September 2024

West Seattle Link Extension

Final Environmental Impact Statement

ECOSYSTEMS TECHNICAL REPORT

Appendix N.4

SOUNDTRANSIT

U.S. Department of Transportation
Federal Transit Administration

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Appendix N.4
West Seattle Link Extension
Ecosystems Technical Report

September 2024

Sound Transit

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Acronyms and Abbreviations

dBA	A-weighted decibel(s)
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
FTA	Federal Transit Administration
NEPA	National Environmental Policy Act
NOAA Fisheries	National Oceanic and Atmospheric Administration National Marine Fisheries Service
SEPA	State Environmental Policy Act
Sound Transit	Central Puget Sound Regional Transit Authority
Suquamish Tribe	Suquamish Indian Tribe of the Port Madison Reservation
U.S.	United States
WSBLE	West Seattle and Ballard Link Extensions
WSDOT	Washington State Department of Transportation

1 INTRODUCTION

1.1 Overview

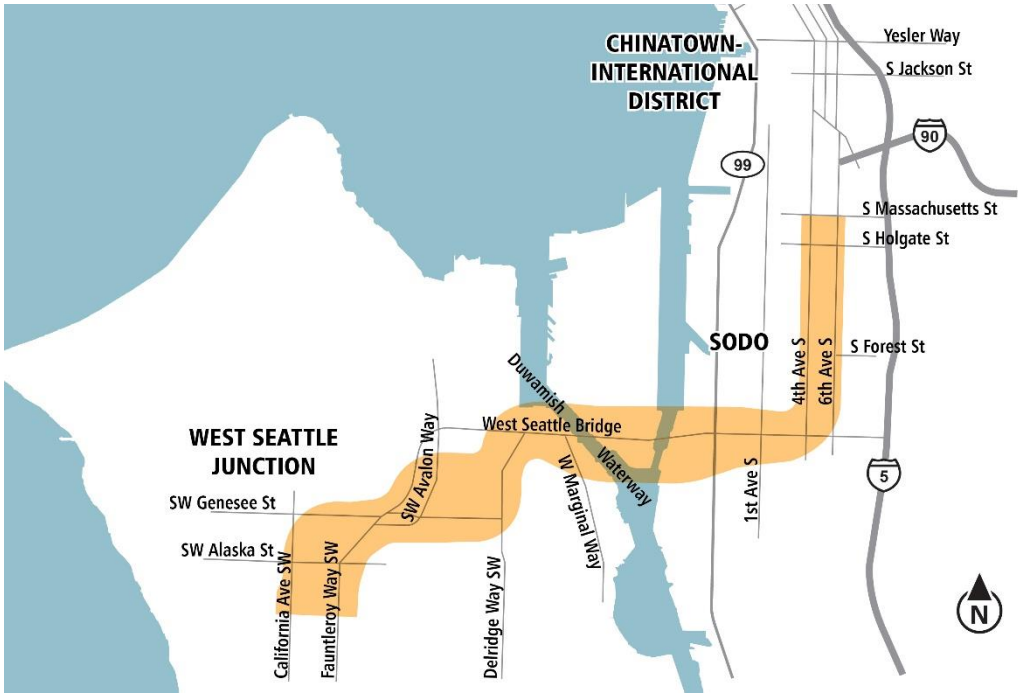
Central Puget Sound Regional Transit Authority (Sound Transit) is proposing to expand Link light rail transit service from SODO to West Seattle. The West Seattle Link Extension Project (the project) is a 4.1-mile corridor in the city of Seattle in King County, Washington, the most densely populated county of the Puget Sound region (Figure 1-1). The project would include stations at SODO, Delridge, Avalon, and Alaska Junction. The project is part of the Sound Transit 3 Plan of regional transit system investments, funding for which was approved by voters in the region in 2016.

The Draft Environmental Impact Statement (EIS) published in January 2022 evaluated both the West Seattle Link Extension and the Ballard Link Extension together as one West Seattle and Ballard Link Extensions (WSBLE) Project. The extensions were evaluated together in the WSBLE Draft EIS because of their location, schedule, and review efficiencies for partner agencies.

In July 2022, the Sound Transit Board directed that further studies be prepared for the Ballard Link Extension, to evaluate additional station options and other refinements (Motion M2022-57). Some of these project options and refinements require additional conceptual engineering and environmental review. Rather than delay completion of the environmental review process for the West Seattle Link Extension while additional review is conducted for the Ballard Link Extension, Sound Transit and Federal Transit Administration (FTA) have decided to move forward under separate environmental reviews for each extension.

As described in the WSBLE Draft EIS, the two extensions will operate as separate lines, and the extensions are standalone projects with independent utility. Proceeding with separate environmental review processes for each extension enables Sound Transit and FTA to minimize delay in delivering the West Seattle Link Extension while further analysis is undertaken on the Ballard Link Extension. Accordingly, this Final EIS is for the West Seattle Link Extension only. The Ballard Link Extension will undergo separate environmental review, building on the analysis that has already been completed.

Figure 1-1. West Seattle Link Extension Project Corridor



The West Seattle Link Extension would provide fast, frequent, and reliable light rail in Seattle and connect dense residential and job centers throughout the Puget Sound region. The Puget Sound Regional Council (the regional metropolitan planning organization) and the City of Seattle have designated the following Manufacturing/Industrial Center and urban village in the project corridor:

- **Manufacturing/Industrial Center.** The project corridor includes the Duwamish Manufacturing/ Industrial Center. SODO Station is in the Duwamish Manufacturing/Industrial Center.
- **Urban Village.** West Seattle Junction is a neighborhood in the project corridor designated by the City of Seattle as an urban village. The Alaska Junction and Avalon stations are in the West Seattle Junction Urban Village.

Puget Sound Regional Council

Puget Sound Regional Council, the regional metropolitan planning organization, develops policies and coordinates decisions about regional growth, transportation, and economic development planning within King, Kitsap, Pierce, and Snohomish counties. Puget Sound Regional Council is composed of over 80 jurisdictions, including all four counties; cities and towns; ports; state and local transportation agencies; and tribal governments within the region.

These designations indicate that these areas will continue to increase in residential and/or employment density over the next 30 years.

Existing local transit connections in the project corridor include bus and light rail. The King County Metro Transit (Metro) RapidRide C bus line currently provides service between West Seattle, Downtown Seattle, and South Lake Union. The RapidRide H bus line provides service between Burien and Downtown Seattle via Delridge. Other local bus service also operates in the project corridor.

Regional transit service in the project corridor includes regional bus service, ferry service, light rail, Sounder commuter rail, and Amtrak passenger rail service. Light rail currently operates between the Angle Lake Station in the city of SeaTac and Northgate Station in Seattle, traveling through the Downtown Seattle Transit Tunnel. There is an existing light rail station in SODO in the West Seattle Link Extension Corridor.

Extensions of light rail are under construction north to Lynnwood, east to Bellevue and Redmond, and south to Federal Way, all of which are anticipated to be operational by 2026. Additional planned light rail extensions would continue south to the Tacoma Dome, expected to begin service in 2035, and north to Everett, planned to begin service between 2037 and 2041. The Ballard Link Extension is scheduled to begin service between SODO and Ballard in 2039. The West Seattle Link Extension is scheduled to open in 2032 and would include a new SODO station where riders to and from West Seattle could transfer to the existing SODO station and light rail system until the Ballard Link Extension begins operation. The Ballard Link Extension would permanently connect the West Seattle Link Extension to the existing 1 Line, allowing riders to continue north to Everett. Figure 1-2 shows the full system planned for operation in 2042 under the target schedule. Table 1-1 lists the project Build Alternatives.

Figure 1-2. Link Light Rail System Expansion

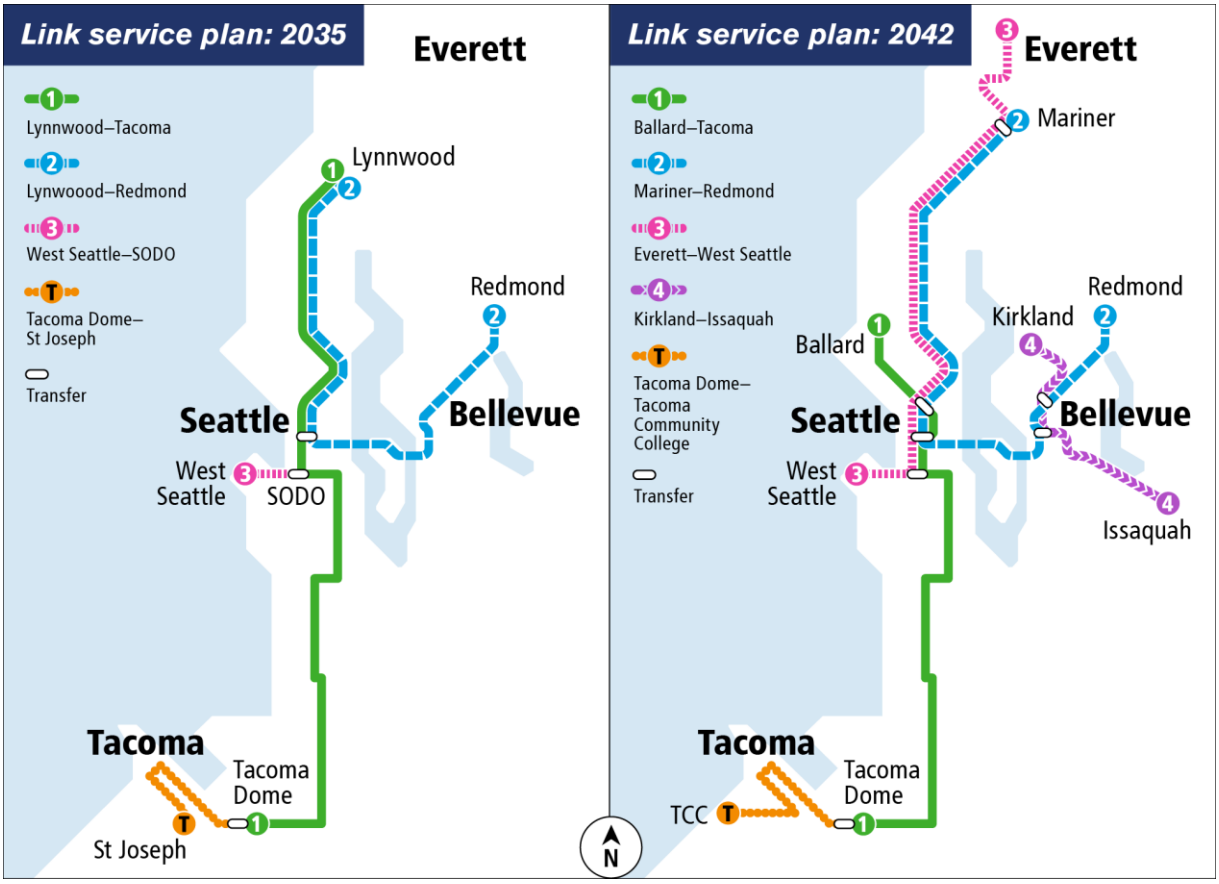


Table 1-1. Summary of West Seattle Link Extension Build Alternatives

Segment	Alternative or Design Option	Abbreviation	Stations (and Station Profile)	Connections
SODO	**Preferred At-Grade Lander Access Station Option**	**SODO-1c**	**SODO (At-Grade)**	**All Duwamish Segment alternatives.**
SODO	At-Grade Alternative	SODO-1a	SODO(At-Grade)	All Duwamish Segment alternatives.
SODO	At-Grade South Station Option	SODO-1b	SODO (At-Grade)	All Duwamish Segment alternatives.
SODO	Mixed Profile Alternative	SODO-2	SODO (Elevated)	All Duwamish Segment alternatives.
Duwamish (DUW)	**Preferred South Crossing Alternative**	**DUW-1a**	**None**	**All SODO Segment alternatives. All Delridge Segment alternatives.**
Duwamish (DUW)	South Crossing South Edge Crossing Alignment Option	DUW-1b	None	All SODO Segment alternatives. All Delridge Segment alternatives.
Duwamish (DUW)	North Crossing Alternative	DUW-2	None	All SODO Segment alternatives. All Delridge Segment alternatives.
Delridge (DEL)	**Preferred Andover Street Station Lower Height South Alignment Option**	**DEL-6b**	**Delridge (Elevated)**	**All Duwamish Segment alternatives. Connects to WSJ-5a and WSJ-5b.**
Delridge (DEL)	Dakota Street Station Alternative	DEL-1a	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-1, WSJ-2, and WSJ-4.
Delridge (DEL)	Dakota Street Station North Alignment Option	DEL-1b	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-1, WSJ-2, and WSJ-4.
Delridge (DEL)	Dakota Street Station Lower Height Alternative	DEL-2a	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-3a and WSJ-3b.
Delridge (DEL)	Dakota Street Station Lower Height North Alignment Option	DEL-2b	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-3a and WSJ-3b.
Delridge (DEL)	Delridge Way Station Alternative	DEL-3	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-1, WSJ-2, and WSJ-4.
Delridge (DEL)	Delridge Way Station Lower Height Alternative	DEL-4	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-3a and WSJ-3b.
Delridge (DEL)	Andover Street Station Alternative	DEL-5	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-1, WSJ-2, and WSJ-4.

Segment	Alternative or Design Option	Abbreviation	Stations (and Station Profile)	Connections
Delridge (DEL)	Andover Street Station Lower Height Alternative	DEL-6a	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-5a and WSJ-5b.
Delridge (DEL)	Andover Street Station Lower Height No Avalon Station Tunnel Connection Alternative	DEL-7	Delridge (Elevated)	All Duwamish Segment alternatives. Connects to WSJ-6.
West Seattle Junction (WSJ)	**Preferred Medium Tunnel 41st Avenue Station West Entrance Station Option**	**WSJ-5b**	**Avalon (Retained Cut), Alaska Junction (Tunnel)**	**Connects to DEL-6a and DEL-6b.**
West Seattle Junction (WSJ)	Elevated 41st/42nd Avenue Station Alternative	WSJ-1	Avalon (Elevated), Alaska Junction (Elevated)	Connects to DEL-1a, DEL-1b, DEL-3, and DEL-5.
West Seattle Junction (WSJ)	Elevated Fauntleroy Way Station Alternative	WSJ-2	Avalon (Elevated), Alaska Junction (Elevated)	Connects to DEL-1a, DEL-1b, DEL-3, and DEL-5.
West Seattle Junction (WSJ)	Tunnel 41st Avenue Station Alternative	WSJ-3a	Avalon (Tunnel), Alaska Junction (Tunnel)	Connects to DEL-2a, DEL-2b, and DEL-4.
West Seattle Junction (WSJ)	Tunnel 42nd Avenue Station Option	WSJ-3b	Avalon (Tunnel), Alaska Junction (Tunnel)	Connects to DEL-2a, DEL-2b, and DEL-4.
West Seattle Junction (WSJ)	Short Tunnel 41st Avenue Station Alternative	WSJ-4	Avalon (Elevated), Alaska Junction (Tunnel)	Connects to DEL-1a, DEL-1b, DEL-3, and DEL-5.
West Seattle Junction (WSJ)	Medium Tunnel 41st Avenue Station Alternative	WSJ-5a	Avalon (Retained Cut), Alaska Junction (Tunnel)	Connects to DEL-6a and DEL-6b.
West Seattle Junction (WSJ)	No Avalon Station Tunnel Alternative	WSJ-6	Alaska Junction (Tunnel)	Connects to DEL-7.

1.2 Purpose of Report

The purpose of this report is to document ecosystems and their associated species in the vicinity of the West Seattle Link Extension (the project), and to evaluate potential impacts associated with the alternatives. This report covers both aquatic and upland ecosystems and the species they support, as well as wetland resources in the study area. This report describes the affected environment as well as the expected long-term impacts (during transit operations) and short-term impacts (during project construction) on these ecosystem resources for each of the project alternatives. This report also discusses measures intended to avoid and minimize impacts, including compensatory mitigation for unavoidable impacts.

The project would pass through primarily urban and industrial areas, as well as dense residential areas that are highly modified from pre-development conditions. However, the routes would also cross or run adjacent to greenbelts, parks, waterbodies, and several small wetlands where vegetation, wildlife, and water quality could be affected by the project. This report focuses on those potential effects.

1.3 Data Gathered

Sound Transit performed a literature and data review to identify and characterize potentially affected resources in and near the project. Before the field reconnaissance, existing documentation and information were compiled and reviewed so that the reconnaissance effort could focus on verifying data and filling information gaps. Field delineations were also performed at wetlands and streams.

Existing ecosystem resource information was gathered from many local, state, and federal agencies. These information sources included published and unpublished reports, maps, websites, aerial photographs, and communication with agency staff familiar with resources within the study area.

1.3.1 Agency and Public Contacts

The ecosystems project team contacted the following agencies to obtain natural resources information specific to the project:

- **City of Seattle.** Maggie Glowacki, Seattle Department of Construction and Inspections Planner, was contacted to find out whether the City of Seattle had a database or map of wetland mitigation sites in the WSBLE vicinity. Ms. Glowacki indicated that she did not have any information other than the data on the City of Seattle interactive mapping website (City of Seattle 2018a).
- **Washington Department of Fish and Wildlife**. Sound Transit obtained priority habitat and species data, including sensitive data, to determine whether sensitive species and habitats may be affected by the project.
- **Washington Department of Fish and Wildlife**. Sound Transit consulted with the Washington Department of Fish and Wildlife about additional sensitive species and habitats that may be affected by the project, and management options for sensitive bird species along the Duwamish Segment (Sound Transit 2020).
- **United States (U.S.) Fish and Wildlife Service and National Oceanic and Atmospheric Administration (NOAA) Fisheries**. Sound Transit consulted with these agencies for their input on potential Endangered Species Act challenges in the alternatives being studied during the Alternatives Development Phase (Sound Transit 2018).

1.3.2 Maps and Existing Documentation

Maps and existing documents reviewed while preparing this report are listed below:

- Aerial photography of the project corridor (including the King County aerial photography database or Google Earth database)
- City of Seattle critical area maps, including City of Seattle Department of Construction and Inspections environmentally critical areas geographic information system data (City of Seattle 2023a)
- City of Seattle State of the Waters 2007 Report: Volume 1, Seattle Watercourses
- City of Seattle street tree inventory geographic information system data
- National Oceanic and Atmospheric Administration National Marine Fisheries Service (NOAA Fisheries) Critical Habitat Designation Maps
- NOAA Fisheries Endangered Species Act Status of West Coast Salmon and Steelhead
- NOAA Fisheries 2007 Puget Sound [Chinook] Salmon Recovery Plan
- NOAA Fisheries 2008 Recovery Plan for Southern Resident Killer Whales
- NOAA Fisheries 2019 Endangered Species Act Recovery Plan for the Puget Sound Steelhead Distinct Population Segment
- National Wetlands Inventory data
- Natural Resources Conservation Service Soil Survey maps for King County (Natural Resources Conservation Service 1952)
- U.S. Fish and Wildlife Service and Washington Department of Fish and Wildlife lists of listed and proposed endangered and threatened species and critical habitat, candidate species, and species of concern in King County
- U.S. Fish and Wildlife Service 2015 Recovery Plan for the Coterminous United States Population of Bull Trout
- U.S. Fish and Wildlife Service Critical Habitat Maps for threatened and endangered species
- Washington Department of Fish and Wildlife Priority Habitats and Species data
- Washington Department of Fish and Wildlife SalmonScape fish data and maps
- Washington Department of Fisheries catalog of Washington streams and salmon utilization
- Washington State Department of Ecology (Ecology) 303(d) listed waters information
- Washington Department of Natural Resources Natural Heritage Program database

1.4 Related Laws, Regulations, and Guidelines

Federal, state and local regulations guide the management of aquatic ecosystems, upland ecosystems, plant species, and wildlife species in the Seattle area. Specific regulations that would apply to the West Seattle Link Extension are noted in the following sections.

1.4.1 Federal

The following federal regulations would apply to the project:

- National Environmental Policy Act (NEPA)
- Sections 401, 402, and 404 of the Clean Water Act
- Section 7 of the Endangered Species Act
- Magnuson-Stevens Fishery Conservation and Management Act
- Marine Mammal Protection Act
- Bald and Golden Eagle Protection Act
- Migratory Bird Treaty Act
- Protection of Wetlands, Presidential Executive Order 11990
- Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (2008 or as revised)
- Coastal Zone Management Act

1.4.2 State

The following Washington state regulations would apply to the project:

- Washington State Environmental Policy Act (SEPA)
- Washington Coastal Zone Management program
- Hydraulic code (Washington Administrative Code Chapter 220-660)
- Shoreline Management Act
- Washington State Growth Management Act
- Protection of Wetlands, Governor's Executive Order 89-10
- Protection of Wetlands, Governor's Executive Order 90-04
- Water Pollution Control Act (Revised Code of Washington 90.48)
- *Wetland Mitigation in Washington State* (Ecology et al. 2006)

1.4.3 Local

The following City of Seattle regulations would apply to the project:

- Critical Area Ordinances, Seattle Municipal Code Chapter 25.09, Regulations for Environmentally Critical Areas
- Seattle Municipal Code Chapter 23.60A, Seattle Shoreline Master Program Regulations
- Seattle Municipal Code Chapter 25.11, Tree Protection
- City of Seattle, Department of Construction and Inspections, Director's Rule 16-2008, Designation of Exceptional Trees
- City of Seattle Executive Orders 03-05, Tree Replacement and 2023-03, One Seattle Tree Plan
- City of Seattle, Department of Construction and Inspections, Director's Rule 13-2018, Great Blue Heron

1.5 Study Areas

The study area for ecosystem resources varies according to the type of resource. Each area was measured from the edge of the project footprint and area used for construction (the project limits). The project limits encompass all alternatives currently under consideration and include areas that would be temporarily disturbed during construction.

1.5.1 Wetlands

The study area for wetlands covers all lands within the project limits as well as those lands extending 300 feet beyond the edge of the project limits. In addition, the City of Seattle requested that Sound Transit assess Longfellow Creek farther upstream beyond the area of potential construction activities. Therefore, wetlands along Longfellow Creek were assessed as far south as Southwest Dakota Street, which is an additional 400 feet beyond the project limits.

1.5.2 Aquatic Species and Habitat

The study area for aquatic resources covers shorelines and waters 300 feet downstream and 100 feet upstream at each waterbody crossing (or up to 300 feet upstream if channel configuration could result in stream buffers overlapping the project limits) or to the extent that sound could travel underwater (for example, to the first bend in a waterway). The additional area of waters downstream on directional waterways was studied to capture the distance to which turbidity or other water quality concerns could affect downstream areas and the species residing there. The study area also includes the entire stretch of any waterbody paralleling the project within 200 feet from the edge of the project limits, and the stretch of Longfellow Creek between Southwest Andover Street and Southwest Genesee Street. Documented observations of sensitive federal or state-listed species within 0.25 mile and in Elliott Bay are also included.

For streams or waterbodies with Endangered Species Act-listed species, the study area includes at least the segment of stream or waterbody through which sound could travel in water (that is, to the first bend in the channel or where noise would dissipate to background levels).[1]

1.5.3 Vegetation and Wildlife Resources

The study area for vegetation (including regulated trees) and wildlife reaches 200 feet from the edge of the project limits. The study area also includes documented occurrences of sensitive wildlife species within 0.25 mile of the project limits (or up to 0.5 mile if higher noise sources such as blasting or pile-driving are needed).

[1] For this technical report, the study area for Endangered Species Act-listed species includes Elliott Bay outside the East Duwamish Waterway's outlet. When the project Biological Assessment is complete, and underwater noise calculations are made, Elliott Bay may be eliminated from the study area if it is determined that harmful in-water construction noise would not extend outside the waterway.

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2 STUDY OBJECTIVES AND METHODS

This section outlines the study objectives used to guide the ecosystems analysis effort, and the methods used to gather data. Detailed methods are provided in the *Ecosystems Technical Analysis Methodology* report (see Attachment N.4A). The FTA invited cooperating and participating agencies to review and comment on the draft report. The following discussion summarizes the approach defined in the finalized methodology report.

2.1 Wetlands

2.1.1 Study Objectives

The wetland study was conducted to locate all wetlands in the study area and determine their ratings, buffers, and the functions and values they provide to wildlife, local hydrology, and water quality. The intent was to provide a conservative estimate of the potential impacts to wetlands from each alternative.

2.1.2 Methods

Field surveys were conducted to identify, map, and describe wetlands within the study area. Field surveys occurred on publicly owned property and rights-of-way, and private properties where accessible. Vegetation and potential wetlands for areas where rights of entry were not obtained were reviewed based on field reconnaissance from public areas; current City of Seattle, state, and federal habitat maps and reports including the National Wetland Inventory database (U.S. Fish and Wildlife Service 2018); and the examination of aerial photographs. The field surveys determined the presence or absence of wetlands, and the wetlands were mapped based on soil test pits, vegetation, and aerial photos. Due to this, mapping may differ from other public wetland mapping sources.

At wetlands where field surveys were conducted, vegetation, soil, and hydrology conditions were documented at sample points using methods outlined in the U.S. Army Corps of Engineers Wetland Delineation Manual (U.S. Army Corps of Engineers 1987) and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region Version 2.0 (U.S. Army Corps of Engineers 2010). Wetlands were classified according to the U.S. Fish and Wildlife Service (Cowardin et al. 1979) and hydrogeomorphic (Brinson 1993) classification systems and rated according to the City of Seattle critical area ordinance and the Washington State Wetland Rating System for Western Washington, 2014 Update (Hruby 2014). Wetland functions were evaluated using the Washington State Department of Transportation (WSDOT) Wetland Functions Characterization Tool for Linear Projects (Null et al. 2000). Regulatory buffers were determined based on Seattle Municipal Code Chapter 25.09.

Completed survey forms and wetland rating forms are included in Attachments N.4B, Wetland Determination Data Forms, and N.4C, Ecology Wetland Rating Forms. Photographs of these wetlands are provided in Attachment N.4D, Ecosystem Photographs. Additional descriptions of the wetlands are provided in Attachment N4E, Wetland and Stream Impacts within the Study Area.

Those areas that were observed to possess all three wetland indicators are included in this technical report to provide a conservative estimate of potential impacts from each alternative. Note that wetland buffer analyses included paved areas within the buffer to address City of Seattle requirements because the City of Seattle sometimes requires mitigation for changes to such paved areas within a designated buffer. The mitigation required for affected paved areas will be determined during final permitting on a case-by-case basis.

2.2 Aquatic Habitat and Species

2.2.1 Study Objectives

The aquatic assessment was performed to determine which key aquatic features (streams, lakes, and bays) were present in the study area, and what species they could support.

2.2.2 Methods

A field reconnaissance survey was conducted to identify, map, and describe aquatic species and habitat within public rights-of-way within the study area (such as Longfellow Creek riparian corridor). Project team biologists used methods outlined in Sound Transit's stream habitat assessment guidelines (see Attachment N.4A, Ecosystems Technical Analysis Methodology), which uses a Phase 1 Project approach (planning level study) to provide analysis for SEPA/NEPA and Endangered Species Act compliance. Within the Phase 1 approach, Track A methods were used for assessing riparian vegetation effects where property access was not granted, and Track B methods were used on Sound Transit, WSDOT, or City of Seattle right-of-way and easement areas.

Biologists collected information about the condition of in-stream and riparian habitats and identified the ordinary high water mark of streams. Field assessment was limited to areas accessible from public rights-of-way, lands open to the public, or where private property owners allowed access. Aquatic habitats outside of public rights-of-way were identified based on field reconnaissance from public areas; current local, state, and federal habitat maps and reports; and aerial photographs.

Background information about riparian vegetation, physical in-stream habitat, biological connectivity, water quality and quantity, stream typing, fish presence, known fish barriers, and habitat use were collected during the pre-field review phase. Field observations were limited to the study area; however, available information (such as the Washington Department of Fish and Wildlife Fish Passage database) was used to evaluate downstream fish passage (Washington Department of Fish and Wildlife 2023a).

2.3 Upland Habitat and Species

2.3.1 Study Objectives

The upland assessment was performed to determine what natural or semi-natural habitats were found within the study area, what wildlife species these habitats could support.

