UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OR 97232-1274

Refer to NMFS No:
WCRO-2021-01064

September 26, 2022

Todd Tillinger
Chief Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, Bldg. 1202
Seattle, Washington 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the City of Sumner and BNSF White River Restoration Project and Sumner Staging Tracks Project (NWS-2020-1140) (HUC6 – 171100)

Dear Mr. Tillinger:

Thank you for your letter of May 6, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the City of Sumner and BNSF White River Restoration Project and Sumner Staging Tracks Project (NWS-2020-1140).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action.

The enclosed document contains a biological opinion prepared by NMFS pursuant to section 7 of the ESA on the effects of the proposed action. In this opinion, NMFS concludes that the proposed action would adversely affect but is not likely to jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS steelhead. NMFS also concludes that the proposed action is likely to adversely affect designated critical habitat for PS Chinook salmon and PS steelhead but is not likely to result in the destruction or adverse modification of that designated critical habitat. This Opinion also documents our rationale and conclusion that the proposed action is not likely to adversely affect Southern Resident killer whales or their designated critical habitat.

This Opinion includes an incidental take statement (ITS) that describes reasonable and prudent measures (RPMs) NMFS considers necessary or appropriate to minimize the incidental take associated with this action, and sets forth terms and conditions that the U.S. Army Corps of Engineers (Corps) must comply with in order to be exempt from the prohibitions of section 9 of the ESA.

Section 3 of this document includes our analysis of the action's likely effects on EFH pursuant to Section 305(b) of the MSA. Based on that analysis, the NMFS concluded that the action would adversely affect designated freshwater EFH for Pacific Coast Salmon. Therefore, we have provided 2 conservation recommendations that can be taken by the USACE to avoid and minimize potential adverse effects on EFH.

Section 305(b) (4) (B) of the MSA requires Federal agencies to provide a detailed written response to the NMFS within 30 days after receiving this recommendation. If the response is inconsistent with the EFH conservation recommendations, the USACE must explain why the recommendations will not be followed, including the scientific justification for any disagreements over the effects of the action and recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, the NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we request that in your statutory reply to the EFH portion of this consultation you clearly identify the number of conservation recommendations accepted.

Please contact Bonnie Shorin at Bonnie.Shorin@noaa.gov; or Stephanie Ehinger at stephanie.ehinger@noaa.gov, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Kim W. Kratz, PhD
Assistant Regional Administrator
Oregon Washington Coastal Office

cc: David Moore, USACE
Doug Beale, City of Sumner
Calvin Nutt, BNSF
Ellen Garcia, BNSF
Jacalen Printz, USACE

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion [and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the

City of Sumner and BNSF White River Restoration Project and Sumner Staging Tracks Project (NWS-2020-1140)

NMFS Consultation Number: WCRO-2021-01064

Action Agency: U.S. Army Corps of Engineers, Seattle District

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
Puget Sound steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern Resident Killer Whale (*Orcinus Orca*)	Endangered	No	No	No	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	No	No

Consultation Conducted By: National Marine Fisheries Service
West Coast Region

Issued By:

Kim W. Kratz, Ph.D.
Assistant Regional Administrator
Oregon Washington Coastal Office

Date: September 26, 2022

TABLE OF CONTENTS

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3, below.

1.1. Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at Oregon Washington Coastal Office in Lacey, Washington.

1.2. Consultation History

The Corps requested formal consultation on May 6, 2021, for the White River Restoration and Sumner Staging Tracks Projects in Sumner, Washington. The Corps endorsed and advanced to NMFS the applicant's (City of Sumner and BNSF) effects determination that the proposed action 'may affect, is likely to adversely affect' listed Puget Sound (PS) Chinook salmon and PS steelhead and their designated critical habitats. The Corps also endorsed the applicant's effect determination that the proposed action 'may affect, but is not likely to adversely affect' Southern Resident killer whales (SRKW). The Corps and applicant provided a Biological Evaluation, 60% submittal structural designs, and letters of support from the Puyallup Tribe of Indians, Muckleshoot Indian Tribe, Pierce Conservation District, Pierce County, Cascade Water Alliance[1], and Forterra[2]. On February 3, 2022, the Corps, NMFS, USFWS, and the applicants met virtually to discuss project specifics and answer questions from the Services (NMFS and USFWS). On February 17, 2022, NMFS provided a list of questions and a draft description of the proposed action to the Corps to review and finalize with the applicant in order for NMFS to complete its cursory review. On March 9, 2022, the Corps and the applicant provided written responses to the questions posed by NMFS and edits to the draft proposed action description. On May 25, 2022 NMFS received substantial updates to the proposed action including changes to the anchor system of the ELJs, related BMPs, and elimination of the previously proposed electric

[1] Cascade Water Alliance is a municipal corporation made up of seven municipalities including five cities and two water/sewer districts.
[2] Forterra is a 501(c)3 non-profit organization working on conservation issues throughout Washington State.

weir to isolate some work areas. NMFS determined information was complete and initiated formal consultation with the Corps on May 25, 2022. On June 8, 2022, the applicant proposed an extended mixing zone and coordinated approval with the Department of Ecology and NMFS. Clarification to the changes extended into August 2022.

