
B3	WR-1—Bellevue Way South of Park and Ride	1	8,255.03	0.19
B3	WR-2—Bellevue Way North of Park and Ride	1	1,786.00	0.04
B2E Total				**0.23**
B7	WR-1—Bellevue Way South of Park and Ride	1	117,224.34	2.7
B7 Total			117,224.34	2.7

TABLE F2-2
Short-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B1	WR1 and 2- Bellevue Way North/South of Park and Ride	1	77,547.73	1.78
B1 Total		**1**	**77,547.73**	**1.78**
B2A	WR1 and 2- Bellevue Way North/South of Park and Ride	1	74,156.87	1.7
B2A Total		**1**	**74,156.87**	**1.7**
B2E	WR1 and 2- Bellevue Way North/South of Park and Ride	1	49,351.58	1.13
B2E Total		**1**	**49,351.58**	**1.13**
B3	WR1 and 2- Bellevue Way North/South of Park and Ride	1	72,165.00	1.66
B2E Total		**1**	**72,165.00**	**1.66**

TABLE F2-2
Short-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B7	WR1 and 2- Bellevue Way North/South of Park and Ride	1	28,503.57	0.65
B7 Total		**1**	**28,503.57**	**0.65**
E1	WR-12 Bear Creek	2	3,749.98	0.09
E1 Total		2	**3,749.98**	**0.09**
E2	WR-13 – Marymoor Park Mitigation Wetland	2	12,693.77	0.29
E2	WR-12 Bear Creek	2	3,749.98	0.09
E2 Total		**2**	**16,443.75**	**0.38**
E4	WR-12 Bear Creek	2	3,749.99	0.09
E4 Total		**2**		**0.09**

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B2A	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B2A	WR-2—Bellevue Way North of Park and Ride	1	79.44	0
B2A Total			**175.08**	**0**
B2E	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B2E Total			**95.64**	**0**
B3	WR-3—Sturtevant Creek	1	18,083.10	0.42
B3	WR-1—Bellevue Way South of Park and Ride	1	95.64	0
B3	WR-2—Bellevue Way North of Park and Ride	1	79.18	0
B3 Total			**18,257.92**	**0.42**
B7	WR-1—Bellevue Way South of Park and Ride	1	15,401.57	0.35
B7	WR-1—Bellevue Way South of Park and Ride	1	11,808.24	0.27
B7	WR-1—Bellevue Way South of Park and Ride	1	18,345.21	0.42
B7	WR-1—Bellevue Way South of Park and Ride	1	2,322.82	0.05
B7	WR-1—Bellevue Way South of Park and Ride	1	9,495.06	0.22

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
B7	WR-5—118th Ave SE	1	20,165.90	0.46
B7	WR-4—Mercer Slough I-90	1	497.79	0.01
B7 Total			**78,036.59**	**1.78**
D2A-12TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D2A-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D2A-12TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2A-12TH	WR-11—West of 140th Ave NE	3	9,811.90	0.23
D2A-12TH	WR-9—Allied Waste	4	20.17	0
D2A-12th Total for Cat 3		**3**	**17587.57**	**0.4**
D2A-12th Total for Cat 4		**4**	**20.17**	**0**
D2A-6TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D2A-6TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2A-6TH	WR-11—West of 140th Ave NE	3	9,811.90	0.23
D2A-6TH	WR-9—Allied Waste	4	20.17	0
D2A-6th Total for Cat 3		**3**	**15,661.39**	**0.36**
D2A-6th Total for Cat 4		**4**	**20.17**	**0**
D2E-12TH	WR-8—Kelsey Creek Riparian	3	2,365.15	0.05
D2E-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D2E-12TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2E-12TH	WR-11—West of 140th Ave NE	3	7,083.60	0.16
D2E-12TH	WR-9—Allied Waste	4	20.17	0
D2E-12th Total for Cat 3		**3**	**14,864.22**	**0.33**
D2E-12th Total for Cat 4		**4**	**20.17**	**0**
D2E-6TH	WR-8—Kelsey Creek Riparian	3	2,365.15	0.05
D2E-6TH	WR-10—East of 140th Ave NE	3	3,469.12	0.08
D2E-6TH	WR-11—West of 140th Ave NE	3	7,083.60	0.16
D2E-6TH	WR-9—Allied Waste	4	20.17	0
D2E-6th Total for Cat 3		**3**	**12,938.06**	**0.29**
D2E-6th Total for Cat 4		**4**	**20.17**	**0**
D3-12TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05