2.3.2 Methods

Project team biologists delineated and classified land cover on aerial photographs and visited a sample of these areas within the study area during a field reconnaissance survey. Major plant communities/habitat types were identified and classified based on the structural categories defined in *Wildlife-habitat Relationships in Oregon and Washington* (Johnson and O'Neil 2001). As the Johnson and O'Neill cover categories were not available as geographic information system layers, maps were created using data from the National Land Cover Database (National Land Cover Database 2016), and Green Seattle Partnership data on forested areas in the city.

Heritage and exceptional trees, as defined by the City of Seattle, were identified using a geographic information system layer of trees available from the City of Seattle (City of Seattle 2023c). Invasive species populations were identified during field reconnaissance surveys and through maps available from King County (King County 2023a,b). Washington Department of Natural Resources Natural Heritage Program data were also be used to identify rare plant occurrences in the study area (Washington Department of Natural Resources 2021).

Biologists identified vegetation types and wildlife species associated with the cover types and habitat elements in the study area through literature review and field visits. Data and geographic information system map review included Audubon Society bird surveys (2018); Washington Department of Natural Resources Natural Heritage Program data (2021), U.S. Fish and Wildlife Service and NOAA Fisheries critical habitat and essential fish habitat databases (U.S. Fish and Wildlife Service 2023; NOAA Fisheries 2019b, 2023), and the Washington Department of Fish and Wildlife Priority Habitats and Species database (Washington Department of Fish and Wildlife 2019a).

The City of Seattle has mapped management areas for great blue heron (*Ardea herodias*) and bald eagle (*Haliaeetus leucocephalus*) in the study area, in the West Duwamish Greenbelt. Because mapping for these nests was outdated, biologists conducted nest presence surveys of the north portion of the greenbelt in July 2018, May 2019, and January 2020. Biologists visited known nesting sites and scanned for new great blue heron nest trees or any eagle nests. The survey was conducted by walking transects in the greenbelt and by observing the greenbelt from nearby public locations (tuʔəlaltxʷ Village Park and Shoreline Habitat, Diagonal Avenue South public shoreline, and Harbor Island Marina). In addition, biologists performed nest monitoring at the known blue heron colony in the greenbelt in the nesting seasons of 2020 through 2023.

Monitoring the West Duwamish Greenbelt would be conducted annually throughout the EIS phase of the project to determine heron and eagle nesting activity.

2.4 Impact Assessment Methods and Assumptions

2.4.1 Impact Assessment Methods

This ecosystems impact assessment describes the extent, magnitude, duration, and character of impacts on ecosystems resources for each alternative and option. Impacts were quantified where quantitative data were available, such as the area of wetland and wetland buffer impacts, and acreage of land cover types.

2.4.1.1 Direct Impacts

The impacts analyzed in this report include direct impacts that occur at the same time and place as the project. These include both temporary impacts resulting from construction, and long-term impacts resulting from the operation of the project.

Long-term Impacts during Operation

Long-term impacts refer to impacts that would occur during the operation of the project and include impacts where the operations footprint would result in permanent changes to the land cover type. Project team biologists assessed long-term impacts by overlaying the conceptual designs for the Build Alternatives onto ecosystem resource base maps (see Attachment N.4F, Best Management Practices for Ecosystems Resources). The operational project footprint includes the guideway, station footprints (including parking), roadway improvements, storm drainage ponds and stormwater vaults, ground improvement areas, and ancillary features.

Not all areas within the operational project footprint would be subject to long-term impacts—especially where tunnels would be excavated using mined excavation. Conversely, some impacts could take place outside of the footprint. For example, some hazard trees adjacent to the footprint may need to be removed to protect light rail safety and reliability.

Long-term impacts would include shading vegetation from the elevated guideway, and possible reduced light and rainfall reaching the vegetation. This analysis conservatively assumes that the area under the elevated guideway would be a long-term impact on upland vegetation because guideway column placement is unknown and depending on the height and orientation of the guideway, light and precipitation could be blocked by the structure. However, shrubs and herbaceous plants may be able to grow where the guideway is high enough above the ground. Sound Transit will re-evaluate this assumption during the permitting phase.

The wetland impact analysis also conservatively assumes a complete loss of any wetland or buffer that is under the guideway, regardless of the guideway's profile at that location. Although elevated guideways would not permanently fill the wetlands within the permanent footprint, some wetland areas below it would likely experience long-term effects from shading. During the project permitting phase, Sound Transit would prepare a more detailed assessment of long-term impacts and identify detailed temporary construction limits to distinguish which resources might be temporarily affected and could be restored following construction.

Short-term Impacts during Construction

Short-term impacts refer to impacts that would occur during construction of the project. This ecosystems analysis covers estimations of short-term impacts that would occur within the construction footprint. For this analysis, Sound Transit assumes that areas supporting native upland or wetland vegetation outside of the operational footprint would be restored to vegetation compatible with light rail operations after construction is completed. Site restoration features would be installed immediately following construction in each project segment.

2.4.1.2 Indirect Impacts

Indirect impacts can be positive or negative. They may be caused by the project, but occur later in time or at a distance, but are reasonably foreseeable. These may include station area development impacts by others, which could change the pattern of land use, population density, or water quality. If a project leads to changes in the distribution of plants or wildlife outside of the study area, this would also be an indirect impact. Indirect impacts may also occur through the implementation of mitigation measures for other environmental impacts, or through supporting projects that are not yet defined or part of the project alternatives.

2.4.1.3 Cumulative Impacts

Cumulative impacts cover the potential long-term incremental effects of the project in conjunction with past, present, and reasonably foreseeable future actions. These impacts were considered in accordance with cumulative impact analysis regulatory guidance.

Development actions were placed into three categories:

- Past actions include non-native settlements dating back to the 1800s, and continuing trends in development patterns up to the present.
- Present actions are those projects by private developers or local, state, or federal agencies just completed or under construction.

- Reasonably foreseeable future actions are those that are reasonably likely to occur by virtue of being funded, approved, or under consideration for regulatory permitting; undergoing environmental review under NEPA or SEPA; or part of an officially adopted planning document or publicly available development and thus could be under construction at any time from the present through 2042 (the project's design year).

Ecosystems impacts are studied at a broad level to capture how reasonably foreseeable future actions would affect the function of ecosystems at a system-wide level. The study area for examining these impacts differed by resource, as follows:

- Habitats, migratory animals, animals with large foraging areas, and avian species are analyzed at the wildlife corridor level.
- Fish species are analyzed at the watershed level to capture impacts on stream quality.

2.4.2 Impact Assessment Assumptions

Sound Transit would implement best management practices where necessary to avoid or minimize impacts. Also, where possible, Sound Transit will design and locate project features to avoid or minimize impacts on sensitive resources. For example, guideway columns and fill slopes would be situated outside of sensitive areas to the maximum extent practicable. Attachment N.4F provides a compilation of best management practices that could be used to avoid or minimize project construction and operational impacts on sensitive ecosystem resources, including state and federal protected species and their habitats, wetlands, and aquatic resources. These best management practices 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.

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3 AFFECTED ENVIRONMENT

This section describes the affected environment of the West Seattle Link Extension.

The project would start in the SODO area, cross over the Duwamish Waterway (also known as the Duwamish River) on a bridge paralleling the West Seattle Bridge, pass along the north end of the West Duwamish Greenbelt at Pigeon Point, cross through the Delridge area, and end in the West Seattle Junction area. An overview of the wetlands, aquatic habitat, and terrestrial habitat along the alignments is shown on Figure 3-1. Figures 3-2 through 3-5 show individual segments.

3.1 Wetlands

Ten wetlands were identified in the study area: one wetland in the Duwamish Segment, and nine wetlands in the Delridge Segment. No wetlands were identified in the West Seattle Junction Segment. These wetlands are classified as follows:

- **Slope Wetlands:** Two wetlands (wetlands WSE1 and WSE4) are slope wetlands associated with the West Seattle Golf Course and the north end of the West Duwamish Greenbelt. (Wetland WSE-1's buffer overlaps the edge of the West Seattle Junction Segment.)
- **Riverine Wetlands:** Two wetlands (wetlands WSE2 and WSE3) are riverine wetlands associated with Longfellow Creek where the creek runs between Southwest Nevada Street, Southwest Genesee Street, and the West Seattle Golf Course. Three additional riverine wetlands (WSE12, WSE15, and WSE16) have been identified along the Longfellow Creek greenbelt between Southwest Andover Street and Southwest Dakota Street.
- **Depressional Wetlands:** Three small depressional wetlands (WSE11, WSE13, and WSE14) are in the Longfellow Creek greenbelt close to the creek between Southwest Andover Street and Southwest Dakota Street.

Table 3-1 summarizes classification and rating information for the field-identified wetlands in the study area.

All of the wetlands are in areas altered by human development. They are rated as follows:

- **Category IV:** Three wetlands (WSE1, WSE4, and WSE14, each less than 0.1 acre in size) are rated as Category IV (the lowest quality), and they have low habitat scores based on limited habitat complexity, limited contributions to water quality, and a location adjacent to paved roads and other human disturbance; they are not contiguous with other wetland or forested habitat. These wetlands receive water from groundwater and precipitation, as well as from stormwater runoff.
- **Category III:** Five wetlands near Southwest Andover Street (WSE11, WSE12, WSE13, WSE15, and WSE16, each less than 0.1 acre in size) are rated as Category III. These wetlands provide moderate habitat and water quality functions within the Longfellow Creek greenbelt and two of them provide flood control functions when the creek water levels are high.
- **Category II:** Two wetlands (WSE2 and WSE3, between 0.4 and 0.5 acre in size) are higher-quality (Category II) as they flank the fish-bearing Longfellow Creek, to the north and south of Southwest Genesee Street, and provide multiple water quality, flood control, and habitat functions. Beaver activity is evident, shrub and tree layers provide shelter for wetland-associated mammals and birds, and areas with seasonal inundation could provide amphibian habitat.

Physical and biological restoration efforts have occurred in the creek, starting in the 1990s, and included native tree and shrub plantings around wetland WSE3 and along the forested portions of the creek.

Table 3-1. Wetlands in the Study Area

Wetland Identification [a]	Estimated Size (acres)	Cowardin Class	Hydrogeomorphic Class	Rating [b]	Function Score [b, c]	Buffer Width [c, d]	Location
WSE1	0.05 [e]	palustrine, emergent	Slope	IV	3 (low)	50 feet	West Seattle Golf Course
WSE2	0.45 [e]	palustrine, emergent, palustrine scrub-shrub	Riverine	II	6 (moderate)	110 feet	West Seattle Golf Course along Longfellow Creek
WSE3	0.35 [e]	palustrine forested	Depressional	II	6 (moderate)	110 feet	Along Longfellow Creek between Southwest Genesee and Southwest Nevada streets
WSE4	0.05	palustrine, emergent, palustrine scrub-shrub	Slope	IV	4 (low)	50 feet	Pigeon Point under West Seattle Bridge
WSE11	<0.01	palustrine scrub-shrub	Depressional	III	5 (moderate)	110 feet	Along Longfellow Creek between Southwest Andover and Southwest Yancy streets
WSE12	0.01	palustrine, emergent,	Riverine	III	5 (moderate)	110 feet	Along Longfellow Creek between Southwest Andover and Southwest Yancy streets
WSE13	0.01	palustrine scrub-shrub	Depressional	III	5 (moderate)	110 feet	Along Longfellow Creek between Southwest Andover and Southwest Yancy streets
WSE14	<0.01	palustrine forested	Depressional	IV	5 (moderate)	50 feet	Along Longfellow Creek between Southwest Yancy and Southwest Dakota streets
WSE15	<0.01	palustrine, emergent,	Riverine	III	5 (moderate)	110 feet	Along Longfellow Creek about 100 feet south of Southwest Yancy Street
WSE16	0.02	palustrine, emergent,	Riverine	III	5 (moderate)	110 feet	Along Longfellow Creek about 150 feet south of Southwest Yancy Street

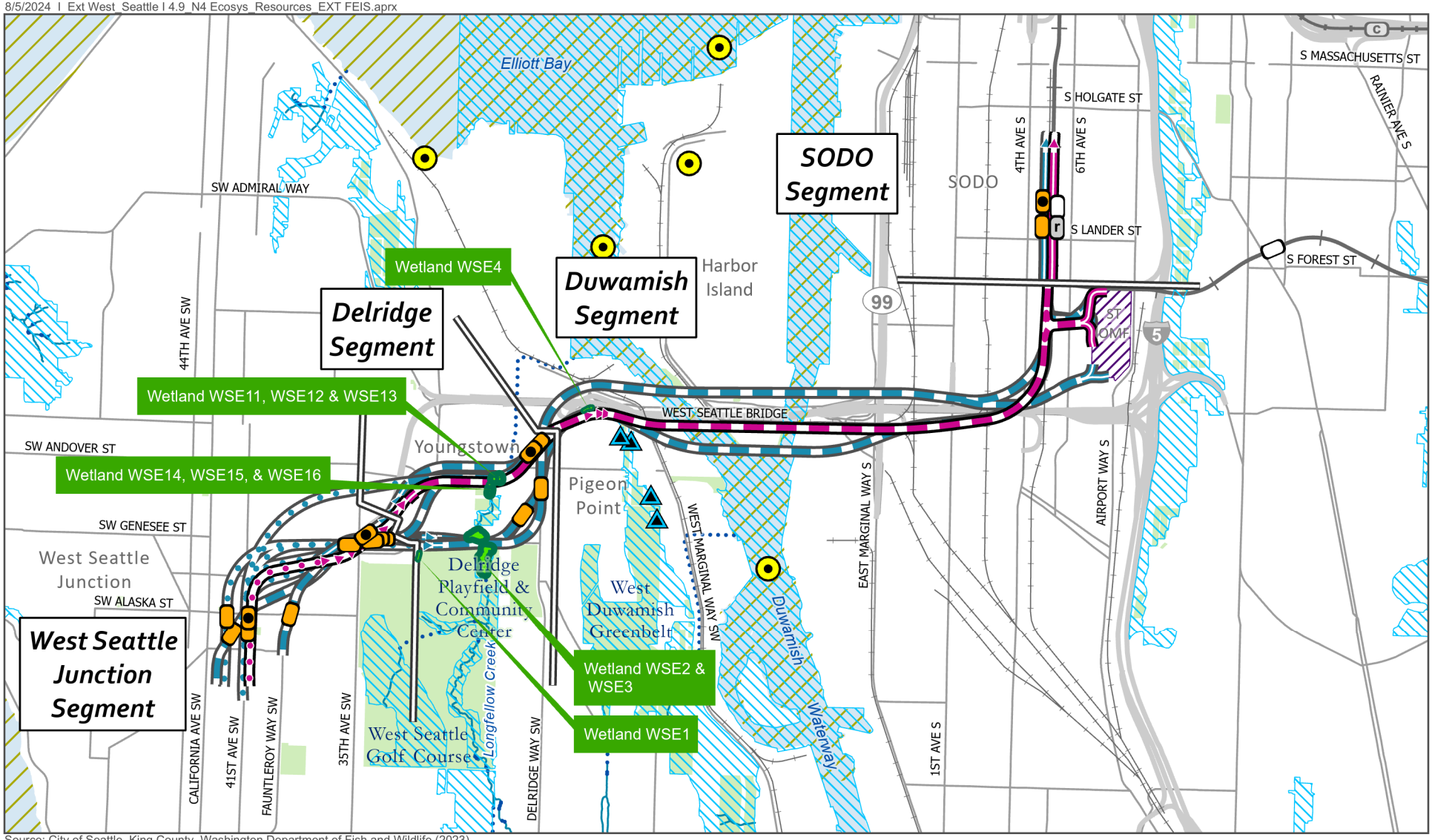
[a] Wetlands WSE5 through WSE10 are part of the Ballard Link Extension study area and are not included in this report.

[b] Ecology 2014; City of Seattle 2023a.

[c] Seattle Municipal Code 25.09.160 classifies habitat function score (Ecology 2014) of 3 to 4 as low, 5 to 7 as moderate, and 8 to 9 as high.

[d] Seattle Municipal Code 25.09.160: Category IV wetlands 1,000 square feet or more, regardless of connections to waters, receive a 50-foot buffer. Category II wetlands over 100 square feet (or of any size abutting a Type S, F, Np, or Ns water) with a moderate habitat score receive a 110-foot buffer.

[e] Acreages of wetlands WSE1 through WSE3 are estimated based on geographic information system analysis. Wetlands WSE4 and WSE11 through WSE16 are field-delineated.



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New
- Relocated
- Existing

- Segment Line
- Sound Transit Operations and Maintenance Facility (ST OMF)
- Existing Link Light Rail
- East Link Light Rail (Under Construction)
- Railroad
- Stream
- Piped Stream
- Park

- Great Blue Heron Nest
- Other Seabird Sightings
- Critical Habitat
- WDFW Priority Habitat
- Wetland
- Wetland Buffer

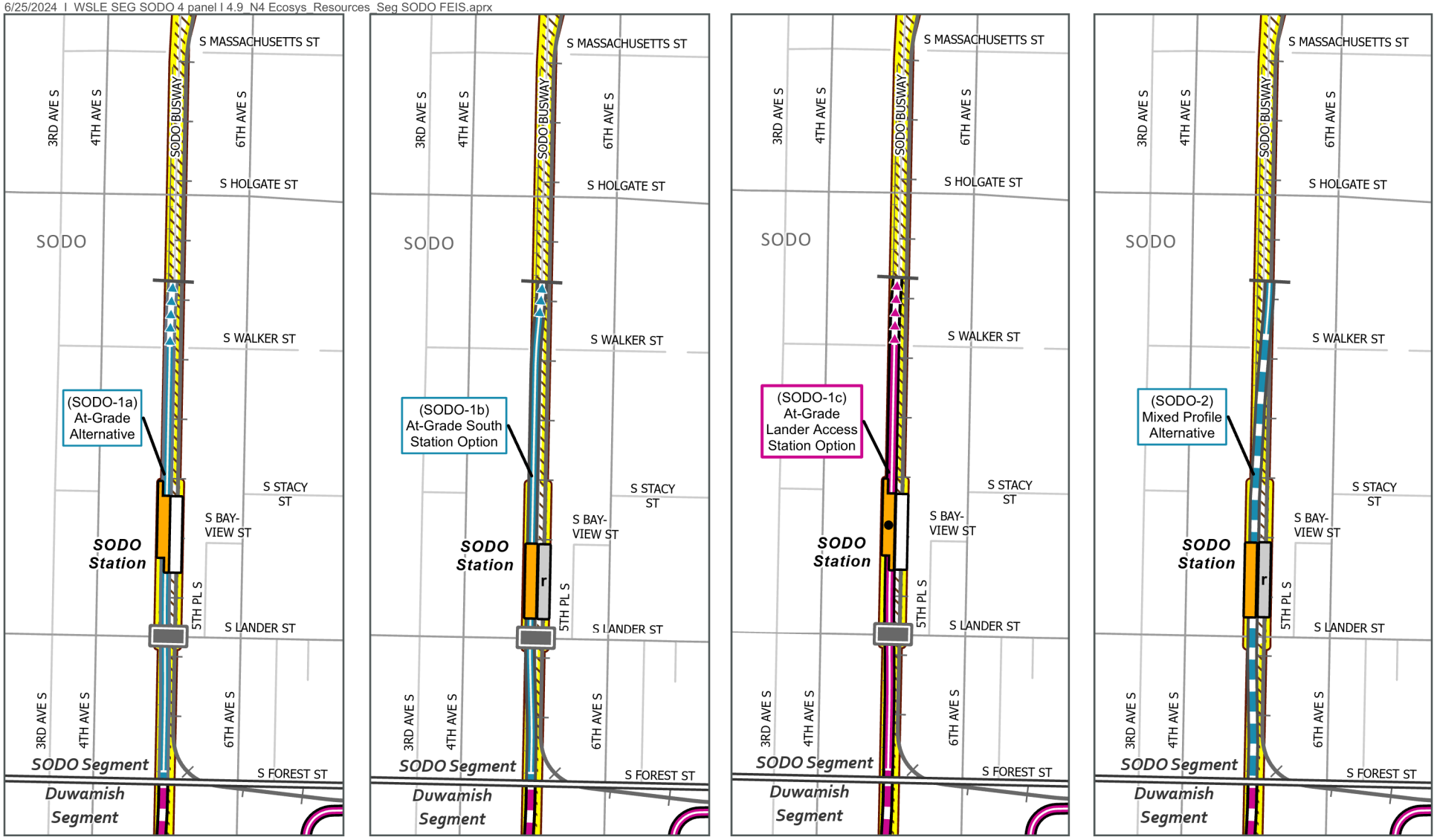
Note: 1) Critical habitat species identified on Figures 3-3b and 3-4b. 2) City and federal mapping of wetlands was reviewed and field verified where possible. Mapping may differ from other public wetland mapping sources.

0 0.5 1 Mile

N

FIGURE 3-1
Ecosystems Resources

West Seattle Link Extension



Source: City of Seattle, King County (2023).

Preferred Alternative
- Elevated
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New
- Existing
- r Relocated

- Segment Line
- Existing Link Light Rail
- Railroad
- SODO Busway
- Proposed Overpass

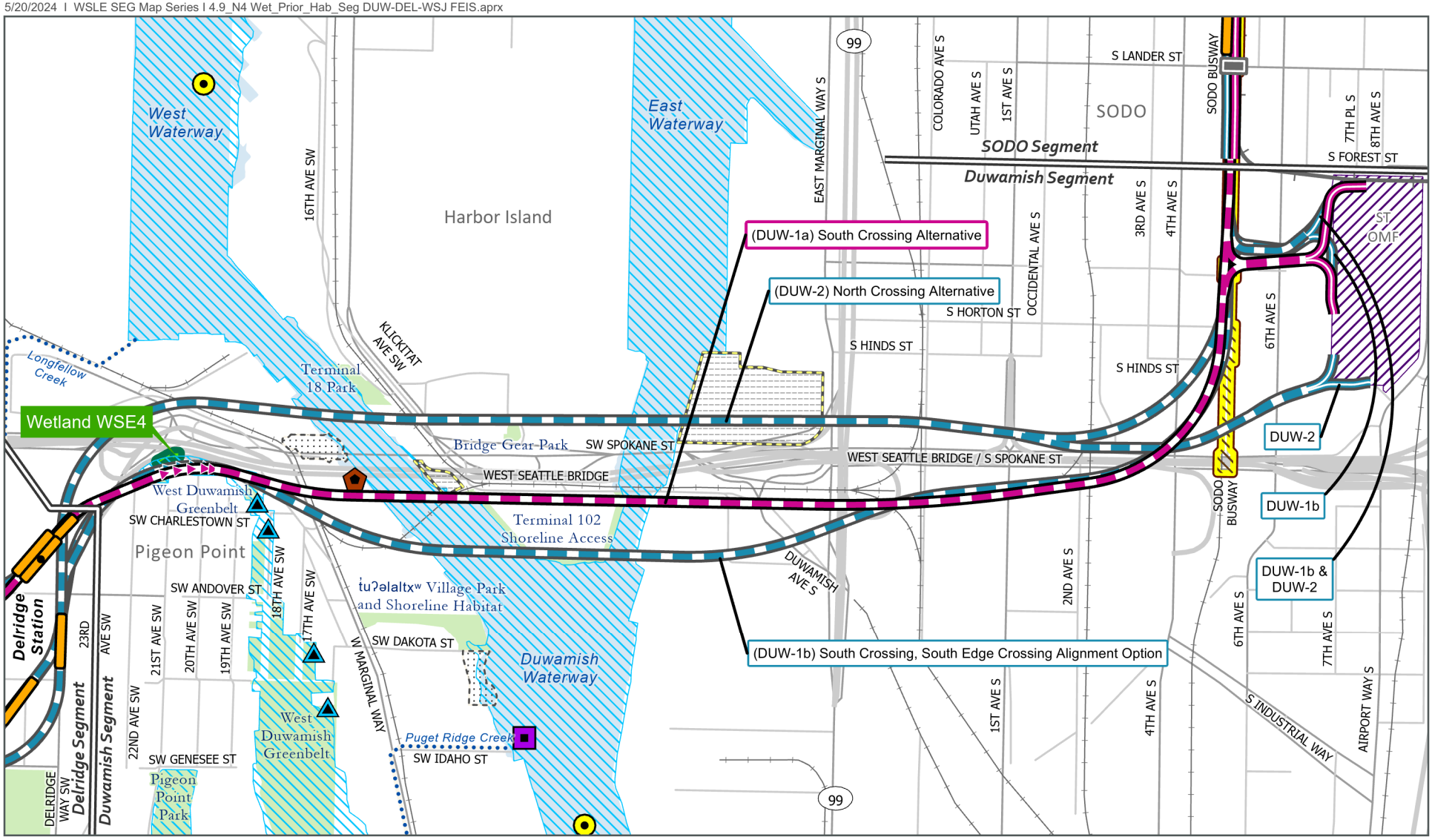
Notes: 1) USFWS, NOAA, WDFW, and the City of Seattle do not map any critical areas or priority habitats in this map view. 2) No wetlands are present along the SODO alignment.

FIGURE 3-2
Ecosystems Resources
SODO Segment

West Seattle Link Extension

0 500 1,000 Feet

N



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New

- Segment Line
- Existing Link Light Rail
- Railroad
- SODO Busway
- Proposed Overpass
- Sound Transit Operations and Maintenance Facility (ST OMF)
- Park
- Existing Mitigation Site (not related to this project)
- Proposed Mitigation Site (not related to this project)

- Great Blue Heron Nest
- Peregrine Falcon Nest
- Purple Martin Colony/Nest
- Other Seabird Sightings
- Piped Stream
- Wetland
- Wetland Buffer
- WDFW Priority Habitat

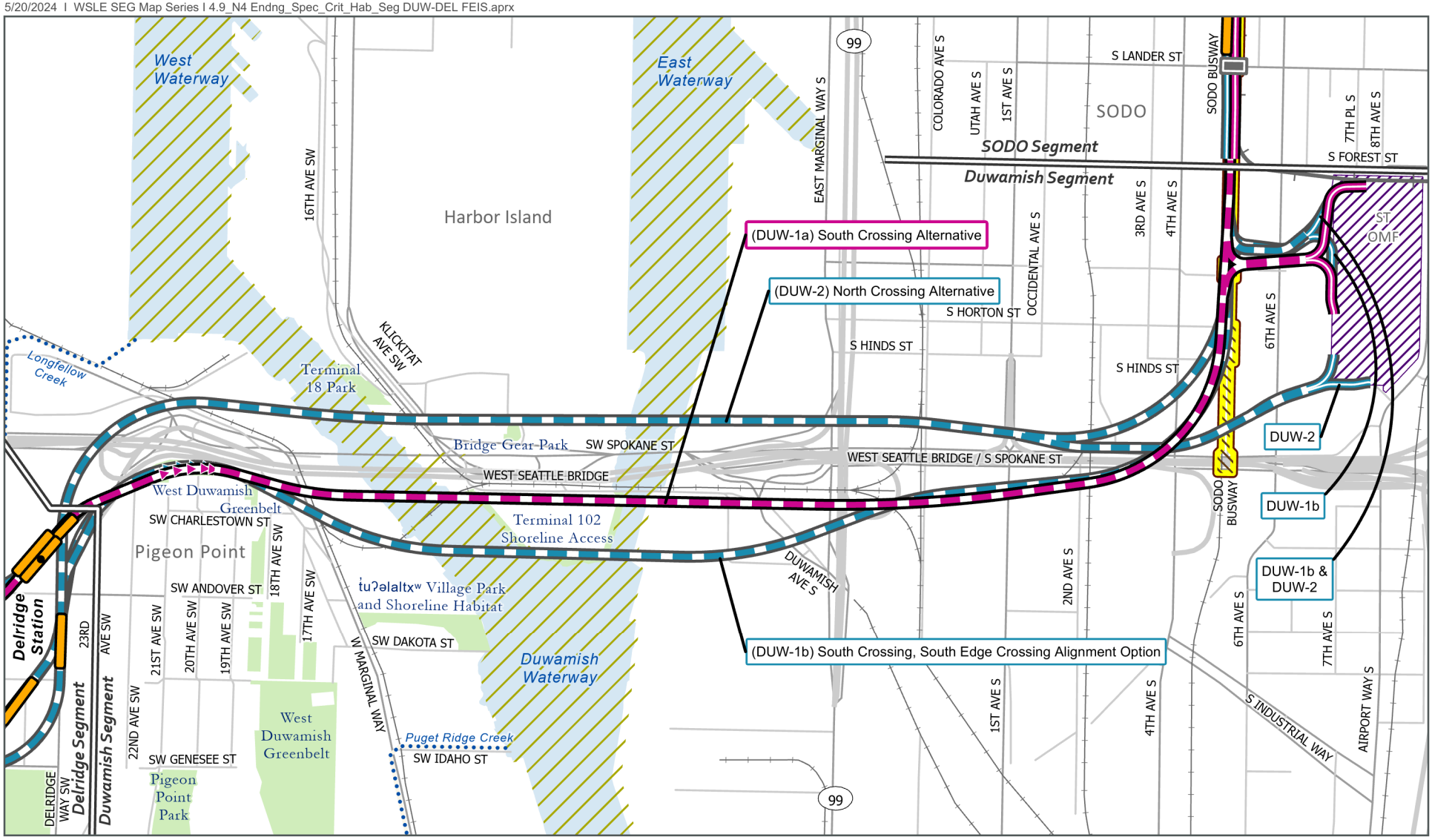
Notes: 1) The WDFW Salmon Stock Inventory maps wild populations of salmon in the Duwamish Waterway and Longfellow Creek. 2) City and federal mapping of wetlands was reviewed and field verified where possible. Mapping may differ from other public wetland mapping sources.