	Status	Corps Species Determination	Corps Critical Habitat Determination	NMFS Species Determination	NMFS Critical Habitat Determination	Species Listing	Critical Habitat Listing
Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*)	T	LAA	LAA	LAA	LAA	06/28/05 (70 FR 37160)	09/02/05 (70 FR 52630)
Puget Sound steelhead (*O. mykiss*)	T	LAA	LAA	LAA	LAA	05/11/07 (72 FR 26722)	02/24/16 (81 FR 9252)
Southern Resident Killer Whales (*Orcinus orca*)	E	NLAA	N/A	NLAA	NLAA	11/18/05 (70 FR 57565)	11/29/06 (71 FR 69054)

T = threatened, E = Endangered

Figure 1. Image of Table Indicating USACE and NMFS Effects Determinations

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was initiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed actions articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (see 50 CFR 402.02). The Corps is proposing to the permit the project under section 404 of the CWA. Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

1.3.1 Project Overview

The City of Sumner, Washington (City) and BNSF Railway Company (BNSF) are jointly proposing environmental restoration and the construction of railroad staging tracks in Sumner, Washington. These two projects are considered together in this biological Opinion because excavated materials from the restoration project would be used to construct the new BNSF staging tracks. The purpose of the restoration component of the project is to improve aquatic habitat and water quality and to reduce flood risk by implementing a river corridor restoration project that includes channel and floodplain reconnection efforts. The restoration project would restore approximately 203 acres in and along the White River.

The proposed action includes:

- Construction of ten staging tracks built in parallel to the current tracks along the eastern edge of the project area.
- The 24th Street E railroad crossing would be permanently closed and four existing culverts that cross the existing rail line would be lengthened to the width of the proposed staging tracks embankment.
- The existing pedestrian crossing north of Stewart Road SE would also be extended. The proposed staging tracks would cross over the Dieringer Tailrace with two bridges.
- A 750-square foot prefabricated building would be installed at the northern end of the staging tracks to power the yard air system and eliminate the need to idle trains while staging. The building would have power, hookups through new utility extensions.
- At the northern end of the project area, north of Lake Tapps Parkway E, retaining walls would be constructed to support the tracks. Walls would also be constructed at the south end of the project adjacent to 150th Avenue, and in a few other locations along the length of the project to avoid impacts to adjacent property and provide vehicle passing and turnaround locations along the BNSF access road.
- Lighting would be installed to illuminate the switches at the north and south ends of the project area.

All in-water work, except for cofferdam removal, would occur during the work window of July 1 to August 31. The in-water work window was developed with input from the Washington Department of Fish and Wildlife (WDFW) and the Puyallup Tribal Fisheries. Cofferdam removal is proposed and permitted by WDFW from September 1 through November 30, outside of the approved in-water work window provided that no sheetpile is removed using a vibratory pile driver and turbidity impacts are limited to 300 feet downstream of the active in-water work area.

1.3.2 Site Preparation

Site preparation would occur during the first year of construction and includes staging and stockpiling of restoration materials (e.g., large wood, and streambed, planting, and habitat materials), construction equipment, and other materials within a 72-acre area at the north end of the project site (Figure 1). The staging area is outside of the restoration footprint and would also be used for staging, fueling, and maintaining construction equipment. Site preparation would also include construction of access points at the following locations:

- Stewart Road from the north,
- 24th Street E from the east, until 24th Street E crossing is removed,
- Right-of-way east of the General Dynamics Land Services building from the south,
- 24th Street E from west to the western revetments,
- 16th Street from the west to the 3.85 pond revetments.

Additionally, improvements to 24th Street E along the White River and temporary closure of the Sumner Link Trail on the west side of the White River would be necessary to support construction activities.