TABLE F2-3
Long-Term Direct Impacts on Wetlands by Project Alternative

Project Alternative	Wetland Name	Category	Area Affected (square feet)	Area Affected (acres)
D3-12TH	WR-6—BNSF Matrix	3	1,926.18	0.04
D3-12th Total			**4,286.38**	**0.09**
D3-6TH	WR-8—Kelsey Creek Riparian	3	2,360.20	0.05
D3-6th Total			**2,360.20**	**0.05**
D5-12TH	WR-8—Kelsey Creek Riparian	3	5,026.85	0.12
D5-12TH	WR-6—BNSF Matrix	3	2,117.26	0.05
D5-12TH	WR-10—East of 140th Ave NE	3	4,592.72	0.11
D5-12TH	WR-11—West of 140th Ave NE	3	7,053.12	0.16
D5-12TH	WR-9—Allied Waste	4	26.39	0
D5-12th Total for Cat 3		**3**	**18,816.34**	**0.44**
D5-12th Total for Cat 4		**4**	**26.39**	**0**
D5-6TH	WR-8—Kelsey Creek Riparian	3	5,026.85	0.12
D5-6TH	WR-10—East of 140th Ave NE	3	4,592.72	0.11
D5-6TH	WR-11—West of 140th Ave NE	3	7,053.12	0.16
D5-6TH	WR-10— East of 140th Ave NE	4	26.39	0
D5-6th Total for Cat 3		3	**16,699.08**	**0.39**
D5-6th Total for Cat 4		**4**	26.39	0
E2	WR-13—Marymoor Park Mitigation Wetland	2	3,541.29	0.08
E2 Total			**3,541.29**	**0.08**

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
B1	WR-1 WR-2 Bellevue Way North/South of Park and Ride	33,691.66	0.77
B1 Total		**33,691.66**	**0.77**
B2A	WR-1 WR-2 Bellevue Way North/South of Park and Ride	116,205.60	2.67
B2A Total		**116,205.60**	**2.67**
B2E	WR-1 WR-2 Bellevue Way North/South of Park and Ride	84,575.61	1.94

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
B2E Total		**84,575.61**	**1.94**
B3	WR-1 WR-2 Bellevue Way North/South of Park and Ride	116,451.94	2.67
B3	WR-3 Sturtevant Creek	4,933.10	0.11
B3 Total		**121,385.04**	**2.78**
B7	WR-1 WR-2 Bellevue Way North/South of Park and Ride	17,243.67	0.4
B7	WR-4 Mercer Slough I-90	5,703.18	0.13
B7	WR-3 Sturtevant Creek	3,756.90	0.09
B7	WR-5 118th Ave SE	10,559.49	0.24
B7 Total		**20,019.57**	**0.46**
D2A-12TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2A-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D2A-12TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2A-12TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D2A-12th Total		**14.970**	**0.34**
D2A-6TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2A-6TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2A-6TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D2A-6TH	WR-11 West of 140th Ave NE	3,379.02	0.08
D2A-6th Total		**12,757.64**	**0.29**
D2E-12TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2E-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D2E-12TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2E-12TH	WR-7 Kelsey Creek Ponded	557.03	0.01
D2E-12TH	WR-11 West of 140th Ave NE	2,283.80	0.05
D2E-12th Total		**13,878.85**	**0.31**
D2E-6TH	WR-10 East of 140th Ave. NE	6,313.33	0.14
D2E-6TH	WR-10 East of 140th Ave NE	2,509.75	0.06
D2E-6TH	WR-7 Kelsey Creek Ponded	557.03	0.01
D2E-6TH	WR-11 West of 140th Ave NE	2,283.80	0.05
D2E-6th Total		**11,663.91**	**0.26**
D3-12TH	WR-6 BNSF Matrix	2,214.94	0.05
D3-12TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D3-12th Total		**2,770.48**	**0.06**