0 500 1,000 Feet

N

FIGURE 3-3a
Wetlands and Priority Habitat/Species
Duwamish Segment

West Seattle Link Extension



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New
- Segment Line
- Existing Link Light Rail
- Railroad
- SODO Busway
- Proposed Overpass
- Sound Transit Operations and Maintenance Facility (ST OMF)
- Park
- Piped Stream
- Critical Habitat

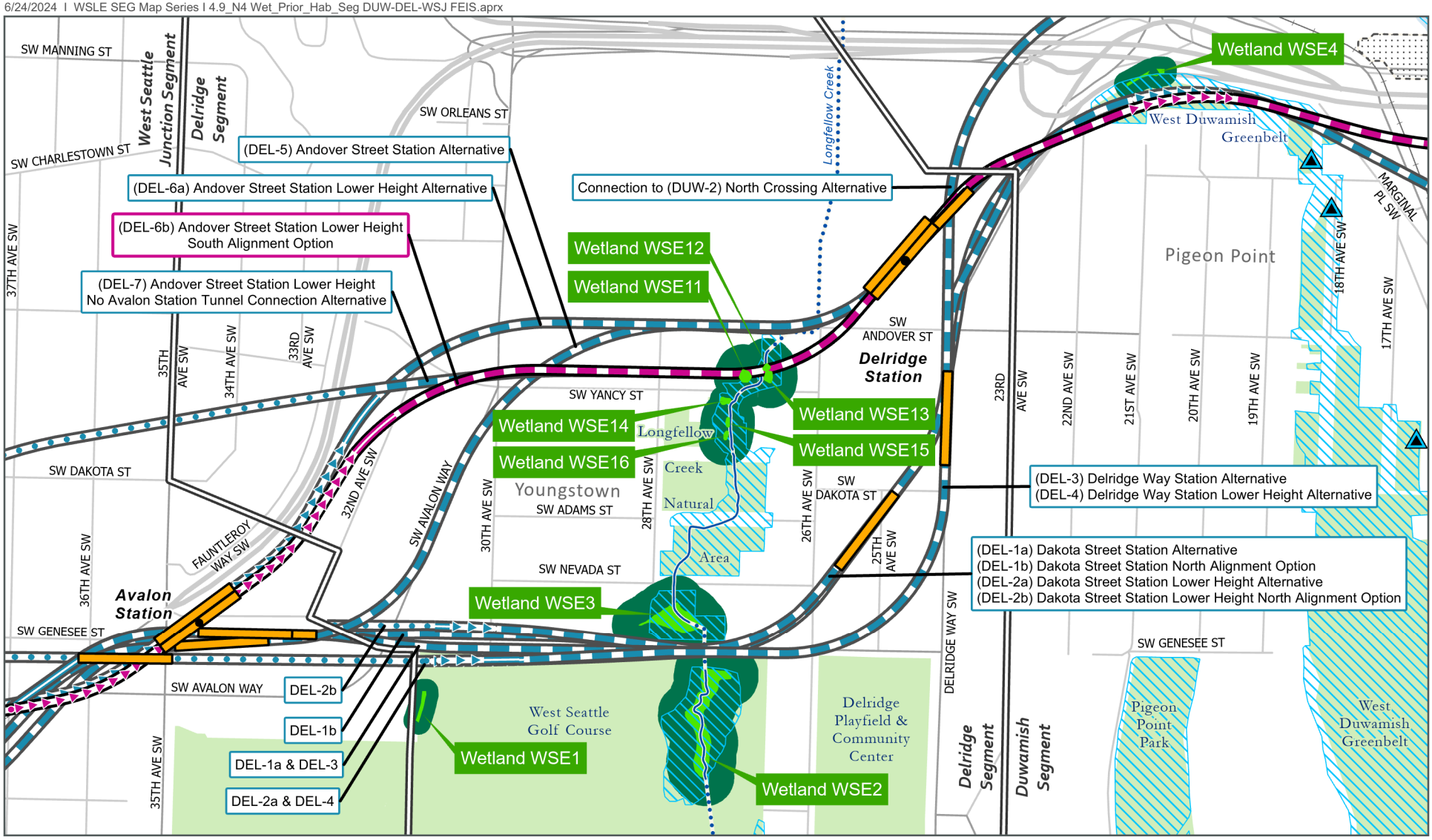
Note: The critical habitat shown is for Chinook salmon, steelhead and bull trout.

FIGURE 3-3b
Endangered Species Critical Habitat
Duwamish Segment

West Seattle Link Extension

0 500 1,000 Feet

N



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New

- Segment Line
- Railroad
- Park
- Existing Mitigation Site (not related to this project)

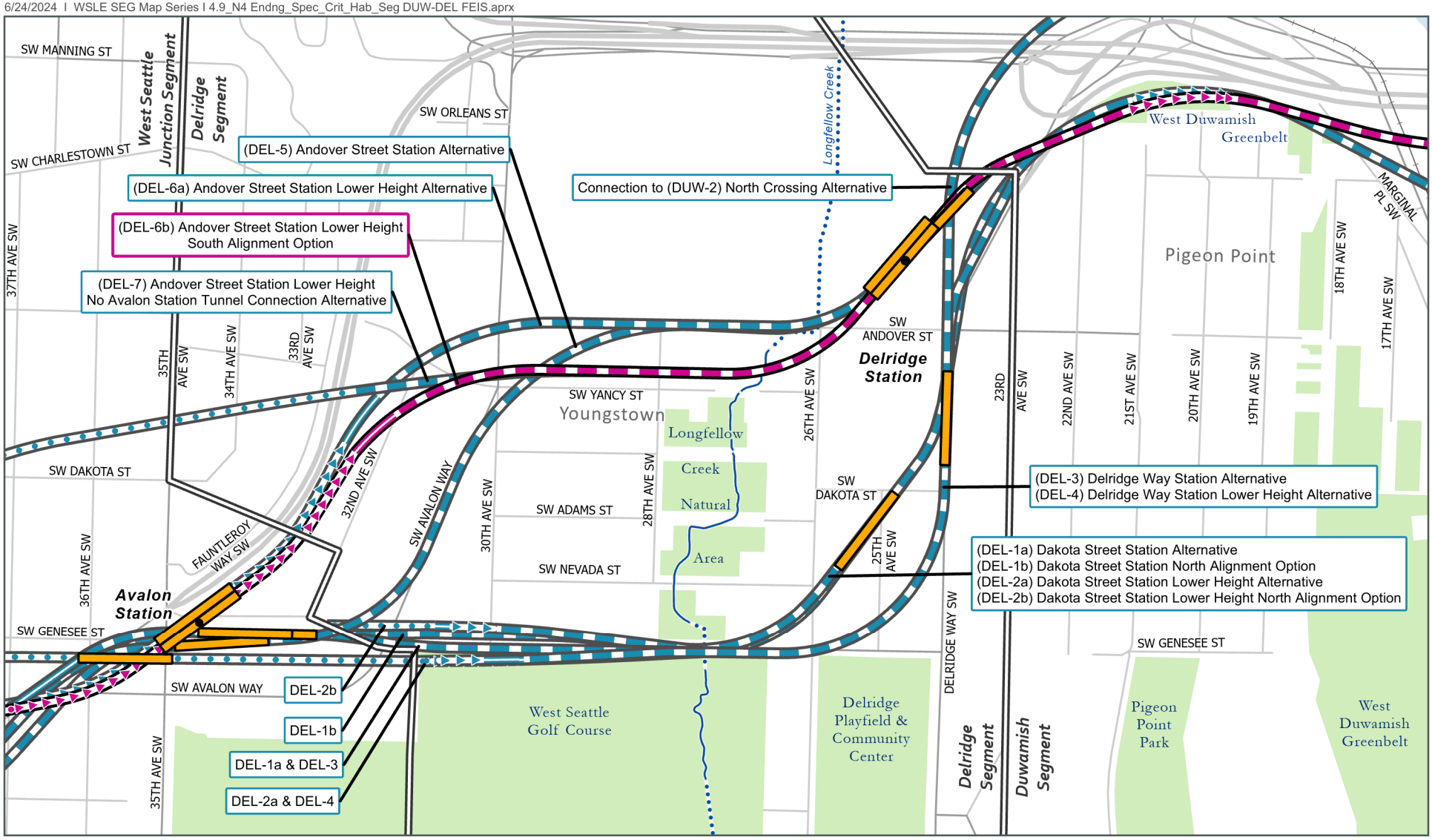
- Great Blue Heron Nest
- Stream
- Piped Stream
- Wetland
- Wetland Buffer
- WDFW Priority Habitat

Notes: 1) The WDFW Salmon Stock Inventory maps wild populations of salmon in Longfellow Creek. 2) City and federal mapping of wetlands was reviewed and field verified where possible. Mapping may differ from other public wetland mapping sources.

0 500 1,000 Feet N

FIGURE 3-4a
Wetlands and Priority Habitat/Species
Delridge Segment

West Seattle Link Extension



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New

- Segment Line
- Railroad
- Park

- Stream
- Piped Stream

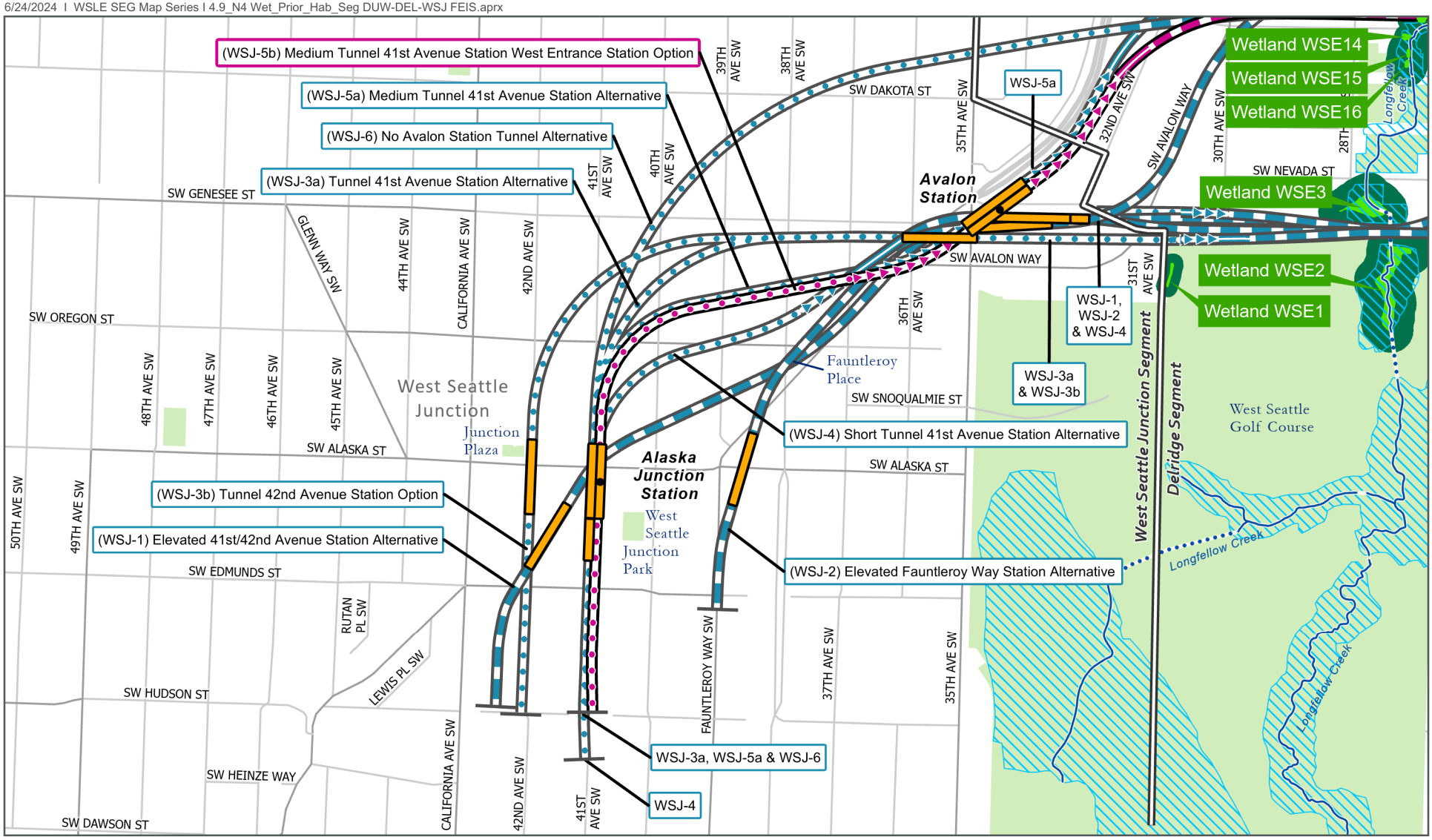
Note: The steelhead trout critical habitat follows the streams.

FIGURE 3-4b
Endangered Species Critical Habitat
Delridge Segment

West Seattle Link Extension

0 500 1,000 Feet

N



Source: City of Seattle, King County, Washington Department of Fish and Wildlife (2023).

Preferred Alternative
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Other Alternatives
- Elevated
- Tunnel
- At-Grade
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New

- Segment Line
- Park

- Stream
- Piped Stream
- Wetland
- Wetland Buffer
- WDFW Priority Habitat

Notes: 1) The WDFW Salmon Stock Inventory maps wild populations of salmon in Longfellow Creek. 2) City and federal mapping of wetlands was reviewed and field verified where possible. Mapping may differ from other public wetland mapping sources.

0 500 1,000 Feet

N

FIGURE 3-5
Wetlands and Priority Habitat/Species
West Seattle Junction Segment

West Seattle Link Extension

Wetland determination data forms and wetland rating forms are provided in Attachments N.4B, Wetland Determination Data Forms, and N.4C, Ecology Wetland Rating Forms. Photographs of the individual wetlands are included in Attachment N.4D, Ecosystem Photographs. Detailed wetland descriptions are provided in Attachment N.4E, Wetland and Stream Impacts within the Study Area.

3.2 Aquatic Habitat and Species

The project would cross two waterbodies: the Duwamish Waterway and Longfellow Creek. Both of these waterbodies are in Water Resource Inventory Area 9.

3.2.1 Duwamish Waterway

The Duwamish Waterway is an urban waterway at the outlet of the Lower Duwamish River that provides tidally influenced saltwater habitat, pockets of shoreline habitat in between industrial shoreline areas, and estuary habitat where it merges with Elliott Bay. In the study area, the waterway splits into the East Waterway and West Waterway on either side of Harbor Island before reaching Elliott Bay (see Figures 3-3a and 3-3b).

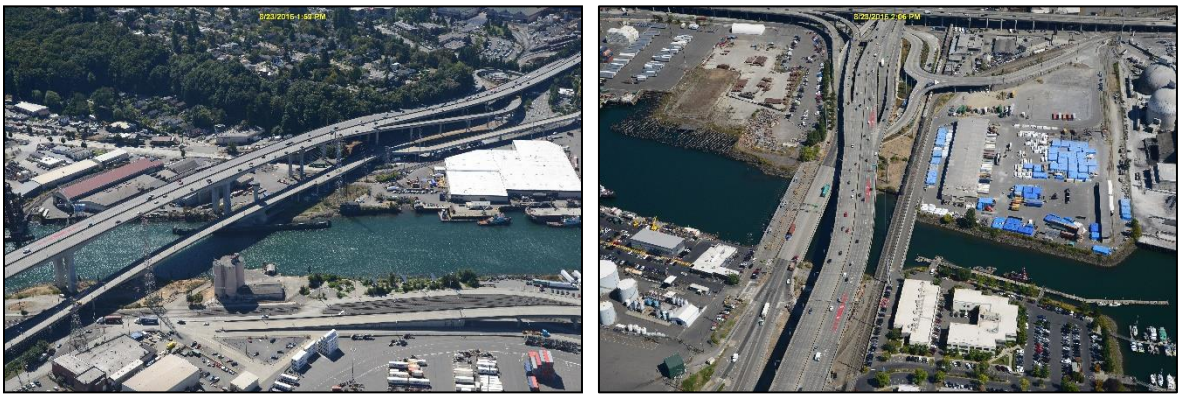
The waterway flows through a heavily developed industrial area, and very little natural estuarine habitat or intertidal shoreline habitat remains within the study area along the East Waterway (eastern side of Harbor Island) or West Waterway (western side of Harbor Island) (Figure 3-6). More than 92 percent of the shoreline in the study area lacks riparian vegetation (Kerwin and Nelson 2000), and benthic habitat quality is affected by regular dredging used to maintain the navigation channel. Historically, the lower portions of the Duwamish River meandered through tidal wetlands and shallows. Over time, the river changed significantly due to industrialization, dredging, and straightening (Elliott Bay Trustees 2019). Conditions of the waterway in the study area now include a deep channel and steep shorelines armored with rock or wood bulkheads; some patches of steep shoreline contain rock or gravel with some silty areas. Some of the shoreline is hidden by over-water structures, and little vegetation is present. Substrates of exposed shoreline include sand/mud, gravel or rock, with limited aquatic vegetation. Small pockets of degraded habitat for shorebirds is present among rocks or where silty sediment is exposed, such as along the shorelines of Harbor Island south of and underneath the West Seattle Bridge. Upland habitat within 200 feet is almost entirely developed with streets, office buildings, a marina, parking lots, and industrial storage areas.

Many water quality concerns exist in the Duwamish Waterway; the Lower Duwamish River has experienced historical discharges of hazardous wastes for over 100 years. Industries along the lower waterway that affect water quality include manufacturing, shipyards, cargo handling and storage, lumber milling, and petroleum storage. The river also provides a discharge point for many storm drains and combined sewer overflows. Three active Superfund sites along the river are undergoing remediation: the Harbor Island Superfund Site, the Lockheed West Seattle Superfund Site, and the Lower Duwamish Waterway Superfund Site (Elliott Bay Trustees 2019). The Harbor Island Superfund Site and the Lower Duwamish Superfund Site overlap the study area. The East Waterway still contains high levels of polychlorinated biphenyls, arsenic, polycyclic aromatic hydrocarbons, and mercury. Ecology also lists several water quality concerns in the waterway, including fecal coliform, Ammonia-N, and temperature (Ecology 2022). Temperatures at monitoring stations throughout the Duwamish River have occasional exceedances of criteria, which could temporarily alter the behavior of salmonids, or be detrimental to spawning, survival, or migration. Temperatures exceeding potentially lethal limits have been measured in the Lower Duwamish River estuary (King County and Washington State Conservation Commission 2000). Detailed information on water quality in the waterway can be found in Appendix L4.8, Water Resources Technical Report.

A final restoration plan for the Lower Duwamish River was completed in 2013 (NOAA Fisheries 2013). In 2014, as part of a National Resource Damage Assessment settlement, the Boeing Company constructed one of the largest restoration projects on the Lower Duwamish River—almost 5 acres of mudflat, marsh, and riparian vegetation, thus providing habitat for fish and wildlife. This site along the shoreline of the river is about 3 miles upstream from the study area. Four additional completed or planned restoration sites along the river are within or near the ecosystems study area (see their locations on Figure 3-3a):

- City of Seattle's Bluefield Holdings/Wildlands Site 1: The company Bluefield Holdings, Inc. completed this restoration project on the west side of the West Duwamish Waterway underneath the Spokane Street Bridge. The industrial property has been converted to tidal marsh, mudflat, and a riparian buffer. Credits derived from the project have been sold to responsible parties to address injuries to natural resources.
- City of Seattle's Bluefield Holdings/Wildlands Site 2. Bluefield Holdings purchased one portion of this site from the Port of Seattle; the other portion is City of Seattle property. The site is intended for restoration and use as a mitigation bank. It is on the east side of the West Waterway, just south of the West Seattle Bridge.
- Terminal 25 South Project. The Port of Seattle is planning and has funded this 9-acre wildlife habitat restoration project at Terminal 25 on the East Waterway, just north of the West Seattle Bridge. This project will restore estuarine wetland functions as well as restore and create riparian habitat and off-channel rearing and refuge habitat for salmonids and other fish and wildlife.
- About 1 acre of industrial property has been restored to tidal marsh, mudflat, and riparian buffer at the t̓uʔəlaltxʷ Village Park and Shoreline Habitat along the west side of the West Waterway, south of Harbor Island.

Figure 3-6. Shoreline Habitat at Duwamish Waterway in the West Waterway (Left) and East Waterway (Right)



Studies for remediation projects in the area, including an injury assessment plan finalized in 2019, have identified over 80 species of birds, 6 species of mammals, and over 50 species of fish that use the lower portions of the Duwamish River for foraging, resting, or reproducing for at least some of the year (Elliott Bay Trustees 2019). Over 60 species of benthic invertebrates are also found in the waterway, including clams, marine worms, crab, and shrimp species (Windward 2010). Marine mammals such as harbor seals and California sea lions might also travel up the waterway into the study area. Osprey, bald eagle, great blue heron, and many species of gulls and waterfowl use the waterway for foraging. Osprey might use trees or utility poles near the waterway for nesting. River otters, raccoons, and muskrats forage on shorelines in the Duwamish Waterway and might also forage along shorelines in the study area.

Salmonids passing through the waterway include coho salmon (*Oncorhynchus kisutch*), Chinook salmon (*O. tshawytscha*), chum salmon (*O. keta*), and pink salmon (*O. gorbuscha*). Trout species include steelhead (*O. mykiss*) and cutthroat trout (*O. clarkii*). Sockeye salmon (*O. nerka*) may also occasionally enter or spawn in the river (NOAA Fisheries 1997). The Duwamish River and its tributaries support both natural and hatchery salmon runs. The waterway provides the single point of entry for these salmon species to access the Duwamish River/Green River system from Puget Sound and travel up to 60 miles inland. Peak juvenile salmon outmigration occurs through the waterway between late April and early June (Simenstad et al. 1982). Other fish species that might use the Lower Duwamish River, including the Duwamish Waterway, include English sole (*Parophrys vetulus*), Pacific staghorn sculpin (*Leptocottus armatus*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Theragra chalcogramma*), Pacific herring (*Clupea pallasii*), and brown rockfish (*Sebastes auriculatus*) (Elliott Bay Trustees 2019).

Outside the study area, the Duwamish Waterway flows into Elliott Bay, a large estuary system that provides habitat for a wide variety of fish species and marine mammals, including California sea lions (*Zalophus californianus*), harbor seals (*Phoca vitulina*), harbor porpoise (*Phocoena phocoena*), and southern resident killer whales (*Orcinus orca*). Humpback whales (*Megaptera novaeangliea*), grey whales (*Eschrichtius robustus*), and minke whales (*Balaenoptera acutorostrata*) have also been sighted in south Puget Sound and are possible visitors to Elliott Bay (Orca Network 2021).

3.2.1.1 Applicable City of Seattle Shoreline Habitat Regulations

Seattle's Shoreline Master Program, which regulates development in shorelines of the state, was adopted pursuant to the Shoreline Management Act (Seattle Municipal Code 23.60A). Operating in much the same way as a zoning code, the Shoreline Master Program regulates in-water or over-water development on shorelines of the state and on uplands within 200 feet of the ordinary high water mark of these jurisdictional shorelines. The Seattle Shoreline Master Program specifies shoreline zones, permitted uses, and development standards.

The Shoreline Master Program regulations apply to the Duwamish Waterway in the study area. However, there is very little existing vegetation or wildlife habitat within 200 feet of the waterway in the study area. Shoreline designations within 200 feet of the waterway fall within the Urban Industrial shoreline zone (City of Seattle 2023a).

3.2.1.2 Applicable Tribal Treaty Rights

The Muckleshoot Indian Tribe has treaty-protected fishing rights and Usual and Accustomed Areas in the Puget Sound region, which includes the Duwamish Waterway. The Suquamish Indian Tribe of the Port Madison Reservation (Suquamish Tribe) also has treaty-protected fishing rights and Usual and Accustomed Areas in the Puget Sound region, which includes the Duwamish Waterway. The Muckleshoot Indian Tribe is signatory to the Treaty of Point Elliott and the Treaty of Medicine Creek. The Suquamish Tribe is signatory to the Treaty of Point Elliott.

3.2.2 Longfellow Creek

Longfellow Creek is an approximately 4-mile-long, Type F (fish-bearing) perennial stream that drains into the Duwamish Waterway. Its watershed drains 2,685 acres of West Seattle. The upper 0.9 mile of the creek (upstream of the study area) has been diverted into underground pipes, and roughly one-third of the total creek flow drains through pipes beneath shopping centers, houses, and roads (City of Seattle 2023a). The middle portion of the creek,

including the portion within the study area, includes open-channel sections with riparian vegetation and large, deep pools that can support fish and several pedestrian crossings (three bridges and a boardwalk) over the creek. The lowest portion of the creek flows about 0.5 mile through underground pipes from just south of Southwest Andover Street to a grated outlet near Terminal 5, where it outfalls to the Duwamish Waterway). The lowest portion of the creek, and the middle portion just south of Southwest Andover Street, are tidally influenced.

The City of Seattle regulates Longfellow Creek and its buffer area as a fish and wildlife habitat conservation area and the creek itself as a riparian watercourse (Seattle Municipal Code 25.09.012 and 25.09.200). The City regulates any development in or over Longfellow Creek, and within 100 feet of the creek in the riparian management area. The riparian management area is mapped perpendicular from open-channel sections of stream; the piped stream and areas perpendicular from the piped stream are excluded from City of Seattle riparian management regulations.

The City of Seattle allows some development within the outer portion of the regulated riparian area. This limited riparian development area is 75 to 100 feet from the edge of stream for streams with anadromous fish. At Longfellow Creek along Southwest Genesee Street and Southwest Andover Street, most of this limited riparian development area has already been developed as housing, parking lots, or streets; south of Southwest Genesee Street, this limited development area is managed as golf course fairway. In between Southwest Genesee Street and Southwest Andover Street, the limited riparian development area overlaps existing parks, trails, and edges of housing developments.

The 100-foot fish and wildlife habitat conservation area at Southwest Genesee Street (including the limited development area), is overlapped by the larger 110-foot regulated wetland buffers for wetlands WSE2 and WSE3. The conservation area between Southwest Andover Street and Southwest Dakota Street is overlapped by the regulated 110-foot regulated wetland buffers of WSE11, WSE12, and WSE15 and WSE16 and include the 50-foot buffers of WSE14.

Water quality in the creek is of high concern, as rated by Ecology's water quality index that integrates several water quality parameters into one number used to rank streams in the state. Longfellow Creek has periodic exceedances of dissolved oxygen, temperature, and fecal coliform bacteria beyond levels suitable for aquatic life; pH levels are also a concern, though pH levels rarely exceed the Ecology water quality criterion (King County 2016b; Ecology 2022; City of Seattle 2007).