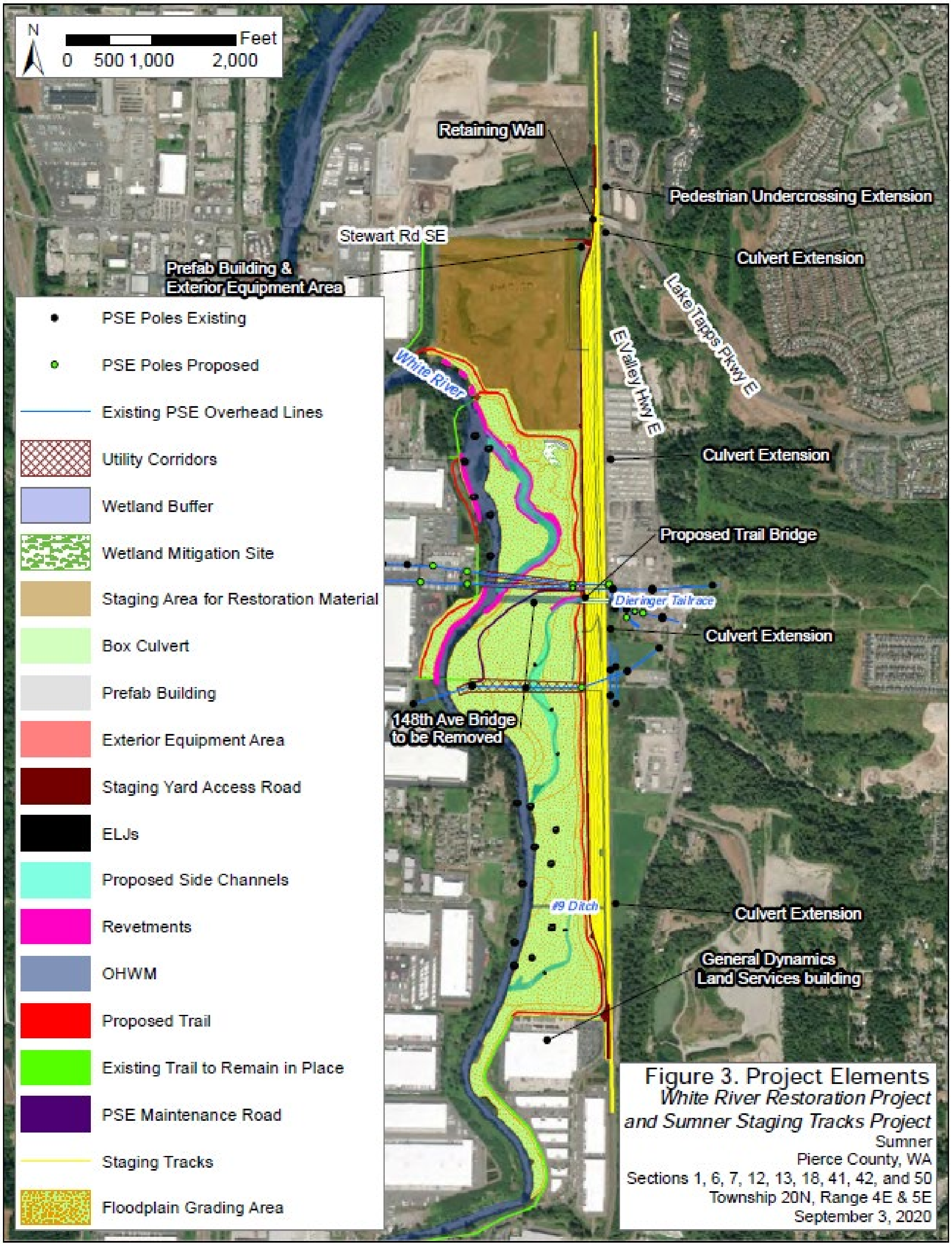

Figure 2. General project area and location of specific project components (Widener & Associates 2020).

1.3.3 Restoration Project

The restoration component of the project would include excavating and grading the floodplain, installing engineered log jams, complex wood revetments, and large rocks, re-routing the Dieringer Tailrace and #9 Ditch, restoring and enhancing main and off channel areas, revegetation of riparian and wetland areas, relocating the Sumner Link Trail, and replacing a bridge crossing the Dieringer Tailrace.

Floodplain and Channel Restoration

Floodplain excavation and grading would occur throughout the duration of the project. Excavators, scrapers, off-road trucks, and dozers would be used during excavation. In the first 2 years, approximately 755,482 cubic yards of excavated material would be moved to the staging tracks location to build the necessary embankments. After the material for the staging tracks and floodplain capacity has been removed, the grading process would occur. A forested berm along the northern and portions of the eastern edge of the floodplain grading area would be constructed and, in high-risk locations, reinforced with buried rock. The forested berm would provide a forested buffer around the restoration site and would be constructed to a height of the existing 100 year water surface elevation. Lower elevation areas within the floodplain would be graded to connect with side channels to prevent any fish from being stranded during high water events. Grading around the new side channels would create habitat diversity including floodplain wetlands, riparian areas, and upland forested habitat (Figure 2). Upon completion, excavation and grading would increase floodplain capacity by approximately 700,000 cubic yards. Engineered log jams (ELJ) and wood revetments would be installed as part of the restoration effort.