TABLE F2-4
Long-Term Direct Impacts on Wetland Buffers by Project Alternative

Project Alternative	Wetland Name	Area of Buffer Affected (square feet)	Area of Buffer Affected (acres)
D3-6TH	WR-7 Kelsey Creek Ponded	555.54	0.01
D3-6th Total		**555.54**	**0.01**
D5-12TH	WR-10 East of 140th Ave. NE	7,021.97	0.16
D5-12TH	WR-11 BNSF Matrix	5,098.96	0.12
D5-12TH	WR-10 East of 140th Ave NE	6,833.79	0.16
D5-12TH	WR-8 Kelsey Creek Riparian	1,712.24	0.04
D5-12TH	WR-11 West of 140th Ave NE	2,286.16	0.05
D5-12th Total		**22,953.12**	**0.53**
D5-6TH	WR-10 East of 140th Ave. NE	7,021.97	0.16
D5-6TH	WR-10 East of 140th Ave NE	6,833.79	0.16
D5-6TH	WR-8 Kelsey Creek Riparian	1,712.24	0.04
D5-6TH	WR-11 West of 140th Ave NE	2,286.16	0.05
D5-6th Total		**17,854.16**	**0.41**
E1	WR-12 Railroad Crossing	599.79	0.01
E1 Total		**599.79**	**0.01**
E2	WR-13 Marymoor Park Mitigation Wetland	16,530.82	0.38
E2	WR-12 Bear Creek	3,286.11	0.08
E2 Total		**19816.93**	**0.46**
E4	WR-12 Bear Creek	3,286.11	0.08
E4 Total		**3,286.11**	**0.08**

Appendix G

Interstate 90 / Homer Hadley Bridge, Light Rail Transit Stray Current—Assessment of Potential Effects on Fish Memorandum

Herrera Environmental Consultants, Inc.

Memorandum

To	Marti Louther, James Irish, Sue Comis – Sound Transit
cc	Ed Wetzel - Universal Technical Resource Services, Inc
From	José Carrasquero, Eric Doyle - Herrera Environmental Consultants
Date	June 13, 2008
Subject	Interstate 90/Homer Hadley Bridge, light rail transit (LRT) stray current - Assessment of potential effects on fish

Sound Transit retained Herrera Environmental Consultants (Herrera) to conduct a preliminary investigation into the potential effects of changes in the stray electrical current field associated with the Interstate 90 Homer Hadley Bridge over Lake Washington (referred to hereafter as the I-90 bridge). Specifically, Sound Transit is proposing to build the East Link light rail transit (LRT) line on the I-90 bridge. Operation of the LRT system could discharge stray electrical current into Lake Washington. This weak direct (DC) current would leak into the environment through various conductive pathways along the bridge alignment, creating one or more small electrical current fields around the span. Possible current leakage pathways include the bridge's existing cathodic corrosion protection system, and the stray current mitigation system planned as part of LRT expansion. The intent of this assessment is to investigate if the change in stray electrical current conditions is of sufficient magnitude to pose potential adverse effects on aquatic species.

The findings of this assessment are summarized as follows:

1. The proposed LRT system will produce stray electrical current fields that are essentially negligible relative to existing conditions.

2. Expected field intensity produced by leakage from the LRT is difficult to calculate with precision, but will be very low in intensity, ranging from tenths to hundredths of a microvolt per centimeter direct current (µV/cm DC) (Wetzel 2008).

3. These values are one to two orders of magnitude below established physiological detection and behavioral response thresholds for even the most sensitive species of potential concern.

On this basis, it appears reasonable to conclude that any change in stray DC electrical current emissions resulting from LRT operation would be unlikely to result in adverse effects on fish species of potential concern in the Lake Washington system.

The assessment approach and the findings are described in the following sections.

Assessment Approach

The screening level assessment of potential stray current effects consisted of the following steps:

1. Confirm that fish species of potential concern may be present in the study area. (These include but are not limited to species listed under the Endangered Species Act [ESA]; species listed at the state level as species of concern; and game fish.)

2. Identify known biological response thresholds for these or sufficiently similar species in the available scientific literature.