Concentrations of metals in the creek are very low during non-storm flow conditions, but can be higher during storm flow events (City of Seattle 2007). During the summer, the creek periodically fails to meet the dissolved oxygen and temperature criteria necessary for salmonid spawning, rearing, and migration (City of Seattle 2007). Stormwater runoff from urban areas can bring elevated concentrations of nutrients, bacteria, metals, pesticides, or other organic pollutants such as petroleum hydrocarbons and phthalates (City of Seattle 2007). These pollutants originate from sources such as roads, yards, buildings, automobiles, and pet waste. Recent surveys of coho salmon in Longfellow Creek (and in many other streams in the Central Puget Sound) have documented abnormally high levels of pre-spawn mortality in the creek related to toxicity. Contaminants in water are being investigated as a potential contributor to this mortality; stormwater runoff may be a constraining factor in species recovery in the region (Spromberg and Scholz 2011; Scholz et al. 2001). Chinook and chum salmon using the creek have not shown this level of sensitivity to contaminants in Longfellow Creek (King County 2016a).

Longfellow Creek passes through the West Seattle Golf Course while flowing south to north. Within the golf course, fish barriers are present such as at the twelfth fairway in the golf course. Migrating coho salmon can access the creek up to these barriers. (City of Seattle 2007;

Washington Department of Fish and Wildlife 2019b). Within the study area, the creek meanders through patches of reed canarygrass (*Phalaris arundinaceae*) before reaching a beaver dam within wetland WSE2. Salmon have access to the stream within the study area. Vegetation on the stream banks through the golf course consists of Pacific willow (*Salix lucida*), bigleaf maple saplings (*Acer macrophyllum*), Himalayan blackberry (*Rubus armeniacus*), Canada thistle (*Cirsium arvense*), jewelweed (*Impatiens capensis*), reed canarygrass, horsetail (Equisetum sp.), and black cottonwood saplings (*Populus trichocarpa*). After the beaver dam, the creek flows into a 3-foot-diameter culvert under Southwest Genesee Street.

North of Southwest Genesee Street, the creek exits the culvert into a pool about 20 feet wide. This point is within the Longfellow Creek Natural Area. Riparian vegetation along the pool consists of red alder (*Alnus rubra*) trees. North of the pool, the creek continues through a channel that is 6 to 15 feet wide with steep banks. Moderate riparian vegetation along this reach is provided by willows and red alder. Jewelweed, bittersweet nightshade (*Solanum dulcamara*), reed canarygrass, willows, and slough sedge (*Carex obnupta*) are present along the banks of the pool and channel, as well as tree and shrub plantings between the channel and the pedestrian trail. As noted above, ongoing physical and biological restoration efforts have occurred in the creek, starting in the 1990s, including the large woody debris placement and riparian plantings within the study area, north of Southwest Genesee Street. These efforts, in addition to other restoration efforts in the watershed, may contribute to improved water quality in the creek (King County 2016a).

Downstream from the pool, the channel widens out before crossing underneath a pedestrian bridge about 100 feet north of Southwest Genesee Street. Signs of beaver (such as gnawed trees) are present near the pool. Longfellow Creek continues flowing northward as an open channel through forested habitat with red alder, spruce, bigleaf maple, and Douglas-fir (*Pseudotsuga menzesii*), and under pedestrian bridges at Southwest Yancy Street and Southwest Dakota Street. Some portions of the stream are relatively straight with steep banks, other areas have unconfined banks. Pools are present that could provide fish habitat. Large woody debris and beaver evidence (including beaver lodges and dams with ponding) are present. Streamside vegetation includes red alder, western red cedar (*Thuja plicata*), and spruce. The understory is composed of mostly invasive species, including Himalayan blackberry, English ivy (*Hedera helix*), English holly (*Ilex aquifolium*), and reed canarygrass, though native species such as red osier dogwood (*Cornus stolonifera*) are also present, and some portions of streamside are partially shaded by snowberry (*Symphoricarpos albus*).

The section of Longfellow Creek between Southwest Yancy Street and Southwest Andover Street is outside the Longfellow Creek Natural Area but contains similar forested canopy within the greenbelt along the creek. Understory alongside the creek contains more non-native species in this area than within the Longfellow Creek Natural Area. Where the stream passes through the vicinity of Wetlands WSE11, WSE12, and WSE13 within this area, the dominant cover is Himalayan blackberry and red osier dogwood.

As Longfellow Creek approaches Southwest Andover Street, the stream is about 8 to 12 feet wide and channelized, with riprapped banks near the culvert. About 70 feet south of Southwest Andover Street, the stream enters underground pipes and continues flowing northward underground until its outlet into the Duwamish Waterway near Terminal 5.

Longfellow Creek's waters and streamside habitat supports amphibians, benthic invertebrates, and several fish species. Several sculpin species have been documented in the lowest portions of creek (City of Seattle 2007). Adult Chinook, steelhead, and coho salmon have been observed in the creek within the study area and upstream of the study area to the barriers within the West Seattle Golf Course (King County 2016a; City of Seattle 2007; McMillan 2007). Volunteers in the King County Salmon Watcher Program, who have been surveying the creek since 1999, have

consistently sighted adult coho and chum salmon; Chinook salmon and cutthroat trout have been observed on occasion (King County 2016a). Coho migrate upstream through the creek October through December, and chum migrate upstream in November (Salmon Conservation and Restoration 2019). Rainbow trout (*Oncorhynchus mykiss*) have also been documented in the creek. No occurrences of bull trout (*Salvelinus confluentus*) have been documented in the creek (City of Seattle 2023a; Washington Department of Fish and Wildlife 2018, 2023b).

Longfellow Creek supports salmonid spawning activity. Surveys in 1999 also located juvenile rainbow trout and coho in the creek, which indicated that the stream supports spawning activity (City of Seattle 2023a). Numerous releases of coho fry have also occurred in the creek. Redds (spawning beds) have also been observed in the creek (City of Seattle 2007). The highest-quality spawning habitat in the creek currently accessible to salmonids is near Southwest Adams Street, which is a few hundred feet north of where Longfellow Creek crosses under Southwest Genesee Street (City of Seattle 2007).

3.2.3 Federally Listed Species, Species of Concern, Priority Species, and Species of Local Importance – Aquatic Species

Table 3-2 summarizes the federally listed species under the jurisdiction of the U.S. Fish and Wildlife Service and NOAA Fisheries that might occur in the aquatic habitats present in the study area. All of these species are documented in or have the potential to be present in the Duwamish Waterway, including Chinook salmon, steelhead trout, and bull trout. The listed salmonid species spawning upriver do not spawn in the study area but use the Duwamish Waterway for migration, and smolts use the shoreline habitat for shelter when moving downstream to Elliott Bay and when adjusting to saltwater conditions. Chinook salmon and steelhead are also present in Longfellow Creek up to the West Seattle Golf Course (King County 2016a; Kerwin and Nelson 2000).

Yelloweye and bocaccio rockfish (*Sebastes ruberrimus* and *S. paucispinis*) occur in Elliott Bay and may enter the tidally influenced portions of the Duwamish Waterway. Listed whale species (humpback whale and southern resident killer whale) occurring in Elliott Bay are unlikely to visit the Duwamish Waterway; however, construction noise has the potential to reach these species in Elliott Bay. Pacific cod and Pacific herring (candidates for federal listing) and river lamprey (*Lampetra ayresii*; federal species of concern) occur in Elliott Bay and have been documented in the Duwamish Waterway. Marbled murrelets (*Brachyramphus marmoratus*) forage in Elliott Bay, and may visit the Duwamish Waterway for foraging or when traveling between their marine foraging habitat and their upland nesting habitat in the Cascades foothills. Steller sea lions (*Eumetopias jubatus*) are much less common in Elliott Bay than the California sea lion but do occur and might join the California sea lions and harbor seals that regularly forage in the lower portion of the Duwamish Waterway.

Two additional federally listed marine species are possible in the study area but are unlikely to occur. Green sturgeon (*Acipenser medirostris*) might enter Puget Sound to forage in the nearshore zones of bays and estuaries; however, no spawning occurs in Puget Sound rivers and green sturgeon is unlikely to be present in the study area. The closest documented Pacific eulachon spawning is in northern Puget Sound (southern British Columbia); therefore, eulachon are unlikely to be present in the study area.

The Duwamish Waterway is designated critical habitat for bull trout, Chinook salmon, and steelhead. NOAA Fisheries maps the Duwamish Waterway as essential fish habitat for all life stages of finfish, groundfish, coastal pelagic species, and Chinook, coho, and pink salmon (NOAA Fisheries 2019c).

Table 3-2. Federally Listed Aquatic Species and Species of Concern with Potential to Occur in Study Area –Aquatic Habitat

Common Name	Scientific Name	Status	Occurrence in Study Area
Puget Sound/Coastal Distinct Population Segment bull trout	*Salvelinus confluentus*	Federal Threatened; State Candidate	Documented in Duwamish Waterway; critical habitat in Elliott Bay and Duwamish Waterway.
Puget Sound Evolutionarily Significant Unit Chinook salmon	*Oncorhynchus tshawytscha*	Federal Threatened; State Candidate	Documented in Elliott Bay, Duwamish Waterway, and Longfellow Creek; critical habitat in Elliott Bay and Duwamish Waterway; essential fish habitat in Duwamish Waterway and Longfellow Creek.
Puget Sound Distinct Population Segment steelhead trout	*Oncorhynchus mykiss*	Federal Threatened	Documented in in Elliott Bay and Duwamish Waterway. Critical habitat in the Duwamish Waterway and Longfellow Creek.
Coho salmon	*Oncorhynchus kisutch*	Federal Species of Concern	Documented in Duwamish Waterway and Longfellow Creek; essential fish habitat in Duwamish Waterway and Longfellow Creek.
Puget Sound bocaccio	*Sebastes paucispinis*	Federal Endangered; State Candidate	Likely in Elliott Bay, potential in Duwamish Waterway; critical habitat in Elliott Bay.
Puget Sound yelloweye rockfish	*Sebastes ruberrimus*	Federal Threatened; State Candidate	Likely in Elliott Bay, potential in Duwamish Waterway; critical habitat in Elliott Bay.
Pacific cod	*Gadus macrocephalus*	Federal Species of Concern; State Candidate	Documented in Elliott Bay and Duwamish Waterway.
Pacific herring	*Clupea pallasi*	Federal Candidate; State Candidate	Likely in Elliott Bay; documented in Duwamish Waterway; Washington Department of Fish and Wildlife maps spawning habitat on Elliott Bay shorelines.
River lamprey	*Lampetra ayresii*	Federal Species of Concern	Potential in Duwamish Waterway.
Pacific eulachon [a]	*Thaleichthys pacificus*	Federal Threatened	Unlikely; closest documented spawning is in southern British Columbia.
Green sturgeon [a]	*Acipenser medirostris*	Federal Threatened	Unlikely; could occur in Elliott Bay but no spawning occurs in Puget Sound rivers.
Southern resident killer whale [a]	*Orcinus orca*	Federal Endangered	Documented in Elliott Bay; critical habitat in Elliott Bay.
Humpback whale [a]	*Megaptera novaeangliae*	Federal Endangered, State Endangered	Documented in Elliott Bay.
Steller sea lion	*Eumetopias jubatus*	Federal Species of concern	Documented in Elliott Bay; potential in Duwamish Waterway.
Marbled murrelet	*Brachyramphus marmoratus*	Federal Threatened; State Threatened	Occur in Elliott Bay and occasionally in the Duwamish Waterway.

Sources: U.S. Fish and Wildlife Service 2019; NOAA Fisheries 2019b, 2020, 2023; Washington Department of Fish and Wildlife 2023a, 2023c.

[a] Listed marine species found in Elliott Bay but not the Duwamish Waterway are included here because in-water construction noise could reach the bay.

The U.S. Army Corps of Engineers and Washington Department of Fish and Wildlife have established work windows for in-water work to protect listed species of salmonids, and NOAA Fisheries or U.S. Fish and Wildlife Service may require additional restrictions to this work window. The standard in-water work window in the Duwamish Waterway is August 1 through February 15.

Recovery plans are in place for Chinook salmon (NOAA Fisheries 2007), bull trout (U.S. Department of Fish and Wildlife 2015), and steelhead trout (NOAA Fisheries 2019c). The Chinook recovery plan focuses on limiting factors for the species, including the following:

- Water quality in the lower 5 miles of the Lower Duwamish River
- The lack of intertidal habitat in the Duwamish Estuary transition zone where fresh water and salt water mix (juvenile salmon may linger in this area while adjusting to salt water)
- Degraded riparian conditions (which occur in portions of Longfellow Creek and on the Lower Duwamish River)

Management actions recommended by the Chinook recovery plan focus on the following:

- Protecting and/or improving riparian conditions
- Protecting and/or improving natural flows
- Protecting and/or improving water quality
- Protecting and/or improving access to tributaries
- Preventing new bank/shoreline armoring and fill that would reduce habitat for migrating juvenile Chinook

The steelhead recovery plan states specific strategies for the central and south Puget Sound major population group of steelhead (which includes steelhead passing through the study area in the Duwamish Waterway and in Longfellow Creek). The strategies include improving habitat in lower reaches of rivers (through actions such as improving habitat complexity and shade) and improving juvenile survival in nearshore waters. The bull trout recovery plan includes guidance on recovery of the Coastal Recovery Unit (which includes Puget Sound). However, it does not identify the Duwamish River as a core recovery area, because no anadromous run of bull trout is established in this drainage.

A recovery plan is also in place for the marbled murrelet (U.S. Fish and Wildlife Service 1997), including recommendations for the Puget Sound area. Ongoing management actions performed under this plan focus on preserving upland habitat (in mature forests, which do not occur in the study area) and preventing injury or death in the marine environment (such as during oil spills). The health of nearshore environment is also a concern for the species, which spends most of its life in marine waters feeding on forage fish.

Recovery plans are also in place for southern resident killer whales (NOAA Fisheries 2008) and humpback whales (NOAA Fisheries 1991). Known or potential impacts to these species, as listed in the plans, include acoustic disturbance (such as from industrial activities) and habitat degradation (including chemical pollution). Management actions identified for recovery of southern resident killer whales include protecting or increasing runs of Chinook salmon, the whales' preferred prey species.

A final recovery plan is in place for yelloweye rockfish and bocaccio (NOAA Fisheries 2017). Final recovery plans are also in place for eulachon and green sturgeon (as noted above, eulachon and green sturgeon are not likely in the Duwamish Waterway or Elliott Bay).

3.3 Upland Habitat and Species

3.3.1 Vegetation

3.3.1.1 Land Cover Types

The study area is in a densely developed city that has been substantially altered from historical conditions. Land cover is primarily urban, with high density buildings and industrial areas in south Seattle and the Duwamish area, and high, moderate, and low density residential areas in West Seattle (Table 3-3). Forested greenbelts and developed open space such as the West Seattle Golf Course are present adjacent to the residential areas. Figure 3-7 shows the land cover types in the study area.

Most of the highly urban areas, industrial areas, high density housing, and roadways, have limited potential for supporting a robust, diverse community of native wildlife. The primary cover types that provide any nesting or sheltering habitats for wildlife are non-paved areas in the West Duwamish Greenbelt, the Longfellow Creek Natural Area, the adjacent Longfellow Creek greenbelt between Southwest Yancy Street and Southwest Andover Street, the West Seattle Golf Course, in small residential parks, and in landscaping and retained native trees within residential back yards. Wildlife inhabiting these areas are exposed to moderate to high levels of noise associated with traffic and industrial operations.

3.3.1.2 Heritage and Other Protected Trees

The City of Seattle and PlantAmnesty maintain a cooperative program to protect notable trees in Seattle; a tree is nominated as a heritage tree if it has exceptional size, form, rarity, historic contribution, or is part of a notable collection (City of Seattle 2023b, 2023c). No heritage trees overlap the project's footprint; heritage trees mapped within the study area consist of an American black walnut tree near the north end of the West Duwamish Greenbelt and a Japanese maple south of the Alaska Junction Station (City of Seattle 2019b).

Street trees in the study area include many species of ornamental and native trees, including maples (*Acer* spp.), Callery pear (*Pyrus calleryana*), crabapple (*Malus sp.*), hawthorne (*Crataegus sp.*), ash (*Fraxinus* spp.), linden (*Tilia* spp.), ginkgo tree (*Ginko biloba*), elm (*Ulmus* spp.) and giant sequoia (*Sequoiadendron giganteum*). The golf course contains mowed fairways, rows of medium-sized deciduous and coniferous trees bordering the fairways, and a few patches of forest with larger, primarily deciduous trees and a mix of native and non-native understory vegetation. Delridge Playfield has lines of trees but is cleared of any understory species (groundcover is primarily mowed lawn). Riparian habitat along Longfellow Creek is fragmented, but stream and riparian restoration projects have increased habitat quality in many sections, including within the study area. Native tree and shrub plantings were added to increase plant diversity and stream shading and reduce potential erosion. Large woody debris has been anchored in the stream to create pools, shade, and a nutrient source for more complex fish habitat.

Table 3-3. Land Cover Types along the West Seattle Link Extension

Land Cover Type	Acres within 200 Feet of Project [a]	Percent of Land Cover Type Total	Description
Forest (Greenbelts)	38	5%	Includes deciduous and mixed forest with over 20% total tree cover. Occurs in the West Duwamish Greenbelt and Longfellow Creek greenbelt including the Longfellow Creek Natural Area.
High Density Residential (Includes Industrial)	413	60%	Includes developed areas where people reside or work in high numbers (such as commercial/industrial, apartment complexes, and row houses); 80 to 100% impervious surface.
Medium Density Residential	149	22%	Areas with a mixture of constructed materials and vegetation; 50% to 79% impervious surface (such as single-family housing units).
Low Density Residential	53	8%	Areas with a mixture of constructed materials and vegetation; 20% to 49% impervious surface (such as single-family housing units).
Developed, Open Space	12	2%	Areas with constructed material but dominated by managed vegetation (such as lawn grasses); less than 20% impervious surface. Includes large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes).
Open water	20	3%	Areas of open water; less than 25% cover of vegetation or soil.

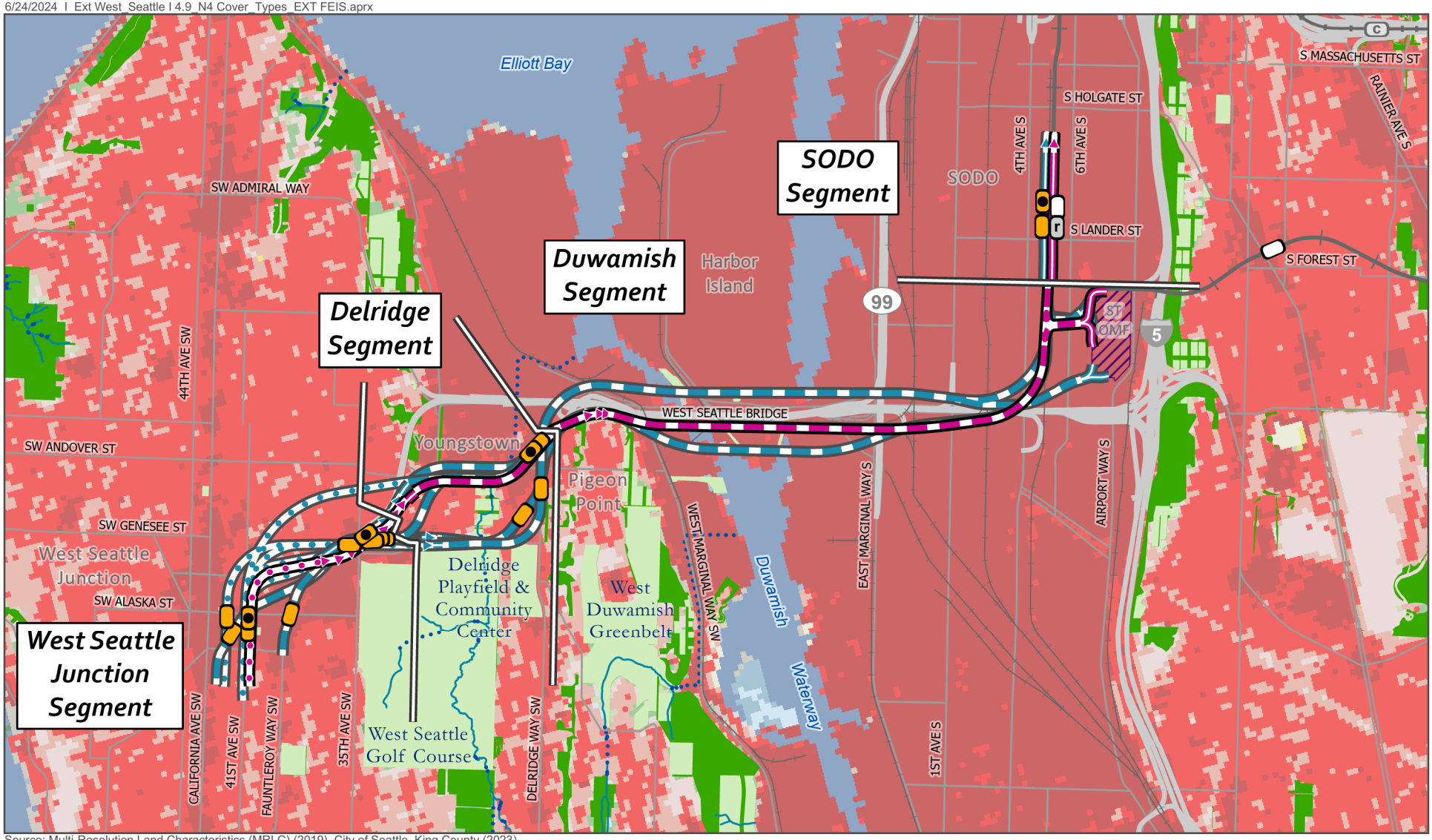
Sources: National Land Cover Database 2016 (for residential, developed, and open water cover types); Green Seattle Partnership 2020 (forest-cover types).

[a] The National Land Cover Database is based on a grid system and Green Seattle Partnership data follows more precise forest-cover boundaries. Therefore, combining these datasets creates some small overlaps between the forest acres and other landcover types.

The City of Seattle also protects trees 6 inches in diameter or larger under a tiered system established in 2023. Tier 1 includes trees designated as heritage trees. Tier 2 trees include any tree that is 24 inches in diameter at standard height or greater, tree groves, each tree comprising a tree grove, and specific tree species below 24 inches in diameter as defined by City of Seattle Director's Rule 7-2023 (note that Tier 2 excludes certain species such as red alder, black cottonwood, and Lombardy poplar). Tier 3 includes trees 12 inches to 24 inches in diameter, and Tier 4 includes trees 6 inches to 12 inches in diameter. Trees less than 6 inches in diameter are not regulated by the City's Tree Protection Ordinance (Seattle Municipal Code 25.11). The tier designations include trees previously termed "exceptional," which are trees considered rare or exceptional by virtue of their size, species, condition, cultural/historic importance, age, and/or contribution as part of grove of trees as defined by Director's Rule 16-2008 (City of Seattle 2008). Exceptional trees have unique historical, ecological, or aesthetic value (City of Seattle 2008). Trees that meet the definition for exceptional are present in the study area and would require protection or mitigation under the City's Tree Protection Ordinance under the appropriate tier. Any trees that are within critical areas would require additional protection or mitigation under the City's critical areas regulations.

3.3.1.3 Rare Plants

Based on the Washington Department of Natural Resources Natural Heritage Program rare plants geographical information system data, no rare plant communities are currently documented in the study area (Camp and Gamon 2011; Washington Department of Natural Resources 2021).



Source: Multi-Resolution Land Characteristics (MRLC) (2019), City of Seattle, King County (2023).

Preferred Alternative
- Elevated
- At-Grade
- Tunnel
- Retained Cut

Other Alternatives
- Elevated
- At-Grade
- Tunnel
- Retained Cut

Station (● *Indicates Preferred Alternative*)
- New
- Relocated (r)
- Existing

- Segment Line
- Sound Transit Operations and Maintenance Facility (ST OMF)
- Existing Link Light Rail
- East Link Light Rail (Under Construction) (C)
- Railroad
- Stream
- Piped Stream
- Park
- Green Space

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Herbaceous
- Hay/Pasture
- Woody Wetlands
- Emergent Herbaceous Wetlands

0 0.5 1 Mile

N

FIGURE 3-7
Cover Types

West Seattle Link Extension

3.3.1.4 Invasive Plants

Invasive species of plants are present throughout the highly modified environment of the study area. Prominent species are English ivy, Himalayan blackberry, and non-native grasses. Ivy is particularly prevalent as groundcover and on some tree trunks in the West Duwamish Greenbelt and in roadside areas under the West Seattle Bridge. Where heavy infestations occur in the greenbelt forest floor, it is currently slowing the regeneration of young trees in the forest; the weight of heavy infestations of ivy on tree branches can increase the chances that tree limbs could break during storms.

King County lists several weed occurrences that have been reported in the study area, some successfully controlled and some ongoing. These include Class A weeds (eradication of all infestations is required by law in Washington), and Class B weeds (in which prevention or control is decided at the local level). Weeds recorded in or near the study area include several Class B weeds (tansy ragwort [*Senecio jacobaea*]; dalmatian toadflax [*Linaria dalmatica*], rush skeletonweed [*Chondrilla juncea*], perennial pepperweed [*Lepidium latifolium*], diffuse knapweed [*Centaurea diffusa*], kochia [*Bassia scoparia*] and spotted knapweed [*Centaurea stoebe*]) and one Class A weed (giant hogweed [*Heracleum mantegassianum*]) (King County 2023a, 2023b; Noxious Weed Control Board 2023).

3.3.2 Forested Corridors and Wildlife

The study area includes the northern end of the West Duwamish Greenbelt, which stretches along the steep slope on the east side of West Seattle's Delridge neighborhood and provides roughly 500 acres of forested habitat corridor. It stretches 4 miles (6.4 kilometers) south from the West Seattle Bridge. The study area also includes the forested greenbelt along Longfellow Creek; this greenbelt is a narrow corridor of trees about 0.25 mile long between Southwest Genesee Street and Southwest Andover Street. The majority of the Longfellow Creek greenbelt is a Seattle city park called the Longfellow Creek Natural Area. Both the West Duwamish and Longfellow Creek greenbelts are Washington Department of Fish and Wildlife-designated Priority Habitat Biodiversity Area and Corridors, and the City of Seattle defines them as environmentally critical areas.

The West Duwamish Greenbelt and the Longfellow Creek greenbelt provide habitat elements that include deciduous and coniferous forest, snags, downed woody debris, and areas with multi-layered canopy. Tree species include red alder, bigleaf maple, Douglas-fir and Sitka spruce (*Picea sitchensis*). The West Duwamish Greenbelt provides contiguous habitat for 4 miles, broken only by trails and a few roads. Tree species are primarily native species; the understory is a mix of native and non-native species, with a thick cover of English ivy within the study area. Tall trees within the northern edge of the greenbelt, within the study area, are predominantly bigleaf maples.

The Longfellow Creek Natural Area and adjacent greenbelt between Southwest Yancy Street and Southwest Andover Street contains deciduous and coniferous trees, including red alder, Douglas-fir, and Sitka spruce, and it is crossed by three two-lane roads, three pedestrian bridges and a boardwalk over the creek. Its understory along the Longfellow Creek Legacy Trail within the natural area has been improved with native species during restoration programs along the creek (Green Seattle Partnership 2019). Understory in the adjacent greenbelt north of Southwest Yancy Street is dominated by non-native weeds such as Himalayan blackberry. Clumps and lines of trees in the West Seattle Golf Course are more fragmented but might be used by wildlife to travel from the Longfellow Creek greenbelt to additional greenbelts to the southwest and south of the golf course. The northern edge of the golf course, along Southwest Genesee Street, contains a line of trees, including ornamental conifers, Western red cedars, and several dozen Douglas-fir trees with trunks ranging from 6 inches to 20 inches in diameter.

These greenbelts provide shelter for mammals tolerant of proximity to urban areas, including mule deer (*Odocoileus hemionus*), coyote (*Canis latrans*), raccoon (*Procyon lotor*), squirrel species, and opossum (*Didelphis virginiana*). Salamanders and frogs have been found in the Longfellow Creek greenbelt. Trees in the natural area and the West Seattle Golf Course provide roosting and nesting habitat for raptors such as the red-tailed hawk (*Buteo jamaicensis*), barred owl (*Strix varia*), kestrel (*Falco sparverius*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*A. cooperii*), and great horned owl (*Bubo virginianus*). Red-tailed hawks and other raptors prey on voles that are found in the grassy vegetation of parks and the golf course areas. Denser trees within the golf courses could provide habitat for state candidate species such as Townsend's big-eared bat (*Corynorhinus townsendii*), pileated woodpecker (*Dryocopus pileatus*), or Vaux's swift (*Chaetura vauxi*). Prominent trees within the West Duwamish Greenbelt may provide perching opportunities for bald eagles.