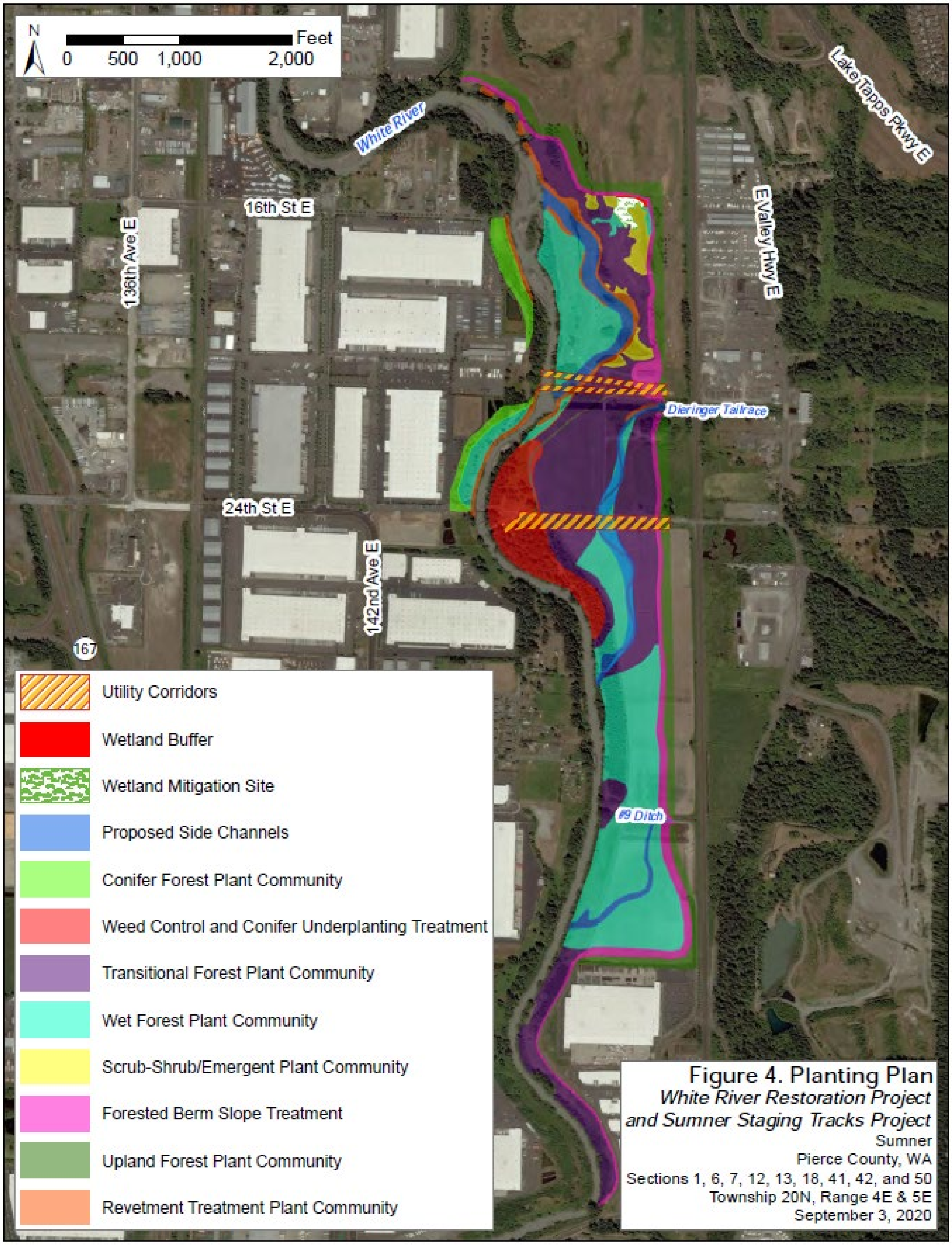

Figure 3. Planting plan for the White River restoration and Sumner Staging Tracks projects (Widener & Associates 2020).

Engineered Logjams

In total, thirty-one ELJs would be constructed for this project; 13 ELJs would be installed below the existing OHWM and 18 would be installed in the floodplain and constructed side channels. Three type-1 ELJs would be placed within the White River, located in an array at the upstream end of the project. Ten type-2 ELJs would be placed within the White River downstream from there, seven along the west bank, and three along the east bank. Additionally, four type-2 ELJs would be installed in the graded floodplain area and fourteen type-3 ELJs would be placed along the constructed side channels before flow is diverted.