3. Identify the strength, dimension, and configuration of the stray current field under existing and proposed conditions.

4. Compare the existing and proposed electrical field conditions to these known response thresholds and determine the likelihood of potential effects.

Fish Presence in the I-90 Bridge Vicinity

For the purpose of this assessment, fish species of potential concern include the following: resident and anadromous salmonids native to the Lake Washington basin (including ESA listed species); Pacific and river lamprey; longfin smelt; forage fish species; and other native and introduced game fish species. These species are referred to hereafter as Lake Washington species.

The potential presence of these species in the general vicinity was determined by consulting with two experts on Lake Washington fisheries investigations: Kurt Fresh, a research scientist with the NOAA Fisheries Northwest Fisheries Science Center; and Roger Tabor, a research scientist with the U.S. Fish and Wildlife Service. While both agreed that specific studies of fish habitat utilization in the immediate vicinity of the I-90 bridge are lacking, they confirmed that several Lake Washington species either utilize habitats in the vicinity of the bridge, or must pass under the structure when migrating between spawning and rearing habitats. As such, it is apparent that a number of Lake Washington species could occur within the area of potential effects.

Fish Response to Electrical Field Exposure: A General Review

To aid in interpreting the findings of this assessment, it is desirable to provide a general review how fish interact with and respond to electrical fields. Weak electrical fields are common in nature, and many organisms have evolved specialized means of detecting and orienting to these

fields. Organisms with this specialized capability are referred to as electroreceptive, meaning they have the ability to detect, orient to, or even produce and navigate by an electrical field. Not all fish species are electroreceptive, and for most species that are this ability is limited to short-range sensory awareness used to locate prey species or detect objects at close range. However, certain fish species, including the sharks, lampreys, and other specialized higher fish, have specialized electroreceptive organ systems that greatly increase sensitivity to weak electrical fields (Hopkins 1983, New 1999, Smith 1991, Gibbs 2004, Von Der Emde 2007, Alves-Gomes 2001).

Electroreceptivity confers a number of useful abilities. For example, electroreceptive predators like sharks and rays are able to detect the weak electrical signals produced by muscle activity in their prey (Kalmjin 1982). Some fish species, such as eels, are able to detect and orient to the weak electrical fields generated by ocean currents, using these fields as a means of navigation (McCleave and Power 1978). Certain fish species that live in highly turbid water environments where eyesight is useless have evolved the ability to produce weak electrical fields that are used like sonar systems to communicate, navigate, and detect predators and prey (Knudsen 1974). Species like lamprey have evolved specialized electroreceptive organ systems to detect prey organisms (Bodznick and Preston 1983). Because of their specialized ability to detect weak electrical fields, electroreceptive fish species are by nature more susceptible to weak electrical fields, like those produced by stray current from LRT systems. Weak fields can stimulate or confuse their sensory systems, potentially altering behavior and physiology in ways that are difficult to observe and detect.

Most of the fish species common to Lake Washington, such as the trout, salmon, perch, and bass, lack specialized electroreceptive organ systems. As such they are unable to detect very weak electrical fields and are thereby relatively insensitive to weak field exposure.

Electroreceptivity should not be confused with behavioral and physiological responses that all fish exhibit in the presence of strong electrical fields. All organisms are susceptible to the effects of electrical shocks, which essentially "short-circuit" physiological systems. Responses to strong electrical field exposure can range from attraction or avoidance, to altered feeding behavior, or even unconsciousness. A sufficiently large electrical exposure can cause seizure, injury, and even direct mortality. Responses to strong electrical field exposure can vary widely, based on the species and size of the fish exposed, site specific conditions, and the nature of the electrical field (Snyder 2003).

For example, the orientation of a fish's body relative to an electrical field is a determining factor in amount of voltage exposure a fish will receive. A fish swimming parallel to an electrical field (i.e., directly towards or away from the source) will experience a larger exposure than one swimming perpendicular to the field. This is because the longest body axis is oriented to the increasing field strength, creating the greatest electrical gradient from end to end and thereby a large voltage potential. The fish oriented perpendicular to field strength presents a minimal aspect to the field, creating much smaller electrical potential from one side of the body to the other, minimal voltage exposure, and little or no effect. Larger fish are inherently more sensitive to strong electrical fields because a bigger body has inherently greater potential voltage gradient.