The Migratory Bird Treaty Act, administered by the U.S. Fish and Wildlife Service, makes it unlawful to take, import, export, possess, sell, purchase, or barter any migratory bird, with the exception of the taking of game birds during established hunting seasons. All bird species, with the exception of three species (English sparrow [*Passer domesticus*], European starling [*Sturnus vulgaris*], and pigeon [*Columba livia*]), that occur in the study area are protected under the Migratory Bird Treaty Act. The greenbelts described above, and trees in the golf course and residential backyards and parks could support many migratory songbird species during wintering, migration, or nesting. Osprey may use trees or utility poles in the study area for nesting; an artificial platform for nesting osprey is present on a parcel adjacent to Sound Transit's existing Operations and Maintenance Facility Central, on the eastern edge of the Duwamish Segment. In addition to the raptor and woodpecker species mentioned above, bird species that might breed in the study area include American robin (*Turdus migratorius*), song sparrow (*Melospiza melodia*), Steller's jay (*Cyanocitta stelleri*), American crow (*Corvus brachyrhynchos*), spotted towhee (*Pipilo maculates*), dark-eyed junco (*Junco hyemalis*), black-capped chickadee (*Poecile atricapillus*), northern flicker (*Colaptes auratus*), Bewick's wren (*Thryomanes bewickii*), red-breasted nuthatch (*Sitta canadensis*), Anna's hummingbird (*Calypte anna*), and great blue heron (Opperman et al. 2006; Audubon Society 2018).

Ambient noise in these greenbelts includes traffic, truck noise at commercial businesses, and a variety of construction noises and operation of trains and heavy equipment along the Duwamish Waterway and associated shipping terminals. Typical background in-air noise levels in the Downtown Seattle area near the waterfront range from 71 to 83 A-weighted decibels (dBA; Parsons Brinkerhoff Quade & Douglas, Inc. 2004). Residential neighborhoods that have freeways or moderately busy arterial streets nearby, or any nighttime noise, are usually in the range of 60 to 65 dBA (Sound Transit 2021). As most of the project corridor contains traffic noise from moderately busy arterials, a background level of 60 to 65 dBA is likely along the project corridor, except for in the SODO Segment or adjacent to the Duwamish Waterway's trains and industrial facilities where background noises may be higher.

3.3.3 Federally Listed Species, Species of Concern, Priority Species, and Species of Local Importance – Upland Species

No federally listed upland plant or wildlife species or designated critical habitat under the jurisdiction of the U.S. Fish and Wildlife Service occurs in the urban environment of the study area. The federally threatened yellow-billed cuckoo (*Coccyzus americanus*) requires extensive hardwood-dominated riparian areas with at least 300 contiguous acres; its designated critical habitat does not overlap the study area. The federally threatened streaked horned lark (*Eremophila alpestris strigata*) uses habitat such as prairies, dune habitats, and sandy beaches, which are also not present in the study area; nor does its designated critical habitat overlap with

the study area. The federally threatened northern spotted owl (*Strix occidentalis caurina*) requires mature coniferous forest, which is not present in the study area, nor does the species' designated critical habitat overlap the study area. The federally threatened marbled murrelet forages in Elliott Bay but requires mature coniferous forest for its nesting habitat; as none is present in the study area, this species is discussed only in the aquatic species section of this document (U.S. Fish and Wildlife Service 2019).

Table 3-4 presents potential species of concern that might use upland habitats in the study area. Townsend's big-eared bat, pileated woodpecker, and Vaux's swift could occur in the West Duwamish Greenbelt. Peregrine falcons (*Falco peregrinus*) are known to use urban buildings and other structures for nesting habitat. A peregrine falcon nest platform was constructed under the west side of the West Seattle Bridge in the late 1990s. The nesting site has been active as recently as 2023 (Urban Raptor Conservancy 2019, 2022).

Table 3-4. Species of Federal or State Concern with Potential to Occur in Study Area – Upland Habitat

Common Name	Scientific Name	Status	Occurrence in Study Area
Townsend's Big-eared Bat	*Corynorhinus townsendii*	Federal Species of Concern; State Species of Concern	Possibly present in study area; forages over and near forests; may use bridges for day roosts.
Great blue heron	*Ardea herodias*	Washington Department of Fish and Wildlife Priority species; City of Seattle Species of Local Importance	Nesting colonies present within the West Duwamish Greenbelt, including within the study area and the construction footprint of some Duwamish Segment alternatives.
Bald Eagle	*Haliaeetus leucocephalus*	Federal Species of Concern; State Species of Concern	Nests in prominent trees in wooded areas within 0.5 mile of water; may forage in study area's waters.
Peregrine Falcon	*Falco peregrinus*	Federal Species of Concern; State Species of Concern	Yes; nesting known at West Seattle Bridge nest box and on Downtown Seattle buildings.
Pileated Woodpecker	*Dryocopus pileatus*	State Species of Concern	Possibly present in greenbelts; uses both mature/old-growth forests, and secondary forests.
Vaux's Swift	*Chaetura vauxi*	State Species of Concern	Possibly present for foraging; breeds in mountains and foothills; forages over wooded areas including in towns.
Band-tailed Pigeon	*Patagioenas fasciata*	Washington Department of Fish and Wildlife priority species	Possibly present in greenbelts.

Sources: Washington Department of Fish and Wildlife 2018, 2019a, 2023c.

The City of Seattle has mapped bald eagle management areas within West Seattle. These management areas fall outside the study area for this project. However, as the City of Seattle mapping may be outdated, surveys were performed in July 2018 and May 2019. No bald eagles were present during these surveys, nor were they observed during the spring and summer 2020 heron surveys in the vicinity, and no bald eagle nests or potential roosting trees were found within the study area.

Purple martins (*Progne subis*) have recently been removed from the Washington Department of Fish and Wildlife priority list, but are still federally protected as migratory birds. Nesting colonies in built structures occur near the study area; one location of nest boxes is present over water along the western edge of the Duwamish Waterway, 0.2 mile south of the study area (Tabor et al. 2010; Washington Department of Fish and Wildlife 2019a).

Great blue herons have established nesting colonies (rookeries) within several areas of the West Duwamish Greenbelt. Herons build platform nests high in trees and might use nests for more than one nesting season. Surveys performed for this project yielded the following results:

- In July 2018, active nesting was confirmed at known nesting sites, and also nest trees farther north than mapped by the City of Seattle (and within the study area). One active heron rookery was observed on the north end of the greenbelt. The rookery included at least nine nests interspersed in three bigleaf maple trees. Most nests were empty; however, two nestlings were observed in nests. Two great blue herons (one juvenile and one adult) were observed foraging across the Duwamish Waterway at the Harbor Island Marina.
- In May 2019, biologists identified two new nest trees in the study area, in addition to the three previously observed during the May 2019 visit, with 15 nests total observed (Jacobs Engineering 2019).
- In 2020, biologists performed nest monitoring at the colony throughout the nesting season. By May 2020, there were at least 19 active nests in the colony in seven nest trees, all within the study area. Of these nests, 18 were monitored through July (1 nest could not be observed after tree leaf-out), and 15 produced at least one fledgling heron, with an average of 1.9 fledglings per nest.
- In 2021, biologists performed nest monitoring at the colony throughout the nesting season, with follow-up visits in fall to observe nest structures. Of 20 nests followed, 16 were presumed to have fledged and four were active but were not observable once tree leaves blocked views of the nests.
- In 2022, biologists performed nest monitoring at the colony throughout the nesting season. Eleven of the 13 nests surveyed in the study area are assumed to have successfully fledged at least one chick, with an average of 1.7 chicks per nest.
- In 2023, biologists performed nest monitoring at the colony throughout the nesting season. Nests were present in four nest trees, and 15 of the 16 nests surveyed in the study area are assumed to have successfully fledged at least one chick.

The U.S. Fish and Wildlife Service protects the great blue heron under the Migratory Bird Treaty Act. Great blue heron is a Washington Department of Fish and Wildlife priority species (Washington Department of Fish and Wildlife 2019a), which is also regulated by the City of Seattle as a designated species of local importance (Seattle Municipal Code 25.09.200(C)(5)). While there is no state-level permit associated with the protection of this species, Washington Department of Fish and Wildlife recommends that great blue heron colonies receive a 60-meter (197-foot) buffer year-round in an urban environment and a seasonal buffer of 200 meters (656 feet) for activities generating sound exceeding 92 decibels by the time the sound attenuates to the outer boundary of a nesting colony (Azerrad 2012). The City of Seattle requires that projects taking place within the 197-foot year-round buffer (or in an additional 300-foot buffer in the nesting season [February 1 through August 31] apply a standard great blue heron management plan (or a Washington Department of Fish and Wildlife-approved alternate plan). The year-round buffer is measured from the outermost nests (collectively referred to as the Great Blue Heron Management Core Zone), while the seasonal buffer is measured from the outer edge of the year-round buffer (great blue heron management area). Key components of a habitat management plan normally include avoiding development in the colony itself; retaining trees that screen the colony; mitigating for development in the year-round buffer; and avoiding construction noise during the nesting season (City of Seattle 2018b).

4 ENVIRONMENTAL IMPACTS

The impact analysis assesses the potential direct, indirect, and cumulative ecosystem impacts of the alternatives. The impacts analysis is divided into long-term operation impacts and short-term, temporary construction impacts. The impact analysis describes the extent, magnitude, duration, and character of potential impacts on ecosystem resources for each alternative. Impacts will be quantified where appropriate and possible (such as the area of wetland impacts).

The project would have long-term direct and indirect impacts on ecosystem resources in the study area, as well as temporary impacts during construction. Columns for elevated guideways and at-grade guideways and features would be placed in some areas currently covered with forested or park habitat. Shading from the elevated guideway would change the amount of light and precipitation reaching street trees and vegetation. Some street trees and greenbelt trees would need to be removed. Disturbance during construction could impact local wildlife and contribute to the spread of noxious or invasive plant species. Wetlands and wetland buffers in the study area may also experience loss of habitat or changed hydrology. Shorelines would be affected by placement of elevated guideway columns and potential outfalls under all alternatives. Benthic habitat would be disturbed during construction within waters that are mapped as critical habitat for several fish species. If in-water construction is required for a bridge over the Duwamish Waterway, cofferdams could be placed within the channel during construction. These dams would surround most of the construction area and water would be removed within the dammed area. This process would temporarily exclude salmonids and other aquatic species from a portion of the waterway. In-water construction during dam installation and removal, as well as during installation of temporary work trestles and permanent pier-protection systems, could create underwater noise and turbidity that would affect these aquatic species. Effects could include the suspension of contaminated sediments because the in-water work would occur within a Superfund site.

This impact assessment is based on the information obtained from overlaying the conceptual designs for the light rail Build Alternatives (both construction footprints and operation footprints) onto ecosystem resource base maps. The acreage values resulting from this analytical approach provide an indication of the size and type of potential impacts and reflect differences among the alternatives. Although these analytical buffers represent a conservative estimate of the areas where long-term and temporary impacts may occur, some impacts could take place outside of these areas as well. For example, some trees in areas adjacent to the analytical buffer may need to be removed to protect light rail safety and reliability. Removal of such hazard trees may accompany construction of any of the light rail Build Alternatives, and hazard tree removal would continue as a maintenance activity during project operations.

4.1 No Build Alternative

The No Build Alternative would not have direct long-term impacts on ecosystem resources. Conversely, implementing the No Build Alternative would lack the beneficial indirect effects of the Build Alternatives over the long term, such as reduced motor vehicle traffic in the region, or possible improvements for past impacts or poorly functioning environmental features along the project corridor that have degraded water quality, wetlands, streams, and regulatory buffers.

4.2 Build Alternatives

4.2.1 Wetlands

4.2.1.1 Long-Term Impacts

SODO Segment

There would be no long-term impacts to wetlands in the SODO Segment because no wetlands occur within 300 feet of the alternatives in this segment.

Duwamish Segment

One wetland was identified within 300 feet of the project limits in the Duwamish Segment (Table 3-1 and Figure 3-1): Wetland WSE4 under the West Seattle Bridge within the Duwamish Segment. This wetland is relatively small at 0.05 acre and provides limited functions, including nutrient and toxicant removal due to its herbaceous vegetation cover and its position on a slope. It has limited wildlife habitat due to the adjacent paved trail and wingwall.

Table 4-1 lists potential wetland impacts in the Duwamish Segment. Preferred Alternative DUW-1a would mostly shade or completely fill Wetland WSE4 and some of its buffer if Preferred Alternative DUW-1a connects to Alternative DEL-2a, Option DEL-2b, Alternative DEL-3 or Alternative DEL-4 (connections to the other Delridge alternatives would not overlap this wetland's location but could impact the buffer). Note that this wetland and its buffer are already partially to fully shaded by the West Seattle Bridge, such that it is in a disturbed environment; any additional shading impacts may not change the amount of light and precipitation reaching the wetland. However, all options for Preferred Alternative DUW-1a will require ground stabilization (such as tie-backs) performed on the steep slope directly south and upslope of the wetland; this stabilization could affect groundwater seeps providing this wetland's hydrology may be altered by ground stabilization. Option DUW-1b would avoid the wetland but have permanent impacts to the southern buffer of the wetland. Alternative DUW-2 would avoid all impacts to this wetland and its buffer.

Delridge Segment

Nine wetlands were identified within 300 feet of the project limits in the Delridge Segment (Table 3-1 and Figure 3-1). Table 4-2 lists potential impacts to these wetlands. Most of these wetlands are relatively small (<0.01 to 0.05 acre), but Wetlands WSE2 and WSE3 are larger (0.5 and 0.4 acre, respectively) and provide multiple water quality, flood reduction, and habitat functions.

Preferred Option DEL-6b and Alternative DEL-7 would pass through the Longfellow Creek greenbelt, just south of Southwest Andover Street where three small Category III wetlands are located: Wetlands WSE11 (<0.01 acre), WSE12 (0.01 acre), and WSE13 (<0.01 acre). Guideway columns may need to be placed in a portion of Wetland WSE11 and in wetland buffer. An elevated guideway about 40 to 70 feet high would cross over all of WSE12 and some of WSE13. Due to its height, the elevated guideway is not expected to affect the productivity of restored wetlands or wetland buffer, though tree heights in restored wetland and buffer would be limited beneath the guideway.

Alternatives DEL-5 and DEL-6a would avoid all long-term impacts to wetlands and wetland buffers by remaining on or near paved portions of Southwest Andover Street.

Table 4-1. Summary of Impacts to Wetlands – Duwamish Segment

Alternative Name	Alternative Identification	Wetland: Long-term Impacts (acres) [a]	Wetland: Construction Impacts (acres) [b]	Wetland Buffer: Long-term Impacts (acres) [a, c]	Wetland Buffer: Construction Impacts (acres) [b, c]	Wetlands Affected
Preferred South Crossing Alternative	**DUW-1a**	**<0.1 [d]**	**0 to <0.1 [e]**	**<0.1 to 0.3 [e]**	**0 to 0.1 [e]**	**WSE4**
South Crossing South Edge Crossing Alignment Option	DUW-1b	0	0	<0.1	0.1	WSE4
North Crossing Alternative	DUW-2	0	0	0	0	Not applicable

[a] To estimate wetland impacts, the impact analyses for all alternatives assumed that areas under elevated guideways would be permanently impacted.

[b] Construction impacts represent areas temporarily impacted by the project, outside of the long-term project.

[c] These wetland buffers include paved areas that would be under the elevated guideway. City of Seattle critical areas code does not exclude paved areas of wetland buffer from mitigation and permitting requirements and determine these on a case-by-case basis; actual impact acreage may be much smaller when permitting is complete.

[d] Impacts are assumed to the entire wetland due to changes in hydrology upslope of the wetland.

[e] This range reflects differences from connecting to different alternatives in adjacent segments.

Table 4-2. Summary of Impacts to Wetlands – Delridge Segment

Alternative Name	Alternative Identification	Wetland: Long-term Impacts (acres) [a]	Wetland: Construction Impacts (acres) [b]	Wetland Buffer: Long-term Impacts (acres) [a, c]	Wetland Buffer: Construction Impacts (acres) [a, b, c]	Wetlands Affected
Preferred Andover Street Station Lower Height South Alignment Option	**DEL-6b**	**<0.1**	**<0.1**	**0.2**	**0.4**	**WSE11, WSE12, WSE13**
Dakota Street Station Alternative	DEL-1a	0	0	0.5	0.4	WSE2, WSE3
Dakota Street Station North Alignment Option	DEL-1b	0	0	0.8	0.4	WSE2, WSE3
Dakota Street Station Lower Height Alternative	DEL-2a	0	0	0.4	0.4	WSE1, WSE2, WSE3
Dakota Street Station Lower Height North Alignment Option	DEL-2b	0	<0.1	0.6	0.4	WSE2, WSE3
Delridge Way Station Alternative	DEL-3	0	0	0.6	0.4	WSE2, WSE3
Delridge Way Station Lower Height Alternative	DEL-4	0	0	0.4	0.3	WSE1, WSE2, WSE3
Andover Street Station Alternative	DEL-5	0	0	0	0.4	WSE11, WSE12, WSE13
Andover Street Station Lower Height Alternative	DEL-6a	0	0	0	0.4	WSE11, WSE12, WSE13
Andover Street Station Lower Height No Avalon Station Tunnel Connection Alternative	DEL-7	<0.1	<0.1	0.2	0.4	WSE11, WSE12, WSE13

[a] To estimate wetland impacts, the impact analyses for all alternatives assumed that areas under elevated guideways would be permanently impacted.

[b] These wetland buffers include paved areas that would be under the elevated guideway. The City of Seattle critical areas code does not exclude paved areas of wetland buffer from mitigation and permitting requirements and determine these on a case-by-case basis; actual impact acreage may be much smaller when permitting is complete.

[c] Construction impacts represent areas temporarily impacted by the project, outside of the long-term project footprint.

Alternative DEL-1a, Option DEL-1b, Alternative DEL-2a, Option DEL-2b, Alternative DEL-3, and Alternative DEL-4 alignments would follow Southwest Genesee Street, pass between wetlands WSE2 and WSE3, and pass north of WSE1, thus avoiding direct impacts to these wetlands. The elevated guideway would avoid directly impacting wetlands WSE2 and WSE3 because the guideway would pass over Southwest Genesee Street, between and outside of the wetlands.

All of the alternatives following Southwest Genesee Street would have impacts to wetland buffers (Table 4-2). These buffer areas include areas of mowed grass along the roadside, as well as areas where the buffer is currently paved and wetland buffer function is currently not provided. The paved areas may be excluded from total impacts when permitting is complete.

West Seattle Junction Segment

There would be no long-term impacts to wetlands in the West Seattle Junction Segment. None of the Build Alternatives in this segment would overlap with wetland WSE1.

4.2.1.2 Construction Impacts

Construction impacts would be limited to the time of construction and immediately following construction. Construction would last 2 to 4 years for an elevated or at-grade guideway. Materials and equipment in the vicinity of wetlands may need to be staged within the wetland buffers, and some ground disturbance may take place within these buffers. The construction contractor would work within construction limits marked with fencing and signage to prevent unintended impacts on wetlands and use currently paved areas for staging when possible. Temporarily disturbed sites that are currently vegetated would be replanted following construction to restore or improve on pre-construction conditions (such as replacing non-native plants with native plants). Herbaceous or shrub vegetation would likely become re-established within 2 years to 3 years. Native plants would be used in wetland buffer and in riparian management areas. Some trees within the wetland buffers may need to be disturbed during construction (Tables 4-1 and 4-2).

SODO Segment

There would be no construction impacts to wetlands in the SODO Segment because there are no wetlands in the study area for this segment.

Duwamish Segment

Along the Duwamish Segment, construction of Preferred Alternative DUW-1a would impact wetland WSE4's buffer for most connection options to the Delridge Segment. Construction of Option DUW-1b would also impact wetland WSE4's buffer. Some connections of Preferred Alternative DUW-1a (Preferred Alternative DUW-1a to Alternative DEL-2a, Option DEL-2b, Alternative DEL-3, and Alternative DEL-4) also impact the wetland itself during construction. Alternative DUW-2 would avoid all construction impacts to this wetland (Table 4-1).

Delridge Segment

Preferred Option DEL-6b and Alternative DEL-7 would have construction impacts to vegetated portions of the Longfellow Creek greenbelt. Areas of vegetation would be cleared for construction access to erect guideway columns and would remain cleared for up to 3 years. These impacts occur in wetland, wetland buffer, and stream buffer. Alternatives DEL-5 and DEL-6a would avoid these impacts as work would be restricted to paved portions of wetland buffer and riparian management area along Southwest Andover Street and on adjacent paved lots.

Along the Delridge Segment, Alternative DEL-1a, Option DEL-1b, Alternative DEL-2a, Alternative DEL-3, and Alternative DEL-4 would avoid impacts to wetlands WSE1, WSE2, and WSE3, but would have some impacts to wetland buffers during construction (Table 4-2). Option DEL-2b would have a small construction impact to the far western corner of Wetland WSE3.

Alternative DEL-2a and Alternative DEL-4 are the only alternatives that would affect wetland WSE1's buffer (the buffer here is within a mowed and forested corner of the West Seattle Golf Course) because these two alternatives would include construction of a tunnel portal on the south side of Southwest Genesee Street.

West Seattle Junction Segment

Along the West Seattle Junction Segment, construction impacts would not affect wetlands. Alternative WSJ-3a and Option WSJ-3b would include construction staging on a small portion of wetland WSE1's buffer (0.002 acre). This impact would occur on existing paved surfaces that do not provide buffer functions or would occur in unpaved areas separated from the wetland by a paved road.

4.2.1.3 Indirect Impacts

Indirect impacts to wetlands in the study area would be limited because all stations and guideways would be in areas that are already densely developed. Elevated guideways would add impervious surfaces and columns that may have the potential to change hydrology at Longfellow Creek. These features may also potentially affect hydrology at wetlands associated with Longfellow Creek or the wetland at the north end of the West Duwamish Greenbelt. The guideways have the potential to intercept and reroute water flow. These effects are expected to be limited at Longfellow Creek because these wetlands receive most of their water from the creek itself, from upstream sources, and at the West Duwamish Greenbelt wetland which receives most water from groundwater seepage. Therefore, intercepted rainwater would not alter the majority of the water sources of these wetlands. The wetland in the West Duwamish Greenbelt could be affected by groundwater changes, as a subsurface drainage system may be required to manage seepage and provide slope stability around guideway columns for Preferred Alternative DUW-1a and Option DUW-1b. Improved stormwater detention could minimize these effects to the West Duwamish Greenbelt wetland.

The project would not interfere with future projects that may provide habitat improvements. Such future projects could include continued restoration efforts along Longfellow Creek or its associated wetlands, or at the City of Seattle's Bluefield Holdings/Wildlands Site 1 on the west side of the West Duwamish Waterway. The specific areas under guideway columns in wetland or wetland buffer area in Longfellow Creek (under Preferred Option DEL-6b or Alternative DEL-7) would not be available for restoration, but the directly adjacent areas would be restored under these alternatives.

Construction could contribute to the spread of invasive plant species within and outside of the study area by transporting them to or from the construction site when moving soil, or by creating bare soil areas that weeds might colonize quickly. However, these are already common in the study area and revegetation with native plants may improve existing conditions in greenbelts and buffers.

4.2.2 Aquatic Habitat and Species

4.2.2.1 Long-Term Impacts

SODO and West Seattle Junction Segments

There are no waterbodies in the SODO or West Seattle Junction segments' study areas. Stormwater in these segments drains to Elliott Bay.

Duwamish Segment

The Duwamish Segment would cross the Duwamish Waterway on a high-level fixed bridge. Depending on the bridge type used, the bridge's minimum clearance over the East Waterway would be 100 to 125 feet, and its minimum clearance over the West Waterway would be 140 feet.

Sound Transit is evaluating bridge types to cross the waterway. Preferred Alternative DUW-1a would be a cable-stay or truss bridge that avoids in-water guideway columns in the Duwamish Waterway. It would be a new structure over the waterway, but would not have any other long-term effects on the waterway. It would have guideway columns built in the shoreline buffer along the waterway.

Some bridge types for Alternative DUW-2 could also avoid in-water guideway columns. However, Option DUW-1b and some bridge types for Alternative DUW-2 would require one or more in-water guideway columns. Bridge types being analyzed include truss, cable-stay, balanced cantilever segmental box girder bridge, and an extradosed bridge. Bridge designs that require in-water guideway columns may include pile caps buried under the mud or placed closer the waterline. Pile caps under the mudline would leave more benthic surface and in-water volume for habitat after construction; pile caps near the waterline would create more structures that shade water or alter fish movements.

In-water and Benthic Habitat

For bridge design that would require guideway columns to be placed in water with Option DUW-1b or Alternative DUW-2, pier-protection systems would also be added to protect the guideway columns from potential vessel strikes. These in-water features would impact up to about 0.5 acre of benthic habitat that is currently available to invertebrates and fish (Table 4-3), and would remove areas of water column currently available to fish and marine mammals. This loss of in-water and benthic habitat could reduce the amount of productivity in these locations.

Benthic and in-water habitat along the Duwamish Waterway's shallower areas provides nutrient cycling services, primary productivity, and niches for macroinvertebrates and forage fish, which are prey for salmonids. Aquatic vegetation is present in some areas of the benthic habitat and in-water habitat that will be eliminated or fully shaded by project structures. Aquatic vegetation is generally sparse in this portion of the waterway. Aquatic plants provide further value as a primary producer in the aquatic food web (e.g., providing detritus for invertebrates, substrate for algae and bacteria, and direct food for some forage fish, invertebrates, and waterfowl). However, the small potential loss in productivity from the project's potential in-water impacts is not expected to have a large influence on the health of adult salmonids, as they are expected to pass quickly through the area. The area is also not known to be an important foraging or spawning area for forage fish that adult salmonids feed on. This is because suitable substrates are lacking, and eelgrass is not present (Windward 2010).

Table 4-3. Summary of Impacts to Aquatic Resources: In-water Impacts, Duwamish Segment

Alternative Name	Alternative Identification	Number of Permanent In-water Guideway Columns	Approximate Area of Construction Impacts in Waterbody (acres) [a]	Over-water Structures (acre) [b]	Permanent Benthic Surface Impacts (acre)
Preferred South Crossing Alternative	**DUW-1a**	**0**	**0 to <0.1 [c]**	**0**	**0**
South Crossing South Edge Crossing Alignment Option	DUW-1b	1 to 5	0.2 to 1.0 [d]	0.7 to 0.9	<0.1 to 0.4 [d]
North Crossing Alternative	DUW-2	0 to 3	0 to 0.9	0.7 to 0.9	0 to 0.5

Note: The ranges of impacts shown represent impacts from different bridge types; the number and exact location of permanent bridge guideway columns and temporary cofferdams, piles and work trestles could vary by bridge type, and some bridge types for Alternative DUW-2 could avoid in-water work. Preferred Alternative DUW-1a would be constructed with either a truss or cable-stayed bridge that would avoid permanent in-water guideway columns.

[a] These construction in-water impacts represent the total area of the cofferdam footprints, piles, and work trestle column support footprints that would be placed on the benthic surface, minus the area of guideway columns and pile caps that would remain permanently in the waters. All in-water work would occur in salmonid critical habitat and essential fish habitat.

[b] This area represents the total area of elevated bridge features over the Duwamish Waterway; this does not include bridge guideway columns or pile caps in the water, which are included in the permanent benthic impacts.

[c] Impact is associated with up to 2,000 square feet of shoreline below mean high water disturbed during riprap removal and replacement.

[d] Less than 0.1 acre of impact is associated with storm drain outfall relocations during construction and for permanent impacts.