In-water ELJs would be installed in years 2 and 3 and would require work below the OHWM and portions of the channel to be dewatered. Before dewatering, fish would be removed and relocated and the work area would be fully isolated until installation is completed (see *Fish Exclusion and Work Area Isolation* section below). The isolation area would extend 35-feet around each in-water ELJ using gravel super sacks or sheetpiles. Gravel super sacks would be placed using a crane or excavator and sheetpile would be installed with a vibratory pile driver. It is assumed that three to four of the in-water ELJs, 25-30 percent of the total, would be isolated using sheetpile (depending on flow conditions), a length of approximately 225-300 feet. Work area isolation installation and decommission is expected to take approximately 4 days per ELJ.

Over the course of the project approximately 3.2 acres of the White River would be isolated for in-water ELJ installation, although these isolation areas would not all be in place concurrently. Access points and isolation areas would be modified based on river conditions, but the total area impacted would not exceed 3.2 acres. One ELJ would be in the middle of the channel in an area that is currently a gravel bar. Water may be diverted to the furthest north channel to install the ELJ in the center of the White River channel depending on the state of the current gravel bar during construction.

All ELJs would include inclined key member logs that span the channel bank into the channel. The key member logs and racking material would be woven between buried wooden piles to minimize lateral movement. The key member logs and piles would be lashed together with steel cable and clamps to ballast the key member logs against buoyant forces. 5/8-inch galvanized steel cables would be tensioned to a minimum of 1,000 pounds and secured with at least four steel clamps. An excavated pool would accompany each ELJ to provide additional habitat complexity. Excavated native alluvium would be placed on the completed ELJ for ballast and to facilitate vegetation development.

After evaluation of risks and benefits, the project proposes to use cables rather than threaded rods to anchor the logs. Reasons include that threaded rod reduces log strength and increases the speed and amount of wood rot. To increase duration of structural integrity of key wood members, cable was chosen and best management practices developed to avoid the common risks associated with anchoring logs with cables.

Best management practices proposed are:

- The City of Sumner will perform visual monitoring of the log structures once every two years to identify any issues with the cable lashings.
- If a cable lashing fully or partially fails, the City would cut or remove exposed cable.

- Fraying cable ends would not be allowed to remain in the water and cables which partially tether logs that would pose a risk to the overall wood structure or channel bank would be cut and all exposed cabling removed.
- Cables which loosen over time, but are not frayed or tethering floating wood and pose no threat to structure stability would remain in place to avoid unnecessary disturbance to the bank.

A total of 14, 21-23-inch timber piles would be driven to secure each type-1 ELJ (Table 1); 10, 21-23-inch timber piles would secure each type-2 ELJ; and 6, 17-18-inch timber piles would secure each type-3 ELJ. Piles would be driven to a depth of 20 to 50 feet below the substrate, depending on structure type. Vibratory pile driving would be used as much as possible and impact driving would be used when necessary. For this Opinion, we assume all piles would require impact driving. A total of 182, 21-23- inch piles would be driven for Type-1 and -2 ELJs, with 117 of them below the existing OHWM. A total of 84, 16-18 inch piles would be driven for Type-3 ELJs, with none below existing OHWM. All timber piles installed below the existing OHWM would be driven in completely isolated dry conditions[3].

Pile driving would occur for up to 10-hours a day, 5 days per week during the in-water work window (July 1-August 31). Cofferdam installation and removal during the in-water work window would create turbidity impacts limited to 1,000 feet downstream of the project area. Cofferdam removal is permitted outside of the approved in-water work window provided that no sheetpile is removed using a vibratory pile driver and turbidity impacts are limited to 300 feet downstream of the active in-water work area.

Table 1. Total number of timber piles to be installed with engineered log jams.

	Timber Pile Size		
Structure (n)	16-18”	21-23”	**Total**
ELJ Type 1 (3)	0	42	42
ELJ Type 2 (14)	0	140	140
ELJ Type 3 (14)	84	0	84
Total	84	182	266

<u>In-Water Complex Wood Revetments</u>

In total, approximately 6,800 linear feet of complex wood revetments would be installed as part of the restoration project; approximately 2,600 linear feet would be installed in the existing channel. Two types of revetments would be installed: dolos-timber and batterpile.

Dolos-timber revetments would be constructed with 22-26-inch diameter base logs, 21-23-inch diameter timber piles, dolosse[4], 6-12-inch diameter racking logs, and cable lashing. Dolos-timber revetment placement areas would be excavated to place the base and racking logs along and selectively into the bank. Timber piles and dolosse would be used to secure the dolos-timber

[3] Email from David J. Moore, USACE, on Monday March 14, 2022. See administrative record.
[4] Dolosse are reinforced concrete blocks in a complex geometric shape that is used to build coastal or in-water revetments and protects against erosion.

revetments in place. A total of 248 dolosse would be placed (Table 2). Cable lashings would be used to attach wood to the timber piles. Five base logs, six timber piles, eight dolosse, and 100 racking logs would be used for every 40-foot unit section of revetment.