Literature Review Methods

Available information on the relevant biological response thresholds of Lake Washington fish species or similar organisms was derived from available scientific literature. Literature sources were identified using the Google Scholar online search engine. The studies relied upon in this assessment express electrical field strength in units of Volts per meter (V/M), volts per centimeter (V/cm), or microvolts per centimeter (µV/cm). These metrics are commonly used to characterize the response of biological organisms to electrical field exposure.

The types of threshold responses reported in this assessment range from physiological detection of the electrical field (e.g., measured changes in cardiac response), to behavioral detection (e.g., attraction, avoidance, twitching), to marked physiological responses including paralysis and injury. When considering this information, it is important to note that electrical fields capable of causing paralysis or injury are many orders of magnitude stronger than what is expected from the I-90 stray current field. The intent of providing this information is to present a basis of comparison to the expected strength of the I-90 stray current field.

Physiological and Behavioral Response Thresholds for Electrical Field Exposure

The literature review identified several exposure response thresholds that are relevant to Lake Washington species. This information is summarized in Table 1. The range of response thresholds shown varies from the smallest observed physiological and behavioral detection limits, to electrical field strength sufficient to cause injury and incapacitation. The intent of providing this broad range of threshold values is to provide a broader context for interpreting the potential effects of the I-90 stray current field.

Stray Current Field Strength and Dimensions Under Existing and Proposed Conditions

The strength and dimensions of the stray current field under existing and proposed conditions was characterized for Sound Transit by Mr. Ed Wetzel of Universal Technical Resource Services, Inc (UTRS) (Wetzel 2008). Per request from Herrera staff, these values were provided in the same units commonly used to characterize biological effects (µV/cm). The maximum strength of the I-90 stray current field under existing and potential future conditions is shown in Table 2. These estimates represent the worst-case stray electrical current field strength and size expected to occur under each condition.

While the LRT system will produce a stray current field, the proposed system design and additional shielding mechanisms will limit the intensity of this field to very low levels. The cathodic protection system is expected to be the dominant source of electrical current emanating from the I-90 bridge. The positioning and orientation of the cathodic protection system and the intensity of the field it produces are not expected to vary measurably under proposed conditions with LRT operation.

Table 1. Electrical field strength associated with observed responses in various fish species.

Response Type	Species Type	Environment Type Where the Response was Observed	Electrical Field or Source Strength Associated with Observed Response	Source
Attraction/avoidance (attraction to the anode, avoidance or repulsion from the cathode)	Lamprey	Marine	1–10 µV/cm	Bodznick and Preston 1983
Twitch response to field exposure	Lamprey	Marine	10-60 µV/cm @ 0.05-0.5 Hz	Muraveiko 1984
Observed physiological detection limit (measurable change in heart rate or the electrical pattern of the heartbeat)	Atlantic salmon, American eel	Freshwater	7-70 µV/cm @ 60-75 Hz	McCleave et al. 1974
Theoretical limit above which chronic electrical field exposure could alter cellular biochemical systems.	n/a	General	90 µV/cm	Weaver et al. 1998
Attraction (anodic taxis)	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.13-0.19 V/cm pulsed DC @ 15 Hz 0.05-0.09 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.16-0.21 V/cm pulsed DC @ 15 Hz 0.09-0.20 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Twitch response to field exposure	Rainbow trout (31 to 48 cm fork length)	Freshwater (conductivity 103 µS/cm @ 11ºC)	0.19-0.43 V/cm pulsed DC @ 20 Hz 0.15-0.71 V/cm pulsed DC @ 30 Hz 0.11-0.97 V/cm pulsed DC @ 60 Hz	Taube 1992 (as cited in Snyder 2003)
	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.06-0.10 V/cm pulsed DC @ 15 Hz 0.03-0.05 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.08-0.13 V/cm pulsed DC @ 15 Hz 0.02-0.10 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Altered migratory behavior (changed orientation relative to electrical field)	American eel elvers (juveniles)	Marine	1 µA/cm^2 to 100 µA/cm^2	McCleave and Power 1978
Observed avoidance responses (electrofishing voltage used to direct fish out of an in-water work area)	Salmonids (adult and juvenile), other resident fish species	Freshwater (riverine ~1-6 ft. depth)	500 to 1,000 V pulsed DC @ 7.5 Hz	Johnson and Hoffman 2000
Observed avoidance responses (electrical fish barrier used to prevent access to an in-water work area)	Salmonids (adult and juvenile)	Freshwater (riverine ~1-6 ft. depth)	~0.5 to 100 V/M pulsed DC @ 2 Hz	Johnson and Hoffman 2000