New in-water structures also have the potential to change the movements of salmon passing through an area (Simenstad et al. 1999). Fish sheltering or rearing in the study area are already passing through an environment with many manmade pilings and other features and these impacts would further reduce available habitat. Swimming around additional structures could lengthen their migration distance. Delayed migration can lead to increased energy expenditure, stress, susceptibility to disease and predation, and altered spawning timing, and could affect survival rates during migration (Anderson et al. 2005). If the fish are routed into deeper water, the risk of being predated upon may also increase (Williams et al. 2003; NOAA Fisheries 2020). As noted in Simenstad et al. (1999), a change in migratory route into deeper waters, without refugia, creates an increased risk of predation for salmon. Typical predators of young salmon in brackish or marine water, such as flatfish, sculpin, larger salmonids, or harbor seals generally avoid the shallowest nearshore areas and are more likely to be present in deeper waters, such as those present in the navigation channel within the West Waterway. Studies around six north-central Puget Sound ferry terminals observed salmon predators preferring deeper waters (Williams et al. 2003). However, for Option DUW-1b or bridge types of Alternative DUW-2 with in-water features, a fish following the shoreline would encounter at most one guideway column, and these are not expected to create a noticeable delay for fish passing through the area. Also, pier protections would be parallel to the shoreline, such that salmon and other fish will have the option of moving on the nearshore side of the structure during migration.

Option DUW-1b would require relocation of an 8-inch Port of Seattle stormwater outfall that discharges to the West Duwamish Waterway and two 18-inch Port of Seattle stormwater outfalls, one that discharges to the West Duwamish Waterway and one that discharges to the East Duwamish Waterway. Preferred Alternative DUW-1a and Alternative DUW-2 would not require relocation of any outfalls. All new outfall relocations are related to conflicts with bridge column foundation locations.

Over-water Shading

Shading over water can change fish behavior and the levels of productivity of marine plants and other marine organisms. This is not expected to occur from such a high bridge crossing, as the bottom of the bridge would have a clearance of approximately 100 to 140 feet above the water. The physical design of over-water structures, in particular their height, influences whether their shadow would create enough shade in the water to constitute an impediment to fish movements or cause decreases in productivity of aquatic vegetation (WSDOT 2006). Higher bridges would allow more light and would have more diffuse changes from light to shade. In shade analyses performed for the State Route 520 bridge construction, WSDOT identified a clearance of at least 24 feet over aquatic bed wetlands or shoreline areas as sufficient for most vegetation cover to remain unaffected. Under higher bridges, reflective and diffuse light would be sufficient to support plant growth, though changes in species composition is possible (WSDOT 2009). Sharp contrasts between light and shade appear to influence fish responses more than gradual changes in lighting (NOAA Fisheries 2011). NOAA Fisheries determined that the Montlake Bridge, with 46 feet of clearance over the Lake Washington Ship Canal, would not produce sharp shade contrasts that would affect salmon behavior or cause delays in their migration (NOAA Fisheries 2011). The Duwamish Waterway bridge would have much more clearance than the State Route 520 or Montlake Bridges, such that its diffuse shade is not expected to have negative impacts to productivity or to aquatic fish species.

In-water pile caps at the waterline (present with some bridge design scenarios for Option DUW-1b and Alternative DUW-2) would prevent daylight from reaching the waters and benthic surface below the pile caps; this could reduce productivity and also increase areas for fish to shelter that may prey upon young migrating salmonids.

Over-water Lighting

The new bridge would include navigation lights at the guideway columns to aid their visibility to watercraft in the Duwamish Waterway and with Federal Aviation Administration/ WSDOT-regulation lights for airplanes at the top of all towers above the deck. The Duwamish Segment's bridge lighting is not expected to result in any noticeable long-term increases in nighttime illumination of fish-bearing waters because industrial lighting is already present around the Duwamish Waterway and on top of the existing West Seattle Bridge. However, these additional lights have the potential to alter the nighttime swimming behavior of young salmon near the bridge, possibly making them more exposed to predation from other fish (Tabor et al. 2011).

Shoreline Modifications

Some of the shoreline habitat around the guideway columns is currently built out with impervious surfaces such as parking lots. Other portions of shoreline that would be changed to guideway columns currently contain steep beaches below bulkheads, with some planted vegetation (including small trees) above the bulkheads. Guideway columns would eliminate a few trees, rock, or wood bulkheads or area of exposed beach. Preferred Alternative DUW-1a would have slightly less overall linear shoreline converted to guideway columns than Option DUW-1b or Alternative DUW-2. Table 4-4 presents specific shoreline impacts by Build Alternative.

Table 4-4. Summary of Impacts to Aquatic Resources: Shoreline, Duwamish Segment

Alternative Name	Alternative Identification	Shoreline: Long-term Impacts (linear feet) [a]	Shoreline: Construction Impacts (linear feet) [b, c]	Shoreline Buffer: Long-term Impacts (acres) [a, c]	Shoreline Buffer: Construction Impacts (acres) [b, c]
Preferred South Crossing Alternative	**DUW-1a**	**400**	**100**	**2**	**5**
South Crossing South Edge Crossing Alignment Option	DUW-1b	500	1,000	2	3
North Crossing Alternative	DUW-2	500	800	2	8

[a] To estimate permanent shoreline impacts, the impact analyses for all alternatives assumed a complete loss of habitat within the permanent footprint. Actual impacts may be less where the guideway is elevated or where shoreline is already developed.

[b] These construction impacts represent areas that would be temporarily impacted by the project, outside of the long-term project footprint.

[c] Shoreline buffer includes both paved and unpaved surfaces; paved areas may be excluded from impact metrics when permitting is complete.

Alternative DUW-2 could impact about 600 square feet of the Port of Seattle's planned Terminal 25 South wildlife habitat restoration project. Sound Transit would coordinate with the Port to identify to identify potential modifications to the restoration site design if this alternative is selected as the project to be built. The guideway would be at least 90 feet above the Terminal 25 South project site, and no impacts on vegetation from shading are expected.

In the Duwamish Segment, some vegetated areas in the West Duwamish Greenbelt would be paved under Preferred Alternative DUW-1a and Option DUW-1b; this could increase stormwater flows to storm drains that drain to the Duwamish Waterway. These effects would be limited because stormwater from all project-related impervious surfaces would receive appropriate flow control and water quality treatment, and the West Duwamish Greenbelt construction area would include new subsurface drains to manage water flow and groundwater. These alternatives would be designed to meet standards of the City of Seattle and Ecology's 2019 *Stormwater Management Manual for Western Washington* (Ecology 2019, 2022).

Delridge Segment

The Delridge Segment crosses over Longfellow Creek. Preferred Option DEL-6b and Alternative DEL-7 would cross an open-channel portion creek in greenbelt area just south of Southwest Andover Street. Guideway columns would need to be placed on small wetlands and in wetland buffer and the riparian management area, and would require tree removals within the greenbelt. Elevated guideway would cross over Longfellow Creek about 80 feet above the creek, and about 40 to 70 feet above vegetated portions of the riparian management area. Due to its height, the elevated guideway is not expected to affect the productivity of the creek or buffer vegetation under the guideway, though tree heights would be limited beneath the guideway.

Alternatives DEL-5 and DEL-6a would follow Southwest Andover Street would avoid these permanent impacts to the creek and its buffer because the creek is culverted from about 70 feet south of the roadway until its confluence with the Duwamish Waterway; riparian habitat would only be regulated perpendicular to open-channel sections south of Southwest Andover Street.

Alternative DEL-5 would result in a small area of the limited development zone of the creek being shaded by guideway; this area is currently paved.

The remaining alternatives (Alternative DEL-1a, Option DEL-1b, Alternative DEL-2a, Option DEL-2b, Alternative DEL-3, and Alternative DEL-4) would parallel the north end of the West Seattle Golf Course along Southwest Genesee Street. They have similar, limited impacts to the stream buffer adjacent to Southwest Genesee Street. These alternatives cross over a culverted portion of Longfellow Creek on an elevated guideway and avoid direct impacts to the creek; guideway columns would be placed on existing impervious surface or vegetated street rights-of-way outside of stream boundaries. These alternatives would have no direct impacts on the riparian management area with the exception of a small impact from Option DEL-1b. The impact would occur where elevated guideway would shade areas that are currently managed vegetation or pavement; the impacted area is also regulated as wetland buffer. The City of Seattle regulates riparian area that is perpendicular to open-channel portions of stream; the management area does not include areas perpendicular from where the creek is piped under Southwest Genesee Street.

Runoff from project features would discharge to combined sewer overflow basins or downstream of the open creek channel. As the project would not change shading over the creek or drain to the creek, it would not impact water quality factors in the creek such as temperature, dissolved oxygen, or contaminants.

Any of the elevated crossings over Longfellow Creek would not preclude future projects to improve salmonid habitat, such as daylighting portions of the creek currently flowing through culverts, planting additional riparian habitat upstream or downstream of the road prism, or removing fish barriers. Under Preferred Option-6b or Alternative DEL-7, the specific locations of guideway columns in the stream buffer would not be available for future habitat improvements, but buffer around them would still be available for such efforts.

4.2.2.2 Construction Impacts

SODO and West Seattle Junction Segments

There are no waterbodies in the SODO or West Seattle Junction segments' study areas.

Duwamish Segment

Preferred Alternative DUW-1a's cable-stay or truss bridge would not have in-water bridge guideway columns. However, under Preferred Alternative DUW-1a, a small area of shoreline (less than 0.1 acre) at or slightly below the mean high water level may be temporarily affected by the removal and replacement of riprap and placement of cofferdams to facilitate construction of guideway columns. This work is expected to occur above the level of the waterway during the time of construction, but would still be considered as and permitted as in-water work because material below the mean high water level may be removed to install a silt fence adjacent to a cofferdam wall. Best management practices would be used to prevent sediments from entering the waterway. In-water work windows and barriers would be used to prevent fish from entering the work area should very high tides occur during riprap removal and replacement.

For all alternatives, barges for material supply and supporting cranes may be periodically used. Barge movement within the navigation channel may be required to lift portions of the bridge; truss or extradosed bridge types would require barge operations for 2 or more days within the navigation channel. Barges in the channel would add to the ship traffic already traveling regularly through the channel. For Option DUW-1b and Alternative DUW-2, these barges may also need to be moored outside the navigation channels; this would create temporary shade

over the benthic habitat, which could cause fish to alter their movement patterns through the channel. This shading could create predation concerns for young salmon altering their migratory path along the shoreline in response to barge shading (see Section 4.2.2.1, Long-Term Impacts, for aquatic habitat and species). Anchoring and moving barges would also temporarily disturb sediments and benthic habitat.

Option DUW-1b and, depending on bridge type, Alternative DUW-2 would require the construction of bridge guideway column foundations in or partially in the Duwamish Waterway. The guideway column foundations would include drilled shafts and cast-in-place concrete pile caps, which are either at the waterline or below the mudline, depending on the bridge design. If in-water foundations are needed, most bridge designs would require a temporary cofferdam system so that the benthic area where the guideway columns would be built could be dewatered. Temporary piles and sheets for cofferdam walls would be driven or vibrated into place, and the bridge guideway columns would be installed within dewatered cofferdams. Temporary work trestles would need to be installed as well, outside of cofferdams, which would require additional temporary pilings driven into the sediment for support. Pier-protection systems, which could be in the form of fender walls, would be vibrated into place outside the cofferdams.

The cofferdams and work trestles would cover up to 1.4 acres of the waterway depending on the alternative and bridge type chosen (refer to the approximate area of construction impacts in Table 4-3). During the years that the cofferdam is in place, the dewatered areas would exclude habitat from use by aquatic species, including listed fish species and benthic invertebrates. Construction of Option DUW-1b or bridge types of Alternative DUW-2 that have in-water guideway columns would require much more barge activity than bridge types that do not require in-water columns.

In-water and Benthic Habitat

The areas of in-water and benthic habitat that would be excluded by cofferdams under Option DUW-1b and some bridge types of Alternative DUW-2 are not currently highly productive habitats (they primarily have a silt/rock benthic surface with limited vegetation on the bottom or within the water column). Forage fish are not expected to spawn in or near these areas because suitable substrates are lacking, and eelgrass is not present. Vegetation and macroinvertebrate productivity in these areas is expected to recover following removal of temporary structures, and the benthic surface will be regraded to match pre-construction conditions (this grading will be performed before the cofferdam is removed). However, there may be a delay in recovery given the amount of time the cofferdams and work trestles may be present.

Presence of cofferdams and shade from work barges would route migrating salmonids around these structures. If cofferdams are built directly adjacent to the shoreline, fish would be routed into deeper water. As noted in Section 4.2.2.1, this has potential to expose juvenile salmonids in particular to predation (Simenstad et al. 1999; Willette 2001; Williams et al. 2003). In summary, the construction features will likely cause changes in juvenile Chinook salmon's intended path of travel, and increase their time in deeper water. In a biological opinion evaluating the effects of numerous shoreline improvement projects in Puget Sound, NOAA Fisheries predicted that the increase in migratory path length from swimming around over-water structures, as well as the increased exposure to piscivorous predators if juvenile salmon are routed towards deeper water likely will result in proportionally increased juvenile Puget Sound Chinook salmon mortality. NOAA Fisheries noted that the same structures were not likely to negatively affect steelhead behavior as steelhead are not as nearshore dependent (Willette 2001). These features are expected to have little effect on bull trout, yelloweye rockfish, or bocaccio, as these species are rare in the Duwamish Waterway. Bull trout or adult rockfish, if present, are likely to use the deeper waters rather than the nearshore. Juvenile yelloweye rockfish or bocaccio are not likely to occur in the construction areas because these areas lack the eelgrass habitats these species prefer.

For in-water work required for Option DUW-1b and some bridge types of Alternative DUW-2, cofferdam placement and removal, pile placement without coffer dams, and installation and removal of support piles for work trestles, would introduce temporary turbidity and sediments into the Duwamish Waterway and temporarily remove in-water and benthic habitat for migrating salmonids. Outfall relocations would also disturb sediments, but to a lesser degree than bridge guideway columns because the area disturbed would be smaller and the construction duration would be less. Impact pile-driving or vibratory driving could create noise at decibels with the potential to injure fish or marine mammal species or change their movements through the area. Vibratory and impact pile-driving could produce sounds that travel unimpeded down the East Waterway and are thus audible to sensitive species within Elliott Bay. Construction barges and cranes would cause above-water disturbance and noise as well.

Over-water Lighting

During construction, temporary lighting close to the water will be used on the temporary cofferdams, work trestles, and associated barges. Preferred Alternative DUW-1a would not require on-water features but would still require lighting during construction close to the water's edge. Artificial nighttime lighting may alter juvenile fish behavior in a way that makes them more susceptible to predators and increases the length of time predators actively feed (WRIA 8 Salmon Recovery Council 2017). The sharpness of artificially lit and unlit areas may factor into fish response to the light (Simenstad et al. 1999). Changes in underwater light regimes at night can alter fish movements and can affect predator/prey interactions in complex ways: fish may avoid the areas to avoid potential predation, or seek those areas to feed on prey (Celadonia et al. 2009; Tabor and Piaskowski 2002). In their biological opinion on the State Route 520 bridge's construction in Lake Washington, NOAA Fisheries determined that lighting associated with construction of the bridge would not affect adult Chinook salmon or steelhead, because the adults are too large to be preyed upon by piscivorous fish, but may influence juvenile Chinook behavior, both exposing them to predators and by allowing them to detect more prey (NOAA Fisheries 2011; WSDOT 2009). During construction of the bridge, best management practices will be employed to minimize lighting required over water during construction (e.g., light shielding will be employed where practical), but some changes in the behavior of fish are expected as a result of this lighting.

Water Quality

Suspended sediments from construction in the Duwamish Waterway might contain contaminants because this excavation (up to 55,000 cubic yards) would be occurring in the Harbor Island Superfund Site. Many contaminants could be resuspended during cofferdam installation, barge movements, some pile-driving, and rewatering of cofferdams, including polychlorinated biphenyls, arsenic, polycyclic aromatic hydrocarbons, and mercury. Exposure to such contaminants could be harmful to the fish and benthic invertebrates that encounter them, as well as to predators such as marine birds and marine mammals that prey on those species. Currents flowing through the area would sweep most suspended sediments downstream and minimize these effects in the immediate vicinity of the construction as well as turbidity. The risk would be greater under Option DUW-1b and some bridge types of Alternative DUW-2 that require in-water construction. Preferred Alternative DUW-1a would avoid most risk but would still require construction adjacent to the water.

Sound Transit would follow extensive best management practices to minimize turbidity and prevent accidental fuel leaks or spills. In-water work in the Duwamish Waterway would be scheduled around the work windows established by the U.S. Army Corps of Engineers and Washington Department of Fish and Wildlife, and approved by NOAA Fisheries and U.S. Fish and Wildlife Service. Use of these windows would minimize the effects on salmonids and other

fish species, especially during the construction and operation of cofferdams. In-water work in the Duwamish Waterway would also include complying with the Marine Mammal Protection Act; this may entail monitoring during loud construction activities to avoid harassment or injury to marine mammals.

The construction contractor would be required to develop, implement, and monitor a temporary erosion and sediment control plan to address potential erosion for the duration of construction. Best management practices would be employed for fish and aquatic habitat protection. All work below the ordinary high water mark, such as during cofferdam construction, would comply with the terms and conditions set forth in the Hydraulic Project Approval issued by Washington Department of Fish and Wildlife for the project. Most excavation of sediments would occur within a dewatered cofferdam to protect the surrounding waters from contaminated sediments in the riverbed. Contaminated soils would be removed from the site and disposed of in regulated upland disposal sites. Barges would use measures such as containment barriers to prevent any contaminants on board from reaching the waters.

There is some risk that contaminated sediments could be mobilized when installing or removing cofferdam walls, or when installing or removing the pier supports for cofferdams or work trestles if these activities occur outside the cofferdam boundaries. All work within the Harbor Island Superfund Site would follow the up-to-date processes for remediation and in-water work established in agreement with Ecology and U.S. Environmental Protection Agency. This coordination would avoid conflicts with existing and future cleanup actions at the Superfund site.

For water quality protection, the project would obtain and adhere to a construction stormwater general permit under the National Pollutant Discharge Elimination System permit program to reduce or eliminate stormwater pollution and other impacts on surface waters, and a Section 401 Water Quality Certification indicating that the project would comply with state or federally approved water quality standards and other aquatic resources protection requirements. A construction stormwater pollution prevention plan, approved by Ecology, would also be implemented before the start of construction. The plan would include best management practices to (1) prevent erosion, (2) prevent sedimentation, and (3) identify, reduce, eliminate, or prevent stormwater contamination and water pollution from construction activity.

Shoreline Modification

Columns constructed along the Duwamish Waterway for Preferred Alternative DUW-1a would not require modifications to habitat enhancements at the City of Seattle's Bluefield Holdings/Wildlands Site 2 along the Duwamish Waterway, assuming a cable-stayed or steel truss bridge type. If guideway columns are placed along the Harbor Island shoreline, they would prevent future restoration at those specific locations, though area directly adjacent to the towers would retain opportunities for habitat enhancement. Alternative DUW-2 could temporarily impact about 0.4 acre of the Terminal 25 habitat restoration project during construction if the restoration project is constructed prior to the project.

Delridge Segment

Estimated construction impacts on the Longfellow Creek riparian management area for the project are summarized in Table 4-5. Some trees or vegetation would need to be cleared during construction or for construction staging. Preferred Option DEL-6b and Alternative DEL-7 would require more clearing within currently vegetated portions of the riparian management area than the other alternatives. Cranes would be used over the creek, but no construction equipment or materials would be staged or placed in the creek below the ordinary high water mark. Longfellow Creek would remain in an open channel during construction of these alternatives.

Alternatives DEL-5 and DEL-6) would mostly avoid the management area during construction (staging may occur within the limited development zone but would primarily occur on currently paved surfaces).

Most of the Southwest Genesee Street alternatives (Alternative DEL-1a, Option DEL-1b, Alternative DEL-2a, Option DEL-2b, Alternative DEL-3, and Alternative DEL-4) all have similar impacts to the management area during construction; most of this impact occurs as vegetation clearing or placement of a work trestle over roadsides that currently provide limited buffer functions to Longfellow Creek. Option DEL-1b's construction disturbance would occur in the same location as its long-term impacts of shading from the overhead guideway.

Under the Delridge Segment alternatives, the potential for impacts on riparian habitat would be minimized by ensuring that work conditions and activities comply with the required project permits, and by implementing best management practices designed to avoid or minimize the delivery of construction-related sediment and pollutant-laden water to streams. Staging areas would be placed outside the Longfellow Creek buffer. The use of artificial lighting for nighttime construction could affect fish using Longfellow Creek, possibly altering their migratory behavior or predation rates of juveniles; lights would be directed away from waters when possible.

4.2.2.3 Indirect Impacts

The project would not interfere with future projects that may provide habitat improvements at Longfellow Creek, such as the Longfellow Creek culvert replacement. Under some bridge designs, guideway columns would be placed partially onshore along the Duwamish Waterway. These guideway columns could remove small patches of intertidal silt, rock or gravel shoreline from an area with already degraded baseline conditions. The guideway columns would not directly conflict with current projects to restore intertidal habitat under Chinook or steelhead salmon recovery plans, nor would they interfere with any future habitat improvements at Bluefield Holdings/Wildlands Site 1. However, if guideway columns are placed along the Harbor Island shoreline they would prevent these patches from being considered for future restoration efforts, although areas directly adjacent to the guideway columns would retain opportunities for habitat enhancement. Mitigation for benthic impacts from the project could include mitigation elsewhere along the Duwamish Waterway, such as improving or restoring intertidal habitat patches or removing over-water structures; this could lead to improvements of water quality or habitat quality overall along the waterway, outside of the study area.

The introduction of light rail transit to the area would result in a slowdown of growth in the region's motor vehicle traffic and could create a slight reduction in current traffic as people switch from single-occupancy vehicles to transit. This effect in turn would slightly decrease (in the short term) or slow the increase (in the long term) of the expected automotive emissions and pollutant-laden stormwater runoff associated with increased traffic and stormwater pollution under the No Build Alternative.

Under Option DUW-1b and some bridge types of Alternative DUW-2, bridge guideway columns could cover benthic habitat in the waterway that currently provides substrate for invertebrates and aquatic vegetation. Some productivity could be lost, which could in turn affect the availability of prey species for salmonids and marine mammals using the waterway; a change in distribution of the prey species could change the movement patterns of these predators.

Table 4-5. Summary of Impacts to Aquatic Resources, Delridge Segment

Alternative Name	Alternative Identification	Longfellow Creek: Long-term Impact (acres)	Longfellow Creek Riparian Management Area within 75 Feet [a]: Long-term Impact (acres) [b]	Longfellow Creek Riparian Management Area within 75 Feet [a]: Construction Impact (acres) [c]	Longfellow Creek Limited Riparian Development Area [a]: Long-term Impact (acres) [b]	Longfellow Creek Limited Riparian Development Area [a]: Construction Impact (acres) [b]
Preferred Andover Street Station Lower Height South Alignment Option	**DEL-6b**	**<0.1**	**0.2**	**0.2 [c]**	**<0.1**	**0.1 [c, e]**
Dakota Street Station Alternative	DEL-1a	0	<0.1	0.1 [c, d]	<0.1	0.1 [c, d]
Dakota Street Station North Alignment Option	DEL-1b	0	0.1 [c, d]	<0.1	0.1 [c, d]	0.1
Preferred Dakota Street Station Lower Height Alternative	DEL-2a	0	0	<0.1	<0.1	<0.1 [c, d]
Dakota Street Station Lower Height North Alignment Option	DEL-2b	0	<0.1	<0.1	0.1	<0.1 [c, d]
Delridge Way Station Alternative	DEL-3	0	<0.1	<0.1	<0.1	<0.1 [c, d]
Delridge Way Station Lower Height Alternative	DEL-4	0	<0.1	<0.1	<0.1	<0.1 [c, d]
Andover Street Station Alternative	DEL-5	0	0	<0.1 [c]	<0.1	0.1 [c]
Andover Street Station Lower Height Alternative	DEL-6a	0	0	<0.1 [c]	<0.1	0.1 [c, e]
Andover Street Station Lower Height No Avalon Station Tunnel Connection Alternative	DEL-7	<0.1	0.2	0.2 [c]	<0.1	0.1 [c, e]

Note: To estimate stream impacts, the impact analyses for all alternatives includes all stream or buffer areas under the guideways, regardless of whether the guideways are elevated or at-grade/retained-cut. All of the long-term impacts shown in this table would be areas shaded by guideway.

[a] The riparian management area is 0 to 100 feet from the stream. The City of Seattle allows some development activities in a subset of the management area (the limited riparian development area) 75 to 100 feet from the stream (Seattle Municipal Code 25.09).

[b] Riparian management area was calculated for areas perpendicular from open-channel sections of Longfellow Creek; piped stream is excluded from City of Seattle riparian management regulations.

[c] These metrics may include paved areas within 75 feet of the stream; these may be removed from impact metrics following coordination with the City of Seattle.

[d] These impact areas are overlapped by the 110-foot wetland buffers around wetlands WSE2 and WSE3.

[e] These impact areas are overlapped by the 110-foot wetland buffers around wetlands WSE11, WSE12, and WSE13.

4.2.3 Upland Habitat and Species

4.2.3.1 Long-Term Impacts

Based on the urban environment in most portions of the study area, operation of any of the project light rail alternatives would not result in long-term impacts on the viability of local wildlife populations. Currently, the predominant types of land cover in the project footprint are high- or moderate-density buildings and industrial areas. The land cover's vegetation is highly modified from pre-development conditions and dominated in many areas by impervious surface or invasive species. In addition, most habitat in these areas occurs along roads and other areas with low value for wildlife. Because the Build Alternatives would be built alongside existing road corridors and fenced rail corridors (existing barriers to wildlife movements), they would not affect areas that serve as connective corridors to other areas of habitat outside of the study area.

Although the potential for adverse impacts would be low, operation of any of the project alternatives would result in some impacts on vegetation and wildlife over the long term. In some areas, the guideway would be within existing forested habitat. Vegetation and wildlife habitat 15 feet beyond the guideway footprint would be permanently converted from forested vegetation to light rail project elements or herbaceous and shrub vegetation. Herbaceous and shrub vegetation cover may be allowed to grow under the guideway in some areas such as environmentally critical areas or parks, but for the purposes of this analysis it is assumed this vegetation will not be present. During operation, Sound Transit would continue to remove hazard trees (trees that might cause a hazard to light rail operations) near the operational footprint as needed. This removal of vegetation or structures that support bird nests during the breeding season could impact nests, eggs, or birds protected under the Migratory Bird Treaty Act. At-grade and retained-cut guideways would reduce the amount of habitat for voles and other species that are prey for raptors. Removing any street trees, heritage trees, or trees in critical areas during maintenance activities would require coordination, associated approvals, and permitting with the City of Seattle.

Based on the existing high levels of noise and vehicle traffic throughout the study area, as well as human activity associated with industrial, residential, and commercial development, wildlife that use habitats adjacent to the light rail Build Alternatives are likely accustomed to noise and human activity. The potential is therefore low for any of the alternatives to affect the viability of local wildlife populations due to increased human access, noise, and light. Some individual animals may move farther into greenbelt habitat to avoid the immediate area of the light rail, but these minor localized movements to avoid these disturbances would not affect the viability of these species. Sound Transit will be using mitigation measures such as special trackwork or sound barriers such as sound walls on elevated tracks to reduce the operational noise of passing trains. Noise analyses prepared for the project determined that during operation of the light rail for all alternatives and design options, cumulative noise levels (light rail noise plus existing ambient noise) would be no more than 2.5 dB above the existing ambient noise levels. This small change is not likely to be perceptible to most wildlife already conditioned to an urban environment with fluctuating noise levels, and is not likely prevent wildlife from using greenbelts and other habitat for foraging, breeding or transiting.

SODO Segment

The SODO Segment is within a heavily developed area that is primarily an industrial district. No terrestrial habitat for wildlife is present within this segment. Long-term effects would be limited to removal of street trees. The project would remove about 0.2 to 0.4 acre of existing tree canopy within the SODO Segment (see Table 4-6). Some trees may be replaced in situ, while others may be mitigated elsewhere as agreed to with the City of Seattle.

Table 4-6. Summary of Tree Canopy Impacts, SODO Segment

Alternative Name	Alternative Identification	Acres of Tree Impacts (Street Trees) [a]
Preferred At-Grade Lander Access Station Option	**SODO-1c**	0.4
At-Grade Alternative	SODO-1a	0.4
At-Grade South Station Option	SODO-1b	0.3
Mixed Profile Alternative	SODO-2	0.2

Source: City of Seattle data, derived from 2021 U.S. Geological Survey lidar project (City of Seattle 2021).