Batterpile revetments would be constructed with 22- to 26-inch and 18- to 22-inch diameter base logs, 16- to 18-inch diameter timber piles (see Table 1), and 6- to 12-inch diameter racking logs. Batterpile revetments would be secured with the 16-18-inch timber piles driven with batter using the same method as the ELJ piles (combination of vibratory and pile driving).

A crane, excavator, impact hammer, and a vibratory hammer would be used to construct the revetments. A total of 930 timber piles would be driven for revetments, with 275 of them below the existing OHWM.

In-water revetments would be installed in years 2 and 3 and would require fish exclusion and work area isolation (see the *Work Area Isolation and Fish Exclusion* section). It would take approximately 5 days to isolate the work area for each revetment, which may be split into several phases for portions of the revetment length. It is anticipated that each isolation structure will require 3 days to remove. Approximately 4.09 acres of the White River would be isolated for revetment installation. Access points and isolation areas may change, but total area impacted would not exceed 4.09 acres. The revetments that cut through the existing Dieringer Tailrace would be installed after the Tailrace has been diverted to the new proposed channel. The applicant expects that a maximum of 25 percent of the 6,800 linear feet perimeter will be required to be isolated for revetment construction; of those approximately 700 feet, would require sheetpile cofferdams.

Cofferdam installation and removal during the in-water work window will create turbidity impacts limited to 1,000 feet downstream of the project area. Cofferdam removal is permitted outside of the approved in-water work window provided that no sheetpile is removed using a vibratory pile driver and turbidity impacts are limited to 300 feet downstream of the active in-water work area.

Table 2. Total number of timber piles to be installed with wood revetments.

	Timber Pile Size		
Structure	16-18”	21-23”	**Total**
Dolo-timber	0	186	186
Batterpile	744	0	744
Total	744	186	930

<u>Rock Roughness Features</u>

A total of 10 rock features would be placed below the OHWM of the White River. Each rock feature would sit on approximately 135 square feet of substrate and be approximately 10 cubic yards. Rocks would be placed as gently as possible from the bank with an excavator to minimize sedimentation. A qualified biologist would be present to ensure fish are not harmed during rock placement. All rocks would be placed during the approved in-water work window (July 1-August

31). Approximately 100 cubic yards of rock roughness features would be placed in the White River.

<u>Off-Channel Habitat and Channel Reconnection</u>

Side channels would be constructed in years 2 through 4. Side channel excavation and grading would occur concurrently with floodplain excavation and grading. However, filling of the Dieringer Tailrace and the #9 Ditch would not occur until water has been diverted to the new proposed side channels. Approximately 0.51 acres of the #9 Ditch and approximately 1.45 acres of the Dieringer Tailrace would be filled. Approximately 13 acres of new open-water side channels would be created. The majority of the side channel grading work would occur upland of the existing White River, Dieringer Tailrace, and #9 Ditch. Excavators, dozers, and graders would be used to excavate out the proposed side channels and trucks would deliver the excavated material to be used as fill for the staging tracks. Each new side channel would have the bottom lined with either native streambed material or imported streambed materials that meet WSDOT Standard Specification for Streambed Sediment 9-03.11(1) augmented with Streambed Cobbles 9-03.11(2) sized appropriately for hydraulic conditions anticipated in the new channel before water is diverted to them. Best management practices (BMPs) such as sediment curtains or silt booms would be put in place prior to water diversion to reduce the risk of sedimentation from the new channels as appropriate.

The #9 Ditch and Dieringer Tailrace would have two sets of block nets installed when their channel connections need to be made. A qualified biologist would check the fish barriers and excluded areas prior to the dewatering of the channel to be abandoned to see if any fish made it past the barrier. Super sacks filled with native alluvium would be used to isolate the connection areas. Water would be diverted with a pump system in the #9 Ditch. Any pumps operated in areas where complete fish exclusion has not been completed will have screened intakes. Once channel connections have been excavated and streambed mix has been placed, water would be diverted to the new channels and the existing #9 Ditch and Dieringer Tailrace would be filled.

Side channel connections with the main stem of the White River would be isolated with gravel super sacks and/or sheetpile cofferdams. Before dewatering, fish exclusion would use the approach described in the *Work Area Isolation and Fish Exclusion* section. The applicant expects that a maximum of 25 percent of the perimeter will be required to be isolated for channel connections and approximately 150 feet, would require sheetpile cofferdams.