Table 1 (continued). Electrical field strength associated with observed responses in various fish species.

Response Type	Species Type	Environment Type Where the Response was Observed	Electrical Field or Source Strength Associated with Observed Response	Source
Recommended voltage settings for electrofishing equipment to avoid fish injury (voltage requirements dependent on conductivity)	Salmonids (juvenile)	Freshwater	100 to 800 V pulsed DC @ ≤30Hz	WSDOT 2006
Electrofishing injury (electrofishing voltage settings associated with spinal and tissue injury)	Rainbow trout (juvenile)	Freshwater	300 V pulsed DC @ 30 Hz	McMichael et al. 1998
			1-9 V/cm within 100 cm of anode (produced by electrofishing at a setting of 350-400 V @ 60 Hz)	Dalbey et al. 1996
Stunning or unconsciousness	Rainbow trout (31 to 48 cm fork length)	Freshwater (conductivity 103 µS/cm @ 11ºC)	0.53-10.4 V/cm pulsed DC @ 20 Hz 0.92-6.5 V/cm pulsed DC @ 30 Hz 0.61-6.4 V/cm pulsed DC @ 60 Hz	Taube 1992 (as cited in Snyder 2003)
	Rainbow trout (21 to 50 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.54-0.70 V/cm pulsed DC @ 15 Hz 0.14-0.20 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
Stunning or unconsciousness (continued)	Colorado pike minnow (30 to 39 cm fork length)	Freshwater (conductivity 530 µS/cm @ 18ºC)	0.25-0.36 V/cm pulsed DC @ 15 Hz 0.18-0.27 V/cm pulsed DC @ 60 Hz	Meismer 1999 (as cited in Snyder 2003)
	Atlantic salmon (adult)	Marine	15-250 V/M @ 50 Hz AC (depending on duration of exposure)	Roth et al. 2003

µV/cm = microvolts per centimeter
V/cm = volts per centimeter
V/M = volts per meter
µS/cm = microsiemens per centimeter (measure of electrical conductivity)
DC = direct current
Hz = Hertz
V = volts
ºC = degrees Celcius
Fork length = the length of a fish from the tip of the nose to the indent, or fork, in the middle of the tail fin

Table 2. Stray electrical current field strength under the I-90 bridge, under existing and proposed conditions

Source	Parameter	Existing Conditions	Proposed LRT Conditions	Notes
Existing cathodic corrosion protection system	Electrical field intensity	Maximum: 26.2 µV/cm DC Typical: 13.1 µV/cm DC	Similar to existing conditions.	LRT operation will have little impact on the potential strength of the stray current field. Maximum rectifier output is the limit of the rectifier specifications. Most units are operating about half the rated output. Planned upgrades in rectifier and anode design will maintain current conditions, or possibly reduce field intensity.
	Maximum electrical field size around each cathode/anode	30 meters (horizontal) 21 meters (vertical)	30 meters (horizontal) 21 meters (vertical)	The electric field will be concentrated between the cathode (anchor cable) and the anode, which are spaced approximately 30 meters apart. Each anode is suspended 10 to 11 meters below the surface and is between 10 to 21 meters in length.
	Minimum horizontal distance between each field	10 meters (horizontal) Pontoons A & R; 5 meters pontoon J; 100 meters remaining pontoons.	10 meters (horizontal) Pontoons A & R; 5 meters pontoon J; 100 meters remaining pontoons.	
Stray electrical current from LRT system	Maximum electrical field intensity	n/a	Uncertain but will most likely range from 10^{-1} to 10^{-2} µV/cm DC	The proposed LRT system will produce a stray DC current field, but the design and additional shielding mechanisms will limit the intensity of this field to very low levels (essentially negligible in comparison to the existing cathodic corrosion protection system). The size and orientation of the potential stray DC current field is difficult to determine. Stray current could leak to the aquatic system through a number of pathways on the structure, including drainpipes, power lines, the cathodic protection system, and even the concrete structure itself when wet with rain. It is not practical to analyze each of these potential pathways for the purpose of this analysis. Given the limited intensity of the field however, its size and orientation would appear to be irrelevant with regards to potential effects.
	Field size and orientation	n/a	Unknown	