[a] Assumes permanent removal of trees within both the operation (long-term) and construction (temporary) footprints. Some trees may be replaced in situ; others may be mitigated elsewhere as agreed to with the City of Seattle.

Duwamish Segment

All the Duwamish Segment alternatives would pass through industrial areas on elevated guideways and cross the Duwamish Waterway on a bridge before passing over or near the West Duwamish Greenbelt. Preferred Alternative DUW-1a and Option DUW-1b would cross the north end of the West Duwamish Greenbelt on a mix of elevated and retained-cut guideway and would require the removal of trees (Table 4-7) and understory vegetation (primarily non-native Himalayan blackberry and English ivy), and installation of slope stabilization such as retaining walls. Tree removal would reduce the amount of trees available for migratory birds and small mammals in the area. Under Preferred Alternative DUW-1a, the amount of vegetation removed would vary, depending on which Delridge Segment alternative it connects to; the greatest impacts would occur when connecting to Alternative DEL-3. Low-growing vegetation may be replanted after construction to stabilize the slope on the north end of the West Duwamish Greenbelt, but large trees would not be allowed close to the guideway for safety reasons. At the northern edge of Pigeon Point, the retained-cut track section would be built parallel to existing roads. As these roads already create barriers to wildlife, this is not expected to affect wildlife populations traveling within the greenbelt. Long-term impacts to the heron colony or peregrine falcon nesting area under Preferred Alternative DUW-1a and Option DUW-1b are discussed in Section 4.2.4.1, Long-Term Impacts, for federally listed species, species of concern, priority species, and species of local importance.

Table 4-7. Summary of Impacts to Priority Habitats, Critical Habitat, and Tree Canopy, Duwamish Segment

Alternative Name	Alternative Identification	Biodiversity Area Long-term Impacts (acres)	Biodiversity Area Construction Impacts (acres) [a]	Tree Canopy Impacts (Street Trees and Biodiversity Area) (acres) [b,c]
Preferred South Crossing Alternative	**DUW-1a**	**1.6 to 2.1 [d]**	**0.5 to 0.9 [d]**	**3.8 to 4.4 [d] [e]**
South Crossing South Edge Crossing Alignment Option	DUW-1b	1.9	0.6	3.8 to 4.4 [d, e]
North Crossing Alternative	DUW-2	0	0	1.8

Note: To estimate critical area impacts, the impact analyses for upland habitat in all alternatives assumed an at-grade profile that would result in a complete loss of habitat within the permanent footprint.

[a] Construction impacts represent areas only temporarily impacted by the project.

[b] Existing tree canopy data derived from 2021 U.S. Geological Survey lidar project (City of Seattle 2021).

[c] Assumes permanent removal of trees within both the operation (long-term) and construction (temporary) footprints. Some trees may be replaced in situ; others may be mitigated elsewhere as agreed to with the City of Seattle.

[d] This range reflects differences from connecting to different alternatives in adjacent segments.

[e] Total includes forested area in the West Duwamish Greenbelt, which is also counted in the Biodiversity Area impact column.

In total, about 3.7 to 4.4 acres that are currently covered by greenbelt tree canopy and street tree canopy would be cleared under Alternative DUW-1a or Option DUW-1b (see Table 4-7). Some trees may be replaced in situ, while others may be mitigated elsewhere as agreed to with the City of Seattle.

Alternative DUW-2 would cross the Duwamish Waterway on the north side of the West Seattle Bridge, avoiding long-term impacts to the greenbelt and the heron colony. About 1.8 acres currently covered by street tree canopy would need to be cleared. This alternative could impact a future potential habitat restoration site planned on the East Waterway, but it is anticipated that the restoration site design could be modified for the project. Alternative DUW-2 may require relocation of an artificial nesting platform near the Operations and Maintenance Facility Central that is used annually by an osprey pair; the platform would be relocated in the vicinity to ensure continued use.

Delridge Segment

The Delridge Segment passes through dense residential areas and parallels existing streets, where the primary direct impacts to upland habitat would be the removal of street trees and trees associated with the greenbelt along Longfellow Creek. About 3.4 to 4.3 acres of existing tree canopy in the Delridge Segment would be removed by the project (see Table 4-8). Some trees may be replaced in situ, while others may be mitigated elsewhere as agreed to with the City of Seattle.

Preferred Option DEL-6b and Alternative DEL-7 would pass through the greenbelt area along Longfellow Creek, just south of Southwest Andover Street. Guideway columns would require tree removals within the greenbelt. Elevated guideway would cross over Longfellow Creek and its buffer about 40 to 70 feet above vegetated portions of the greenbelt. Due to its height, the elevated guideway is not expected to affect the productivity of the vegetation below the guideway; however, tree heights would be limited below the guideway. Wildlife could continue their current movement under the elevated guideway.

Alternatives DEL-5 and DEL-6a near Southwest Andover Street would avoid impacts to wetlands and wetland buffers along Southwest Genesee Street and would have no impact on Longfellow Creek because the creek is culverted under Southwest Andover Street. Guideway columns for these alternatives would require removing a few Douglas-fir, spruce, or red alder trees in the West Duwamish Greenbelt along Longfellow Creek.

All of the alternatives following Southwest Genesee Street would require some vegetation removal along the southern side of the street at the north boundary of the West Seattle Golf Course. The vegetation here consists of mowed grass areas and small to moderate-height trees, including small coniferous trees (including Douglas-fir and western hemlock) and deciduous trees (including ornamental species such as Callery pear). In addition, Options DEL-1b and DEL-2b would impact roadside vegetation on the northern side of Southwest Genesee Street. Option DEL-1b is farther north at the Longfellow Creek biodiversity area and therefore has the greatest impact to this resource (Table 4-8). Alternatives DEL-1a and DEL-3 would remain elevated over Southwest Genesee Street but would require column foundations where trees are currently growing along the golf course edge. Alternatives DEL-2a and DEL-4 descend to retained-cut guideway in the northwestern corner of the golf course. This would remove some trees and grassy areas; however, these alternatives would avoid impacts to the biodiversity area along Longfellow Creek.

The elevated crossings over Longfellow Creek for all alternatives would not preclude future projects to daylight portions of the creek currently flowing through culverts. Wildlife could continue their current movement under the elevated guideway.

Table 4-8. Summary of Impacts to Priority Habitats, Critical Habitat and Tree Canopy, Delridge Segment

Alternative Name	Alternative Identification	Biodiversity Area Long-term Impacts (acres)	Biodiversity Area Construction Impacts (acres) [a]	Tree Canopy Impacts (Street Trees and Biodiversity Area) (acres) [b, c, d]
Preferred Andover Street Station Lower Height Option	**DEL-6b**	**0.2** [c]	**0.2**	3.9
Dakota Street Station Alternative	DEL-1a	0	0.1	4.1
Dakota Street Station North Alignment Option	DEL-1b	0.1	<0.1	4.3
Preferred Dakota Street Station Lower Height Alternative	DEL-2a	0	<0.1	3.9
Dakota Street Station Lower Height North Alignment Option	DEL-2b	<0.1	<0.1	4.1
Delridge Way Station Alternative	DEL-3	0	<0.1	3.5
Delridge Way Station Lower Height Alternative	DEL-4	0	<0.1	4.3
Andover Street Station Alternative	DEL-5	<0.1	<0.1	4.0
Andover Street Station Lower Height Alternative	DEL-6a	0	<0.1	3.6
Andover Street Station Lower Height No Avalon Station Tunnel Connection Alternative	DEL-7	0.2 [e]	0.2	3.4

Note: To estimate critical area impacts, the impact analyses for all alternatives assumed an at-grade alignment that would result in a complete loss of habitat within the permanent footprint.

[a] Construction impacts represent areas temporarily impacted by the project, outside of the long-term project footprint.

[b] Existing tree canopy data derived from 2021 U.S. Geological Survey lidar project (City of Seattle 2021).

[c] Includes tree area in the greenbelt of Longfellow Creek, which is also counted as biodiversity area in Table 4-8.

[d] Assumes permanent removal of trees within both the operation (long-term) and construction (temporary) footprints. Some trees may be replaced in situ; others may be mitigated elsewhere as agreed to with the City of Seattle.

[e] Impact total includes <0.1 acre of guideway passing over Longfellow Creek at a height of 70 feet over the creek.

West Seattle Junction Segment

The West Seattle Junction Segment Build Alternatives would have no long-term impacts to ecosystems other than removal or removal and replacement of some street trees because this segment does not contain other upland habitat. The project would remove between 1.8 and 4.2 acres of existing tree canopy, depending on the alternative (see Table 4-9). Some trees may be replaced in situ, while others may be mitigated elsewhere as agreed to with the City of Seattle.

Table 4-9. Summary of Tree Canopy Impacts, West Seattle Junction Segment

Alternative Name	Alternative Identification	Acres of Tree Impacts (Street Trees) [a]
Preferred Medium Tunnel 41st Avenue Station West Entrance Station Option	**WSJ-5b**	**3.5**
Elevated 41st/42nd Avenue Station Alternative	WSJ-1	3.2
Elevated Fauntleroy Way Station Alternative	WSJ-2	2.5 to 2.8 [b]
Tunnel 41st Avenue Station Alternative	WSJ-3a	2.4 to 2.8 [b]
Tunnel 42nd Avenue Station Option	WSJ-3b	2.5
Short Tunnel 41st Avenue Station Alternative	WSJ-4	4.2
Medium Tunnel 41st Avenue Station Alternative	WSJ-5a	3.4
No Avalon Station Tunnel Alternative	WSJ-6	1.8

Source: City of Seattle data, derived from 2021 U.S. Geological Survey lidar project (City of Seattle 2021).

[a] Assumes permanent removal of trees within both the operation (long-term) and construction (temporary) footprints. Some trees may be replaced in situ; others may be mitigated elsewhere as agreed to with the City of Seattle.

[b] This range reflects differences from connecting to different alternatives in adjacent segments.

4.2.3.2 Construction Impacts

Construction would last 1 to 5 years at any one location along the alternatives (2 to 4 years for elevated or at-grade guideway, 3 to 4 years for stations, and 3 to 5 years for a bridge over the Duwamish Waterway). The estimated durations do not necessarily indicate that continuous intensive construction activity would occur at the areas for the entire duration. It is likely there would be periods when minimal or less intensive construction activity would occur, particularly at cut-and-cover portions and stations when the tunnel boring machine would be operating in the station area.

Ground-disturbing activities could introduce sediment and pollutant-laden water (such as runoff from stockpiled soils or spilled fuels from construction equipment) to aquatic habitat or stormwater features. At most locations, ground-disturbing activities would last between 2 and 3 years, with certain areas of guideway construction, bridge construction, or station construction taking up to 4 years. The Duwamish Waterway bridge could take up to 5 years to construct, with the majority of the work for the fifth year isolated to the deck. Construction of the light rail guideway and associated features would include clearing existing vegetation, soil fill, excavation and grading, relocating drainage systems, ground improvement activities, and dewatering. Temporarily disturbed sites that are currently vegetated would be replanted following construction in each project segment to restore or improve upon pre-construction conditions (such as replacing non-native weeds with native plants), and low-growing vegetation would likely become re-established within a year or two. Some areas of currently forested greenbelt would be restored with only herbaceous or shrub species close to the guideway.

Tree removal, shrub removal, ground disturbance, construction lighting and equipment, and other construction activities have the potential to disturb bird species or their nests. This includes tree-nesting species, ground-nesting species, and raptors using the area for foraging; all such species are protected under the Migratory Bird Treaty Act.

All alternatives would require removal of or disturbance to street trees. Removing street trees or trees in critical areas during construction would require coordination, associated approvals, and permitting with the City of Seattle. Several alternatives would also require removal of native trees and other existing vegetation within habitat biodiversity areas. Some of these trees would

be removed entirely; others in temporarily impacted areas would be replaced with the same or similar trees. Trees larger than 6 inches diameter at breast height are regulated further by the City of Seattle under the Tree Protection Ordinance (Seattle Municipal Code 25.11). According to amendments to the tree code enacted in June 2023, Seattle categorizes trees by tier (Tier 1 includes heritage trees, and Tiers 2 through 4 indicate different diameter classes). The nearest heritage trees within the study area (an American black walnut tree near the north end of the West Duwamish Greenbelt and a Japanese maple south of the Alaska Junction Station) are outside the construction footprint. Street tree replacements would also be performed in compliance with City of Seattle Executive Orders 03-05, Tree Replacement and 2023-03, One Seattle Tree Plan.

Sound Transit estimates that most general project construction noise levels, such as elevated guideway and station construction, would be between 84 and 89 dBA at a distance of 50 feet. Noise would be within City of Seattle code requirements unless variances are obtained.

SODO Segment

The construction taking place at the SODO Segment would have no short-term impacts to ecosystems other than street trees.

Duwamish Segment

In the Duwamish Segment, Preferred Alternative DUW-1a or Option DUW-1b would temporarily impact the West Duwamish Greenbelt, where most terrestrial wildlife habitat occurs on this segment. Construction impacts would occur in the north end of the greenbelt and include disturbance due to the construction footprint, construction noise, and stockpiling of materials. The steep slope at Pigeon Point at the north end of the West Duwamish Greenbelt would need to be stabilized which would require ground disturbance and noise. Vegetation would be cleared within the construction footprint. The outer layer of unstable soil would be excavated, and stabilization features could be installed that could include slope drains, soil nails, retaining walls, or other reinforcement. A temporary work trestle may be required. Preferred Alternative DUW-1a would require a retaining wall consisting of soldier pile walls with anchors, and the slope above the wall would be a soil-nailed slope with plantings and mesh to further stabilize soil; drainage would be routed above the slope.

The amount of greenbelt impact for column construction and slope stabilization would vary depending on the specific connection to the Delridge Segment, but all connection options for Preferred Alternative DUW-1a or Option DUW-1b would require some tree removal within the great blue heron management area (see Section 4.2.4.1 for further details on construction impacts to the heron colony). Small or large mammals using this habitat would be displaced or could be disturbed by construction noise. Hazard trees would need to be removed in and adjacent to the construction zone; if felled during the spring or summer, this could impact migratory songbirds using the trees for nesting. Street trees would also be removed during construction.

Alternative DUW-2 would avoid construction footprint impacts to the greenbelt; however, street trees would still be removed, and construction noise could reach the great blue heron colony in the greenbelt as described further in Section 4.2.4.1. If Alternative DUW-2 requires relocation of the osprey nesting platform near the Operations and Maintenance Facility Central, this would be performed outside the nesting season using standard permits and protocols for osprey nest relocation. No construction disturbance is anticipated to these osprey under any alternative, due to the birds' habituation to the urban environment.

Delridge Segment

Preferred Option DEL-6b and Alternative DEL-7 would have construction impacts to vegetated portions of the Longfellow Creek greenbelt between Southwest Andover Street and Southwest Dakota Street. Areas of vegetation would be cleared for construction access to erect guideway columns, and would remain cleared for up to 2 years. This construction could preclude species from using the northern end of the Longfellow Creek greenbelt during construction. These impacts occur in wetland, wetland buffer, and riparian management area. Street trees would also be removed during construction.

Alternatives DEL-5 and DEL-6a would avoid impacts to greenbelt vegetation as work would be restricted to paved portions of wetland and stream buffer at Southwest Andover Street, though some minor tree or vegetation clearing may be required at the edge of the greenbelt, and street tree removal would still occur. Alternative DEL-1a, Option DEL-1b, Alternative DEL-2a, Option DEL-2b, and Alternative DEL-3 would have similar impacts to the southern edge of the Longfellow Creek Natural Area during construction. Alternative DEL-4 would avoid impacts to the natural area during construction. Mowed right-of-way and street trees along the road, along with vegetated areas of the West Seattle Golf Course, could also be disturbed during construction where equipment is staged; construction noise could affect mammals and birds using the natural area. Street tree removal would occur under all alternatives.

West Seattle Junction Segment

The construction taking place at the West Seattle Junction Segment would have no short-term impacts to ecosystems other than removal or removal and replacement of street trees because there is no other upland habitat in this segment; vegetation is limited to residential landscaping and street trees. Excavation of tunnel options could require some temporary disturbance to street trees and other ground vegetation if cut-and-cover techniques are required, but these areas would be revegetated and restored after construction.

4.2.3.3 Indirect Impacts

Disturbance during construction could contribute to the spread of noxious or invasive plant species. However, noxious weeds are already common throughout the study area. In areas of greenbelt where construction disturbance may occur, revegetation would be performed using native vegetation in areas where non-native vegetation currently exists; this could lead to improvements in terrestrial habitat. Indirect impacts would also include increased human activity and light rail train traffic near wildlife habitat and adjacent to biodiversity areas.

The project alternatives would not interfere with future habitat improvement projects such as culvert replacements along Longfellow Creek or habitat restoration efforts along the creek or the Duwamish Waterway. One exception occurs where Alternative DUW-2 could impact a future potential habitat restoration site planned on the East Waterway, as noted in Section 4.2.3.1, Long-Term Impacts, for upland habitat and species. The project could, under the alternatives for the Duwamish Segment that intersect the West Seattle Greenbelt, limit the extent of future restoration work at the north tip of this greenbelt as the project would permanently remove some trees from this area.

4.2.4 Federally Listed Species, Species of Concern, Priority Species, and Species of Local Importance

4.2.4.1 Long-Term Impacts

SODO and West Seattle Junction Segments

The SODO and West Seattle Junction segments would not have any species of concern or listed species present, as these species and their habitats do not occur in these segments' study areas.

Duwamish Segment

As noted for aquatic habitats, Sound Transit is studying the feasibility of multiple high-level fixed bridge types across the Duwamish Waterway. Some bridge types would reduce or eliminate the in-water impact from the bridge depending on the alternative. Tables 4-3 and 4-4 summarize the range of impacts that could occur by Duwamish Segment alternative based on review of the potential bridge types.

Preferred Alternative DUW-1a would not place permanent features in the Duwamish Waterway. However, the guideway columns would cover some areas of shoreline directly adjacent to the waterway. These areas are currently paved, partially developed, or covered with sparce grass, weeds, or exposed soil, and thus provide limited function as shoreline habitat. No trees or other vegetation currently shades the shoreline in these areas. The steep shoreline along the waterway at these locations provides limited shelter or foraging opportunities for fish, but fish could be present. As noted in Section 3.1.2, Aquatic Habitat and Species, the Duwamish Waterway supports several listed and priority fish and marine mammals, including Chinook salmon, steelhead, bull trout, coho salmon, Pacific cod, Pacific herring, and river lamprey; sea lions and marbled murrelets may also be present. The waterway has designated critical habitat for bull trout, steelhead and Chinook salmon as well as essential fish habitat for additional species.

Option DUW-1b or some bridge types for Alternative DUW-2 would result in long-term impacts to the Duwamish Waterway aquatic environment by placing guideway columns in and partially in the water. As described in detail in Section 4.2.2.1, bridge guideway columns could result in permanent loss of up to 0.5 acre of benthic habitat that might be used by listed fish and fish species of concern for foraging and migration. If used as part of the guideway column construction, above-water pile caps associated would create shade over water, which might reduce productivity in the shaded waters or could provide new habitat for fish species that prey on young salmonids. The bridge itself is not expected to have any shading impacts to the productivity of these waters because it would be 100 feet to 140 feet above the water (as described in Section 4.2.2.1). However, guideway columns and pier-protection systems along the shoreline, as well as navigation lighting on the guideway columns, could change the movement patterns of migrating salmonids, including young salmon sheltering in shallow waters during their passage out to Elliott Bay. Pier-protection systems would be constructed parallel to the shoreline but with extensions angling towards the shore that could temporarily alter the direction of salmon traveling upstream or downstream. Sea lions and marbled murrelets may use the waterway occasionally, but as this not their primary habitat, they are not expected to experience any long-term effects from the addition of features in an already industrialized section of shoreline.

The guideway columns would not directly conflict with current projects to restore intertidal habitat under Chinook or steelhead recovery plans. Where guideway columns would be placed partially on shore, their vertical structure would replace already armored shoreline in most cases, and the overall conditions and shoreline complexity would not change in these locations. However, the guideway columns would increase the steepness of other unarmored shoreline patches. Recovery plans for listed salmon identify shallow areas of shoreline as important to migrating salmonids.

All of the Duwamish Segment alternatives would parallel the West Seattle Bridge, where a peregrine falcon nest has been active in a manmade nest box placed on a bridge support column. These birds are already habituated to an urban environment and traffic on nearby roads and bridges; however, light rail trains moving close to the nest could affect their return to this artificial nest location. During operations, light rail trains would pass about 60 feet with Preferred Alternative DUW-1a, 200 feet with Option DUW-1b, or 300 feet with Alternative DUW-2 from the nest box.

As described in Section 4.2.3, Upland Habitat and Species, Preferred Alternative DUW-1a and Option DUW-1b would cross the north end of the West Duwamish Greenbelt and require the removal of some deciduous trees from the greenbelt. Low-growing vegetation may be used to stabilize this slope where trees are removed, but large trees would not be allowed above the guideway for safety reasons. This is a Washington Department of Fish and Wildlife priority habitat (biodiversity area and corridor) that contains potential foraging habitat for state species of concern such as the pileated woodpecker, potential roosting habitat for bald eagles, and a documented nesting colony of great blue herons. The trees being removed do not contain prominent roost trees for eagles. The area does contain a few snags that pileated woodpeckers might use for foraging, although other similar snags are available in other areas of the greenbelt.

The tree removal area Is also within the core zone of a great blue heron management area (which covers habitat within 60 meters [197 feet] of nests). The removed trees could include trees directly adjacent to the colony if they are determined to be hazard trees based on their proximity to the guideway. The specific boundary of the management area core zone would depend on the specific locations of heron nests during the year(s) of permitting. The herons generally return to the same nest trees each year. However, there are additional suitable nest trees between their current nesting and the project footprint in which they might establish new nests in the future.

Any habitat permanently removed from the great blue heron management area core zone would require coordination with Washington Department of Fish and Wildlife and the City of Seattle to determine permitting and mitigation. Great blue herons can be extremely sensitive to disturbance at their nesting colonies (refer to Vennesland and Norman 2006 for a summary of heron disturbance studies); excessive disturbance can affect the success of nests in the colony or could lead to abandonment of a colony. Carlson and McLean (1996) found that the distance of heron colonies from human activity and the quality of the vegetated buffer around the colony was positively related to nest success. The City of Seattle intends to protect the great blue heron colony from such disturbance effects.

Preferred Alternative DUW-1a and Option DUW-1b would bring elevated structures and moving trains closer to the nest colony than existing roadways, which would bring the potential risk of great blue heron strikes from trains or with wires, or disturbance from train motion and lights. Tree removals would also shrink their current buffer of trees between the colony and the nearest elevated structures and vehicles. Currently, the herons are habituated to the urban environment; they are choosing nests as close as 50 feet from houses and streets in Pigeon Point, and as close as 150 feet from the West Seattle Bridge and its heavy traffic. They might tolerate additional structures and moving vehicles nearby, given their current habituation; they are currently successfully producing fledglings in this environment. However, it is also possible the new structures and train activity could result in them selecting new nest sites farther south along the greenbelt (for example, the birds may choose a nest tree within or adjacent to the existing heron nest trees about 400 feet to 600 feet south of the location of Preferred Alternative DUW-1a and Option DUW-1b). It is not likely that the birds using the northern nests would entirely abandon the greenbelt, given this availability of nearby trees that are farther from the project activity. Monitoring at this site has observed slight shifts in nest tree selection every year.

Alternative DUW-2 would cross the Duwamish Waterway on the north side of the West Seattle Bridge and therefore avoid impacts to the greenbelt habitat and the heron's management area core zone.

Delridge Segment

The Delridge Segment would cross over Longfellow Creek, which is used by listed fish (Chinook salmon and steelhead). However, no project features would be built in the stream and no long-term impacts to fish would occur. One stormwater outfall draining a small amount of non-pollutant generating surface from the Delridge Segment could drain to an outlet in a piped section of Longfellow Creek at its confluence with the West Waterway, contingent on final design. All other stormwater from the project in this segment would be routed to combined sewer rather than discharged to the stream, the project would not have impacts to water quality factors such as temperature, dissolved oxygen, or contaminants that are limiting factors for salmon survival in the creek. Restoration work along the creek for any areas affected by construction would be designed to improve habitat and water quality functions along the creek which would benefit fish using the creek. The project would not preclude future work to fulfill recommendations under the Chinook or steelhead recovery plans. Such future work could include daylighting portions of Longfellow Creek currently flowing through culverts, adding riparian vegetation or in-water debris, or replacing fish passage barriers.

4.2.4.2 Construction Impacts

SODO and West Seattle Junction Segments

Construction in the SODO and West Seattle Junction segments would not affect any species of concern, as these species and their habitats do not occur in these segments' respective study areas. Construction noise would also not affect in-water habitat in Elliott Bay, where sensitive listed species of marine mammals occur.

Duwamish Segment

Species of concern would experience construction impacts in the Duwamish Segment. As noted in Section 4.2.2.2, Construction Impacts, for aquatic habitat and species, Preferred Alternative DUW-1a would avoid construction of in-water features. However, under Preferred Alternative DUW-1a, a small area of shoreline (up to 2,000 square feet) below the mean high water level may be temporarily affected by the removal and replacement of riprap to facilitate construction of nearby project features. This work is expected to occur above the level of the waterway during the time of construction, and thus would not affect salmonids or salmonid habitat when salmon are present, but would still be considered as and permitted as in-water work. Best management practices would be used to prevent sediments from entering the waterway. Barges moored in the area to assist with construction would directly affect any salmonids present along this shoreline.

Under Option DUW-1b or for some bridge types of Alternative DUW-2, in-water construction in the Duwamish Waterway would directly affect listed species of fish in the waterway (see impacts discussion in Section 4.2.2.2). The listed and sensitive fish species would be excluded from foraging in in-water or benthic habitat within the cofferdams for the duration of construction. Salmonids such as Chinook salmon and steelhead might change their behavior or be injured by in-water construction noise such as impact and vibratory pile-driving. Salmon would be routed away from shallow water by cofferdams or work trestles along the shoreline, and experience increased predation risk as described in Section 4.2.2.2. Salmon might also change their behavior due to shading from trestles and barges, or due to construction lighting at night. As noted in Section 4.2.2.2, juvenile salmon are expected to show more behavior changes to construction lighting than adult salmon.

These species' ability to forage in the area could also be negatively affected by turbidity during the construction from either in-water construction, shoreline work, or barge activity. In particular, suspended sediments from construction could contain contaminants because this excavation would be occurring in the Harbor Island Superfund Site. During pile-driving, excavation, and rewatering of cofferdams, many contaminants could be resuspended, including polychlorinated biphenyls, arsenic, polycyclic aromatic hydrocarbons, and mercury. Exposure to such contaminants could be harmful to the listed species that encounter them, as well as to predators such as marine birds and marine mammals that prey on those listed species. Currents flowing through the area would disperse some suspended sediments, lessening their effects in the immediate construction vicinity as well as turbidity. However, the sediments would not reach as far as Elliott Bay; Sound Transit would comply with Ecology's water quality standards under the 401 Water Quality Certification the project would require, which would include preventing contaminants from traveling far from the project.

Sensitive marine mammals and the listed marbled murrelet are also a concern during construction of in-water features (for Option DUW-1b or some bridge types of Alternative DUW-2) or during barge movements for all alternatives. If in-water guideway columns and cofferdams are constructed, impact and vibratory pile-driving could create noise that reaches Elliott Bay at levels high enough to change the movements or foraging of whales or sea lions in the bay. Construction would be permitted to comply with the Marine Mammal Protection Act. This would entail monitoring during activities that create noise at levels that could harass seals and sea lions in the waterway. These construction activities could include noise-reduction measures such as bubble curtains that reduce decibels during impact or vibratory pile-driving, to limit harm or harassment to fish in waters near the activities.