Bridge Construction and Culvert Extensions

A three-span bridge supported by four pile bents would be constructed for a portion of the staging tracks adjacent to and over the existing railroad bridge. An expanded four-span bridge supported by five pile bents would be constructed west of the existing foundation for the remaining tracks. The two bridges would be supported by 276, 14-inch steel piles and sheetpile at the bridge abutments. The existing railroad bridge that carries the two existing tracks over the Dieringer Tailrace would not be impacted in any significant way by construction of the new bridges. The final designs are still under review and would be finalized after review and approval by Cascade Water Alliance. Any design adjustments would not shorten the span, exceed 376 H-piles, or exceed 90 feet in sheetpile length.

A total of four culverts would be extended under the proposed staging tracks, two of which would be installed on fish bearing waters, #9 Ditch and an unnamed ditch[5]. Each culvert would be extended with the appropriately sized corrugated metal pipe (CMP) or high-density polyethylene pipe to span the width of the staging tracks and a portion of the forested berm. See following section for fish exclusion and work area isolation methods.

Riparian Forest and Wetland Restoration
Approximately 172 acres of revegetation of native tree, shrub, and ground cover species would be conducted as part of this project (Figure 3). The planting plan has divided the site into 8 different plant communities: revetment plant community (approximately 5 acres), wet forest community (approximately 64 acres), transitional forest community (approximately 48 acres), conifer forest community (approximately 2 acres), upland forest plant community (approximately 18 acres), scrub-shrub/emergent plant community (approximately 5 acres), forested berm slope treatment (approximately 13 acres), and weed control and conifer under planting treatment (approximately 17 acres). Trees in the weed control and conifer under planting treatment would be preserved as this area would not be graded. Because trees would be preserved here, large woody debris (LWD) recruitment would still be possible within the project reach of the White River during and after construction. Plants would also be added in this area to improve habitat and reduce the risk of invasive species colonization. Utility corridors for overhead power and underground utilities would be planted with shrubs that can tolerate maintenance by utility crews. The onsite mitigation site would include a 1-acre wetland and 0.18-acre wetland buffer.

Trail Relocation and Bridge Construction
In years 4 and 5 the existing portions of the Sumner Link Trail would be relocated and a new pedestrian bridge would be constructed. A new 16-foot trail corridor would be added on the forested bench at the eastern end of the floodplain grading area. Connections would also be made to access the east side of the river. The trail would cross the Dieringer Tailrace on a single-span bridge. The bridge abutments would be installed outside of the existing and proposed OHWM. Four, 18-inch steel pipe piles would be installed at each side of the channel to support the bridge abutments. These piles would be driven upland of the OHWM and outside the floodplain with an impact hammer. Pile driving would occur over 2, 10-hour days. A pre-manufactured grated truss bridge or tied arch bridge would be placed atop the abutments. Cranes, concrete trucks, and concrete pumps would be utilized for during construction. Cranes on either bank would be set an appropriate distance from the riverbank so as not to disturb the river or bank soils. The bridge at 148th Avenue E that cross the Dieringer Tailrace would be removed while the filling of the tailrace is occurring. Debris would be hauled off site for material salvage and/or disposal.

Implementation of Recovery Actions
As further detailed below in chapter 2.3.5 *Critical Habitat in the Action Area* and outlined in the Puyallup-White chapter of the Recovery Plan (NMFS 2006b), restoring floodplain connectivity

[5] The #9 ditch is the southernmost crossing, it has documented fish presence (coho and cutthroat) downstream of the BNSF railroad culvert. Puyallup Tribal Fisheries was unable to find any fish upstream of the of the BNSF railroad culvert via electro-shocking.

is one of the actions outlined to support recovery. The floodplain channel restoration portion of this project specifically addresses this recovery element.

<u>1.3.4 Staging Tracks Project</u>

Staging Track construction

Ten staging tracks ranging from 7,700 feet and 9,200 feet in length would be constructed from years 2 to 5. Staging track construction activities include clearing and grubbing, constructing the embankment, laying rail ties, laying track, and modifying the existing Dieringer Tailrace that runs perpendicular to the existing tracks to support the proposed tracks. The bridge carrying the existing BNSF track would be left in place, and bridges would be constructed over the Dieringer Tailrace for the proposed staging tracks to cross the tailrace. Nearly 670 cubic yards of excavation would be necessary to remove unsuitable materials and extend/construct culverts in order to construct the embankment and lay the tracks. Corrugated metal pipe culverts in non-fish bearing ditches would be extended to match or exceed the existing culvert widths. A pedestrian undercrossing would also be extended.