Source: Wetzel 2008.
AC = alternating current
DC = direct current
LRT = light rail transit

As shown in Table 2, operation of the LRT system on the I-90 bridge will not change the output of the cathodic corrosion protection system in any significant way, meaning that the existing electrical field intensity and orientation associated with this feature will remain unchanged under proposed conditions (Wetzel 2008).

The LRT system is expected to produce a stray electrical current field in and around the I-90 bridge. Because this current can discharge along any conduction pathway, the location and extent of this field is difficult to predict. However, much of the discharge is likely to occur from the stray current mitigation system. The intensity of this stray current field is expected to be on the order of 10^{-1} to 10^{-2} µV/cm DC (Wetzel 2008).

Comparison of Stray Current Field Intensity to Established Response Thresholds

Retrofitting of the I-90 bridge to support the LRT system could conceivably alter the electrical field associated with the structure through two pathways: 1) modification of the cathodic corrosion protection system; and 2) creation of a stray electrical current field leaking from the DC electrical system used to power the trains. As shown in Table 2, the size and intensity of the electrical field produced by the existing cathodic protection system is not expected to change under the proposed conditions. As there is no related change in stressor exposure for fish Lake Washington species, there is no further need to consider this particular issue.

The stray current field produced by the LRT system will result in a change in potential electrical exposure from the existing conditions. However, the range of electrical field intensity likely to occur from stray current leakage appears to be lower than levels necessary for sensory detection or physiological effects in Lake Washington species. The intensity of the stray current field will range between 10^{-1} to 10^{-2} µV/cm DC. These levels are one to three orders of magnitude lower than observed physiological response limits in Atlantic salmon and American eel (7-70 µV/cm DC) (McCleave et al. 1974). These species are representative of the likely sensitivity of the majority of Lake Washington species exposed to stray electrical current.

Lamprey are the most electroreceptive, and thereby the most potentially sensitive of the Lake Washington fish species to stray current field exposure. At least one and possibly two species of lamprey (Pacific and river lamprey) are known to occur in the Lake Washington basin (a third species, western brook lamprey, may also be present). Even in the case of lamprey however, the anticipated stray current field appears to be at least one to as much as two orders of magnitude below known physiological and behavioral response thresholds (Bodznick and Preston 1983; Muraveiko 1984).

In recent years, concerns have emerged regarding the potential health effects of long-term exposure to low intensity electro-magnetic fields. Theoretically, long-term exposure even at levels below behavioral response thresholds could lead to adverse effects that would otherwise go undetected. Considerable research effort has been devoted to this concern. For example, Weaver et al. (1998) examined the biochemical response profile of various cellular systems to electromagnetic field exposure in order to evaluate the potential for human health effects. They

developed a model to estimate the minimum threshold limits at which an electromagnetic field could potentially cause harmful changes in cellular level physiological systems. They determined that 90 µV/cm was the minimum field intensity necessary to alter physiological systems at the cellular level in species lacking specialized electroreceptive organ systems. Like the physiological and behavioral response thresholds discussed previously, the anticipated I-90 stray DC current field is well below this threshold.

Conclusions

The East Link project proposal to locate LRT on the I-90 bridge is likely to create a low intensity stray current field around the bridge structure. The size and intensity of this field cannot practically be determined with accuracy. However the best possible estimate indicates that stray current intensity will be one to three orders of magnitude below physiological or behavioral response thresholds for even the most sensitive Lake Washington fish species. Given these findings, the conclusion of this screening level assessment is that stray current from LRT operation is unlikely to lead to adverse effects on aquatic life, and there is no need to investigate the issue further.

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