The construction of Preferred Alternative DUW-1a and Option DUW-1b could directly impact the nesting great blue herons in the West Duwamish Greenbelt, and any other priority species such as pileated woodpeckers using the greenbelt. Vegetation cleared within the construction footprint would occur within 50 to 100 feet of known great blue heron nest trees. The guideway would also pass close to a known peregrine falcon nesting site on the West Seattle Bridge. While this nest platform is not expected to experience long-term impacts, construction in proximity to the nest could impact nest success during those construction years if the birds are flushed regularly during the nesting season. Preferred Alternative DUW-1a would pass closer to the falcon nest and Option DUW-1b would pass closer to the heron colony. The amount of greenbelt impact would vary depending on the alternative design option or the specific connection to the Delridge Segment, but all would require some tree removal within the great blue heron management area. Construction equipment and staging could occur in the paved areas directly downslope from the nest trees. Depending on the selected alternative, some trees adjacent to the nest trees could be required to be felled as hazard trees during construction (this could occur if the herons expand their colony northward during the period of construction).

Construction noise for Preferred Alternative DUW-1a and Option DUW-1b could exceed ambient noise levels at the heron colony. As noted in Section 4.2.4.1, Long-Term Impacts, the great blue herons using this particular colony are less sensitive to disturbance than would be more isolated colonies. The birds are habituated to an urban environment and are currently choosing nest sites directly over a pedestrian path, near train tracks with loud train horn noise, and close to the West Seattle Bridge and its heavy traffic. Despite this habituation, the herons might not tolerate active construction near the nests if it occurred during the nesting season. Noise from construction of Preferred Alternative DUW-1a or Option DUW-1b could temporarily exceed existing ambient noise levels at the colony. Results from disturbance could be lowered nest success or selection of different trees farther south in the greenbelt for nesting, as described for long-term impacts in Section 4.2.4.1.

Any impact to the heron nesting colony or its management area during construction would require a management proposal based on Washington Department of Fish and Wildlife's recommendations and catered to the project site to meet the City of Seattle's heron management requirements as well. Construction close to the great blue heron colony (including any areas within 500 feet of the nests) could be restricted or modified during the nesting season (February through September) to avoid or minimize impacts to the herons during the nesting season. Construction plans may need to be modified to place staging areas as far from the nesting colony as possible.

Alternative DUW-2 would avoid all physical construction impacts to the West Duwamish Greenbelt but would overlap with the great blue heron management zone's outer area—by City of Seattle requirements, construction noise is restricted during the nesting season in this zone. This area does not contain any habitat for herons and separated from the colony by the West Seattle Bridge. Most construction noise north of the bridge is not likely to reach the colony at levels that would disturb the herons, given the high levels of ambient noise near the colony from trains, traffic, and industrial noise along the Duwamish Waterway. Construction noise from Alternative DUW-2 could also be audible at the heron colony but is not expected to exceed ambient noise levels.

Any of the Duwamish Segment alternatives have the potential to disturb a known pair of peregrine falcons that nest on a placed platform under the West Seattle Bridge. Although the falcons are already habituated to an urban environment and traffic on nearby roads and bridges, under either alternative, the light rail trains moving close to the nest could affect their return to this artificial nest location. Marbled murrelets are not expected to be impacted by the project construction because they are unlikely to use the busy waters of the waterway on a regular basis and are highly mobile. A purple martin colony site in the waterway is also not likely to be disturbed by construction here because it is 0.25 mile from the site and birds using the area are already habituated to construction and industrial boat traffic.

Delridge Segment

Construction of the Delridge Segment is not expected to impact listed species of salmon using the creek. Best management practices would be employed where construction staging occurred within stream buffers, such as silt fences and other devices, to ensure that stormwater runoff or sediments did not reach the creek. Construction of Preferred Option DEL-6b and Alternative DEL-7 would stay above the ordinary high water mark of the creek. Therefore, construction is not expected to exacerbate the current water quality issues in the creek that affect salmonids. Construction lighting would be directed away from the creek to avoid affecting the movements of fish. Priority species such as pileated woodpeckers or other bird species using the greenbelt habitat or West Seattle Golf Course for foraging would be mobile and able to move away from the immediate area of construction.

4.2.4.3 Indirect Impacts

The project would not interfere with future projects that may provide habitat improvements improving conditions for listed species in Longfellow Creek, such as daylighting culverts or improving riparian vegetation to increase salmonid spawning habitat. Indirect impacts would include increased human activity and light rail train traffic near wildlife habitat and adjacent to biodiversity areas at Longfellow Creek, which in turn could influence the wildlife traveling between the Longfellow Creek Natural Area and greenbelts within and south of the golf course, though as there is already traffic along Southwest Genesee Street, wildlife would already be habituated here to moving through a populated area.

Along the Duwamish Waterway, if guideway columns are placed along the Harbor Island shoreline, they would prevent future restoration at those specific locations, though area directly adjacent to the towers would retain opportunities for habitat enhancement.

As noted for aquatic habitat, above, bridge guideway columns placed in the Duwamish Waterway under Option DUW-1b or some bridge types for Alternative DUW-2 would cover benthic habitat in the waterway and lead to some lost productivity. This could in turn affect the availability of prey species for listed salmonids and marine mammals using the waterway; a change in distribution of the prey species could change the movement patterns of these predators. If placed on partially armored shoreline or the small patches of steep intertidal habitat, guideway columns would not directly conflict with current projects to restore intertidal habitat under Chinook or steelhead recovery plans. The baseline conditions along the East and West Waterways, including the unarmored patches, are already degraded with minimal riparian or aquatic vegetation, and are not currently providing quality habitat for migrating or rearing salmonid juveniles in this transitional area between fresh and salt water.

4.2.5 Tribal Treaty Rights Impacts

The Muckleshoot Indian Tribe has treaty-protected rights to fish, hunt, and gather in their Usual and Accustomed Areas in the project corridor. These rights include the waters of the Duwamish Waterway. The Suquamish Tribe has similar treaty-protected rights in these areas. All project work performed in or over the Duwamish Waterway would have the potential to change movements of adult salmonid or obstruct treaty-protected fishing rights. Preferred Alternative DUW-1a would avoid any permanent in-water features or changes to the shoreline, though some barge movements related to construction could temporarily affect fish and treaty-protected fishing rights. The other alternatives may require placement of guideway columns in the water. These guideway columns could affect treaty-protected fishing rights and Usual and Accustomed Areas of the Muckleshoot Indian Tribe temporarily during in-water construction or permanently by placement of the guideway columns. Some bridge types could also impact Tribal treaty-protected fishing rights and access to the Usual and Accustomed Areas of the Suquamish Tribe.

4.3 Cumulative Impacts

Past projects have contributed to massive changes to the Duwamish River, including channelization for the Duwamish Waterway and development of Harbor Island and industrial properties on both sides of the waterway. Loss of estuarine habitat has occurred as tidelands were dredged and filled for industrial development, and also from constructing existing transportation structures, such as the Spokane Street Bridge and the West Seattle Bridge. Contamination of the waterway from adjacent industrial uses has also adversely affected habitat. Loss of aquatic habitat in Longfellow Creek has occurred from channelization, placement of the creek in culverts under roads and private properties, and encroachment of the stream buffer by development. Natural segments in the study area remain in very few places, such as the protected Longfellow Creek Natural Area and adjacent habitat north of the natural area between Southwest Yancy Street and Southwest Andover Street. Upland forested habitat throughout the area has been highly fragmented through historical development, and large areas of continuous habitat have been maintained only in protected parks and greenbelts, such as the West Duwamish Greenbelt.

The alternatives would generally have a low potential to adversely affect the viability of local wildlife populations because of the highly urbanized environment of the study area (see Chapter 3, Affected Environment). There are a few higher-quality habitats that support native fish and wildlife species in the study area, including the Duwamish Waterway, West Duwamish Greenbelt, and Longfellow Creek and its associated natural area and adjacent vegetated habitat. A golf course and some small residential parks also provide lower-quality habitat. Loss of higher-quality upland habitat from some of the project alternatives would have a cumulative impact on overall loss of forested habitat in the city of Seattle, and would reduce the habitat available for some species, such as the great blue herons in the West Duwamish Greenbelt. These habitats also support several federally and state-listed endangered and threatened species and federal and state species of concern. Some reasonably foreseeable future actions could also contribute to cumulative impacts on terrestrial habitat by removing large trees and increasing the amount of impervious surface in the area. As urban development continues within the study area, changes to the landscape have the potential to further degrade or reduce the few remaining high-quality breeding/nesting and foraging habitats for resident and migratory species.

Some alternatives would also result in impacts to aquatic habitat. Preferred Alternative DUW-1a would avoid permanent in-water impacts to aquatic habitat in the Duwamish Waterway, and some bridge types for Alternative DUW-2 would also avoid these impacts. Option DUW-1b could not be built in a way that would avoid in-water impacts and therefore could have a greater contribution to cumulative impacts to aquatic habitat than the other Duwamish Segment alternatives. Impacts from these alternatives could contribute to cumulative impacts on the Duwamish Waterway when considered with past alterations and ongoing development in shoreline areas. The Muckleshoot Indian Tribe is signatory to both the Treaty of Point Elliott and the Treaty of Medicine Creek; the Muckleshoot Indian Tribe has treaty-protected fishing rights and Usual and Accustomed Areas in the Puget Sound region which includes the Duwamish Waterway. The Suquamish Tribe is signatory to the Treaty of Point Elliott and has treaty-protected fishing rights and Usual and Accustomed Areas in the Puget Sound region which includes the Duwamish Waterway. Cumulative impacts to aquatic habitat could adversely affect Tribal treaty-protected fishing rights of the Muckleshoot Indian Tribe. Cumulative impacts to aquatic habitat could also adversely affect treaty-protected fishing rights of the Suquamish Tribe. Reasonably foreseeable future actions within the study area could incrementally contribute to the fragmentation, degradation, and/or loss of valuable aquatic habitats and adversely affect wildlife, including fish. Foreseeable future actions that will remove riparian habitat, disturb stream channels, or fill or alter wetland habitat could further impact these habitats. Federal, state, and local permitting requirements would require mitigation for these impacts, which would reduce the potential for cumulative impacts. Some future actions include components that will positively impact the environment around the West Seattle Link Extension; for instance, the proposed plan to perform remedial cleanup at the East Waterway Operable Unit of the Harbor Island Superfund Site will reduce contaminants in and near the Duwamish River.

Other state and local projects would also benefit terrestrial and aquatic habitat in the study area. Recently, the City of Seattle committed to increasing the city-wide tree canopy cover to 30 percent by 2037 and restoring 2,500 acres of forested parkland by 2025. Through the Green Seattle Partnership, there are active restoration programs within the Longfellow Creek watershed, which remove invasive plants and restore native species. The City has also purchased property to upgrade Duwamish Waterway Park and, through partners, is restoring wetlands in the Delridge neighborhood. These efforts actively work to preserve and enhance existing habitats within the study area, and the project would support those goals by encouraging concentrated development away from these areas and within designated urban centers, thereby reducing the effects of development on existing habitats and resulting in a beneficial cumulative impact for species within the study area. Overall, the potential for cumulative impacts on ecosystems from the project is expected to be minor after mitigation.

Federal, state, and local regulations require the project and other reasonably foreseeable future actions to mitigate any permanent impacts on streams, wetlands, and other high-quality habitats. The Washington State Department of Fish and Wildlife and the Washington Hydraulic Code require mitigation for and minimization of any adverse impacts on fish and/or their habitats. In concurrence with the code, any new or replaced culverts must also be designed so as to not impede fish passage. The project would provide water quality treatment for pollution-generating impervious surfaces that are rebuilt as part of the project. Some of these surfaces do not currently receive any treatment; therefore, the project would benefit the water quality of waterbodies in the area and the aquatic habitat in those waterbodies. In addition, Sound Transit's policy on ecosystem mitigation is to avoid impacts on environmentally sensitive resources as much as possible, and to provide adequate mitigation for unavoidable impacts to ensure no net loss of ecosystem function and acreage as a result of agency projects. Possible mitigation measures include restoration or enhancement of degraded streams, wetlands, and wetland buffers; removal of fish passage barriers; and planting disturbed areas with native vegetation. Where instituted, these measures would provide cumulative benefits to fish, wildlife, and their habitats.

Construction associated with all reasonably foreseeable future actions, including the project, would contribute to temporary habitat loss resulting from vegetation removal for construction staging areas and access. Although erosion and sedimentation could temporarily affect water quality in waterbodies, all projects would be required to comply with permit conditions as well as erosion, sedimentation, stormwater pollution, and water quality plans/protections during construction, which would prevent those impacts. Wildlife within the study area is regularly exposed to the noise associated with a highly urbanized environment, and it is unlikely wildlife would experience much, if any, adverse effects related to construction noise. Following construction, cleared areas would be revegetated and all areas would be restored to pre-construction conditions, where possible, thereby reducing any long-term cumulative construction effects. In-water construction activities could contribute to a cumulative impact on aquatic species related to ongoing disruption if other in-water projects are under construction nearby at the same time, or if they are constructed consecutively. Sound Transit would coordinate with the appropriate regulatory agencies during the permitting process to minimize these potential impacts during construction.

5 MITIGATION MEASURES

Sound Transit's policy on ecosystem mitigation is to avoid impacts on environmentally sensitive resources, and to provide adequate mitigation for unavoidable impacts to ensure no net loss of ecosystem function and acreage as a result of agency projects.

Mitigation for ecosystem impacts is based on a hierarchy of avoiding, minimizing, and compensating for unavoidable impacts. The design of the project already incorporates avoidance and minimization techniques. For example, Preferred Alternative DUW-1a would avoid placing columns in the Duwamish Waterway, and project siting avoids placing project elements in or near wetlands or streams where possible. Further avoidance and minimization measures would continue to be pursued as the project enters final design and permitting stages.

To the extent that impacts could not be avoided, Sound Transit would provide compensatory mitigation to achieve no net loss of ecosystem function. This may occur for impacts to greenbelt acreage, wetlands, or benthic habitat in waterways. Sound Transit would comply with all applicable laws. Wherever it is practical, mitigation sites would be placed close to the actual impacts, to compensate in-kind for the lost functions or values.

5.1 Wetlands

5.1.1 Avoidance and Minimization

Avoidance and minimization measures specific to wetlands could include the following design features and construction actions:

- Siting guideway columns to avoid direct placement in wetlands, where possible.
- Minimizing the placement of construction staging areas in buffers, where possible. The construction contractor would work within construction limits marked with fencing and signage to prevent unintended impacts on riparian vegetation, wetlands, and wetland buffers.
- Taking all practical steps to minimize harm to wetlands, and analyze relevant factors of the project's effect on the survival and quality of the wetlands, per Executive Order 11990.
- Applying a monitoring plan for restoration areas to ensure success of the restoration.

5.1.2 Compensatory Mitigation

To the extent that permanent impacts could not be avoided to wetlands or wetland buffers (as would occur under Preferred Alternative DUW-1a, Option DUW-1b, and all Delridge Segment alternatives), Sound Transit would provide compensatory mitigation to achieve no net loss of wetland function. For instance, enhancing areas currently covered in invasive plants with native vegetation would improve the ability for these wetland buffers to support wildlife. Compensatory mitigation would include a monitoring period to ensure success of the mitigation.

5.1.2.1 Preferred Alternative DUW-1a and Option DUW-1b

These alternatives would have permanent impacts to Wetland WSE-4 and its buffer. On-site wetland buffer mitigation could be provided through native plantings or weed control in the West Duwamish Greenbelt. These mitigation actions could improve wetland buffer habitat where buffers are dominated by non-native plants or where ground cover is sparse. Mitigation for wetland impacts could occur on property adjacent to Longfellow Creek in the Delridge Segment, between Southwest Andover Street and Southwest Yancy Street, if this property is acquired for project construction for Preferred Option DEL-6b or Alternative DEL-7. The property provides opportunity for habitat creation and enhancement adjacent to a stream, wetlands and greenbelt. Sound Transit would plan this mitigation area using applicable policies and regulations and coordination with the City of Seattle.

If additional mitigation is needed (or if the property between Southwest Andover Street and Southwest Yancy Street is not acquired), Sound Transit plans to use one or more of the following methods. The mitigation planning would follow the mitigation sequencing priorities outlined in U.S. Army Corps of Engineers guidance or as agreed to with regulatory agencies:

- Approved In-Lieu Fee program such as the King County Mitigation Reserves Program or mitigation bank such as the Port of Seattle mitigation bank (currently in review), if available. The Port's Wetland Mitigation and Habitat Conservation Umbrella Bank Prospectus lists two new mitigation sites within about 0.5 mile of all Duwamish Segment alternatives' bridge impacts (Terminal 25 and Terminal 105), and two additional sites about 0.5 mile south of Option DUW-1b, Terminal 107 and Terminal 108 (Port of Seattle and Anchor QEA 2021).
- Compensatory mitigation at an advance mitigation site.
- Project-specific mitigation developed by Sound Transit and approved by appropriate regulatory agencies.

Sound Transit would implement compensatory mitigation in accordance with applicable federal, state, and local requirements and guidelines. To the extent practical, wetland mitigation sites would be identified close to impacts and compensated in-kind for lost values.

5.1.2.2 Preferred Option DEL-6b and Alternative DEL-7

Preferred Option DEL-6b and Alternative DEL-7 would have permanent impacts to wetland and wetland buffer. On-site mitigation could occur on property adjacent to Longfellow Creek that would be acquired for project construction of these alternatives, between Southwest Andover Street and Southwest Yancy Street. The existing wetlands and wetland buffers along Longfellow Creek could also provide opportunities for mitigation where native plantings could improve existing wetland or buffer habitat. If additional mitigation area is needed, one of the mitigation options described in Section 5.1.2.1 for Preferred Alternative DUW-1a and Option DUW-1b would be applied. Sound Transit would determine final mitigation actions during final design and permitting.

5.1.2.3 Alternatives DEL-1a, DEL-1b, DEL-2a, DEL-2b, DEL-3, DEL-4, DEL-5, and DEL-6a

These alternatives would have long-term impacts to wetland buffers. Mitigation for these impacts would use one or more of the methods listed within Section 5.1.2.1. Sound Transit would determine final mitigation actions during final design and permitting.

5.2 Aquatic Resources

5.2.1 Avoidance and Minimization

Avoidance and minimization measures specific to aquatic resources could include the following design features and construction actions:

- Avoiding direct impacts to Longfellow Creek by routing the elevated guideway over culverted areas of the creek or spanning the width of the creek where it is in an open channel.
- Siting guideway columns to avoid direct impacts to shorelines, where practical.
- Pursuing bridge design options that avoid or minimize permanent impacts to the waterways.
- Designing stormwater treatment facilities and flow-control measures to minimize impacts on stream water quality and flow or flow to larger waterways (see Appendix L4.8, Water Resources Technical Report). Stormwater flow control might use detention or infiltration facilities such as vaults, or water quality treatment using bioretention or media filter vaults.
- Avoiding in-water construction work at Longfellow Creek.
- Protecting Longfellow Creek from falling debris during over-water bridge construction.
- Minimizing construction staging areas in stream buffers or shorelines.
- Directing nighttime construction lighting away from Longfellow Creek or other waterways to avoid possibly altering the migratory behavior of fish or predation rates of juveniles.
- Ensuring the project is consistent with and receives Washington State concurrence with the Coastal Zone Management Act.

Potential in-water construction activities under Preferred Alternative DUW-1a would be restricted to riprap removal on the shoreline and is expected to occur above water. Should this work touch the water, it would be scheduled to occur during the work windows established by U.S. Army Corps of Engineers and Washington Department of Fish and Wildlife in the Duwamish Waterway. These work windows would also be employed if in-water columns are constructed for Option DUW-1b or for bridge types of Alternative DUW-2 that require such columns. Use of these windows would minimize the effects on salmonids, especially during the construction and operation of cofferdams. In-water work in the Duwamish Waterway would also include complying with the Marine Mammal Protection Act; this may entail monitoring for these animals during construction to avoid harassment or injury, using equipment such as bubble curtains around pile-driving to reduce noise by several decibels, and monitoring underwater sound levels. Specialized construction techniques would be required during any sediment disturbance in the Duwamish Waterway, such as allowing water discharged from dewatering activities to reduce sediments before their release to an approved outlet or facility, which would avoid resuspending contaminants from the Harbor Island Superfund Site.

5.2.2 Compensatory Mitigation

Sound Transit would provide mitigation for unavoidable impacts to benthic habitat, streams, and stream buffers protected under federal, state, and local regulations. This mitigation would address permanent impacts, as well as temporary impacts as required.

5.2.2.1 Preferred Alternative DUW-1a

Preferred Alternative DUW-1a would avoid permanent in-water impacts but would have permanent impacts to regulated shoreline along the Duwamish Waterway. Shoreline impacts could receive mitigation in the form of replanting near shorelines, where appropriate, which could improve conditions for juvenile salmonids in the waterway. The appropriate permitting agencies and jurisdictions would approve mitigation for impacts on shorelines prior to construction.

5.2.2.2 Option DUW-1b and Alternative DUW-2

Option DUW-1b and Alternative DUW-2 would impact regulated shoreline along the Duwamish Waterway, and mitigation for impacts on benthic habitat and fisheries would be required for some bridge types crossing the waterway that would have permanent and/or temporary in-water impacts. Compensatory mitigation within the watershed may be available via a mitigation bank being established by the Port of Seattle (the Umbrella Wetland Mitigation and Habitat Conservation Bank). This mitigation bank would allow mitigation credits to be purchased that would offset environmental impacts within Water Resources Inventory Area 9 (Port of Seattle and Anchor QEA 2019). Potential mitigation sites the Port of Seattle may establish for the bank are listed in Section 5.1.2, Compensatory Mitigation, for wetlands. Shoreline impacts could receive mitigation in the form of replanting near shorelines, where appropriate, which could improve conditions for juvenile salmonids in the Duwamish Waterway. The appropriate permitting agencies and jurisdictions would approve mitigation for impacts on shorelines and benthic habitat prior to construction.

5.2.2.3 All Delridge Segment Alternatives

All Delridge Segment alternatives would avoid stream impacts but would have permanent impacts to regulated riparian management area along Longfellow Creek. Preferred Option DEL-6b and Alternative DEL-7 could affect up to 0.2 acre of vegetation with the riparian management area. The other alternatives would impact less area.

On-site mitigation could occur on property adjacent to Longfellow Creek between Southwest Andover Street and Southwest Yancy Street (as described in Section 5.1.2.1 for Preferred Alternative DUW-1a and Option DUW-1b). At this location, currently paved portions of stream buffer could be changed to vegetated areas of native plants. The existing stream buffers along Longfellow Creek could also provide opportunities for mitigation, where enhancement with native plantings could improve the ability of these areas to support wildlife. Plantings could also improve over-water shade to the creek, thus improving fish habitat.

If additional mitigation is needed (or if the property between Southwest Andover Street and Southwest Yancy Street is not acquired), Sound Transit would use one or more of the other mitigation methods listed within Section 5.1.2.1. Sound Transit would determine final mitigation actions during final design and permitting.

5.3 Upland Vegetation and Wildlife Resources

5.3.1 Avoidance and Minimization

Avoidance and minimization measures specific to upland resources could include the following design features and construction actions:

- Avoiding impacts to greenbelts where possible.
- Minimizing the placement of construction staging areas in forested areas where possible.
- Replanting cleared areas and implementing best management practices to minimize the risk of introducing or spreading invasive species.
- Reducing use of herbicides and fertilizers when restoring disturbed areas by using mulching, ground cover, and other planting strategies that discourage growth of undesirable species.
- Restricting clearing activities to outside the active bird nesting period, to the extent possible, to comply with the Migratory Bird Treaty Act, administered by the U.S. Fish and Wildlife Service. If avoidance scheduling is infeasible, Sound Transit would work with staff at the U.S. Fish and Wildlife Service to conduct pre-construction surveys to determine presence or absence of nesting migratory birds and assist Sound Transit in complying with the Migratory Bird Treaty Act.
- Minimizing tree removal along the corridor, where practical, and coordinating with the City of Seattle to minimize tree removal while also minimizing impacts on safety.
- Using a landscape design that prioritizes native plants and adaptable, low-maintenance plants suitable for the local climate, per the Sound Transit design manual. These plantings may improve upon existing conditions where non-native plants are currently present. Using native plants that do not require extensive irrigation would also allow restored areas to reestablish robust vegetated cover quickly and effectively after construction.

Data collection is in process to identify the precise number of street trees potentially impacted by the project. Within the Duwamish Shoreline jurisdiction, additional data are being gathered, including height, diameter at breast height, species, drip line, and health rating. All trees within the project footprint are being surveyed via desktop analysis, including light detection and ranging data, and confirmed during field investigations.

Work within the great blue heron management zone would require development of and adherence to a habitat management plan in coordination with the City of Seattle, Washington Department of Fish and Wildlife, and U.S. Fish and Wildlife Service. The City of Seattle requires a management plan that normally includes a year-round, 197-foot-radius buffer around nesting colonies, with an additional 300-foot buffer during the nesting season (February 1 through August 31). These metrics are similar to Washington Department of Fish and Wildlife recommendations. The City-required management plan may include a variety of measures, such as retaining trees to screen the colony, work sequencing in the buffers, preventing specific loud activities during the nesting season, monitoring during nesting season, or other measures as developed in coordination with Washington Department of Fish and Wildlife and the City of Seattle.

5.3.2 Compensatory Mitigation

Mitigation would be required under all alternatives for impacts on trees. Sound Transit would coordinate with the City of Seattle on tree replacement requirements. For trees permanently removed, Sound Transit would replace them or provide payment of in-lieu fees in compliance with (1) governing City regulations, (2) Seattle Department of Construction and Inspections Director's Rules, or (3) Executive Orders, or (4) as agreed upon in the West Seattle Link Extension Tree and Vegetation Management Plan. Tree replacement regulations include Seattle's Executive Order 2023-03. Current Seattle Department of Transportation replacement ratios are 3:1 for any tree removed in the City right-of-way and in city parks. Seattle Department of Construction and Inspections would require appropriate replacement for trees meeting the Tier 1, 2, or 3 definitions on private property. It is expected that some of the area proposed riparian area mitigation between Southwest Andover Street and Southwest Yancy Street could be used for tree replacement.

Additional mitigation would be needed under some Duwamish and Delridge segment alternatives that require removing trees and vegetation from contiguous forest habitat in the greenbelts. This mitigation is described in the following subsections.

5.3.2.1 Preferred Alternative DUW-1a and Option DUW-1b

To the extent that impacts cannot be avoided to acreage in the West Duwamish Greenbelt, Sound Transit would provide compensatory mitigation to achieve no net loss of ecosystem function. Sound Transit would mitigate for impacts on forested vegetation using applicable policy and regulations and would coordinate with the City of Seattle on tree replacement requirements, as noted above. The onsite mitigation area proposed in Section 5.1.2.1, on currently paved area between Southwest Andover Street and Southwest Yancy Street, could be used for upland habitat replacement.

5.3.2.2 All Delridge Segment Alternatives

Similar to West Duwamish Greenbelt impacts, Sound Transit would mitigate for unavoidable impacts to greenbelt acreage along Longfellow Creek using applicable policy and regulations. As noted above, tree replacements would be coordinated with the City of Seattle. Sound Transit expects that some of the area proposed for riparian area mitigation between Southwest Andover Street and Southwest Yancy Street could be used for upland habitat replacement within the same contiguous greenbelt where the impacts would occur.

5.4 Federally Listed Species, Species of Concern, Priority Species, and Species of Local Importance

5.4.1 Avoidance and Minimization

Avoidance and minimization measures for listed and sensitive species are covered in Sections 5.2, Aquatic Resources, and 5.3, Upland Vegetation and Wildlife Resources. These measures would fulfill key elements of recovery plans for Chinook salmon and steelhead (such as preserving water quality through stormwater control, preventing changes to water quality during construction in the Duwamish Waterway, and preserving salmon habitat in Longfellow Creek through avoiding in-water impacts).

5.4.2 Compensatory Mitigation

To the extent that impacts cannot be avoided to habitat used by priority species (that is, benthic habitat and stream buffer habitat for priority fish species), Sound Transit would provide compensatory mitigation to achieve no net loss of ecosystem function, or to improve upon baseline conditions. This mitigation would address both permanent and temporary impacts, as required.

Compensatory mitigation for benthic or stream buffer impacts (as described in Section 5.2.2.1 for aquatic impacts) would be planned to address limiting factors for salmon listed in the Chinook and steelhead recovery plans for the Duwamish Waterway and Longfellow Creek. Sound Transit would determine final mitigation actions in coordination with the Muckleshoot Indian Tribe, the Suquamish Tribe, and with federal, state, and local resource agencies during final design and permitting, as appropriate.

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