Approximately 1 million cubic yards of embankment fill and 44,000 cubic yards of subballast fill are also necessary to construct the embankment and lay the tracks. Most of the embankment fill would be sourced from the proposed excavated floodplain material. The area would be graded level for track placement. A retaining wall would be constructed to minimize the fill footprint needed for the staging tracks at the northern end of the project and avoid additional wetland impacts and at the south end of the project avoid impacts to 150th Avenue. A few other additional short sections of wall would be installed to provide BNSF access road vehicle turnaround and to avoid impacts to adjacent property. A total of approximately 2,500 linear feet of wall would be constructed. All walls would be outside the floodplain. Track construction would begin with track berm placement and embankment stabilization. Embankment stabilization is anticipated to be achieved by preloading the embankment and allowing it to settle for approximately one year or by installing rammed aggregate piers under the proposed embankment.

Staging track construction would also include filling 0.78 acres of constructed water features and 9,450 linear feet of drainage ditches originally associated with the Sumner Meadows Golf Links. Erosion control measures would be put in place to protect the Dieringer Tailrace from debris. Ballast would be placed above the staging tracks fill. Utility conduits (signalization, electrical, and air) would be buried prior to ballast placement. Rail ties and rails would be installed after ballast placement. A 3.7 acre access road would also be installed. Compacted gravel would form the surface of the road which would run along the western edge of the staging tracks. Stormwater treatment facilities are included in this proposal and discussed in subsequent sections.

Utility Relocations

Existing utility lines (water, gas, communications, and sewer) would be relocated over the course of the project in order to maintain function upon completion of the project. All underground utilities would be drilled deeper than their existing depths. The existing Puget Sound Energy (PSE) overhead powerlines would remain in their current corridor, but poles would be removed and relocated as necessary to accommodate the proposed project elements. Fiberoptic cables would be installed in new conduit that would be directionally drilled below the project area along 24th Street E.

City of Sumner sewer lines would be directionally drilled to lower elevations and the sewer pump station would be relocated east of the BNSF tracks. The existing water and sewer pipes on the 24th Street pedestrian bridge over the White River would remain in place. PSE gas and communication lines would be directionally drilled below the White River. The lines would then have a new crossing under the White River completed with a directional drill as to not impact the White River. Directional drilling would occur at least 24.5 feet below the thalweg of the river. The lines would be approximately 40 feet below the surface for the majority of their length. The corridors would be planted with native shrubs that can be easily cleared if the corridors need to be accessed in the future

1.3.5 Stormwater

Currently within the project area there is approximately 2.2 acres of non-pollutant generating impervious surface (NPGIS) and approximately 1 acre of pollutant generating impervious surface (PGIS). The 1 acre of PGIS is 24th Street E, which currently has no treatment for stormwater, would be removed as part of this project. The Sumner Link Trail south of the #9 Ditch within the project area is made up of pervious pavement.

The project would install approximately 4.6 acres of NPGIS. Approximately 1 acre of this is the PSE access road. This surface is considered NPGIS as it would be utilized by less than one motorized vehicle per month. Stormwater would sheet flow off the pavement into the habitat restoration area where it would infiltrate. The remaining 3.6 of the new NPGIS would be needed for the relocated Sumner Link Trail.

A total of 3.7 acres of PGIS are proposed as an access road for the staging tracks. Stormwater from this access road would sheet flow or flow through underdrains to vegetated swales before passing though culverts and being released into the habitat restoration area to infiltrate. All new PGIS would be 100% treated through retention and infiltration. No discharge of untreated stormwater to aquatic areas would occur.

New stormwater culverts are proposed just north of the 150th Avenue cul-de-sac and along the western edge of the BNSF right of way (ROW) just south of Lake Tapps. Both culverts are conveying ditch water that gets trapped by the proposed forested berm and would convey stormwater toward the restoration area. The proposed culvert along the western edge of the BNSF ROW will connect the proposed ditch to the ditch outlet where a culvert is necessary as the proposed forested berm is at a higher elevation than the ditch. It will provide overflow conveyance for an existing low spot under/adjacent to Lake Tapps Parkway E (to which the northernmost of the 4 culverts being lengthened outfalls) and thru put conveyance of existing drainages. The culvert north of the 150th Avenue cul-de-sac would convey water originating at the City stormwater pond located south of the project limits and a spring adjacent to the BNSF embankment. A new broad drainage swale is being proposed to intercept the outlet of the proposed culvert.

1.3.6 Fish Exclusion and Work Area Isolation

All fish capture, handling, and relocation efforts would be completed by a qualified biologist and would follow the latest WSDOT Fish Exclusion Protocols and standards (WSDOT 2016).

Methods used at each location requiring fish exclusion and work area isolation vary slightly and are explained in the following sections.

Dieringer Tailrace

Fish exclusion of the tailrace would be conducted by herding fish downstream with a block net. However, because of the size of the area to be excluded, electrofishing may be necessary to successfully remove all fish from the tailrace. Once all fish have been removed, two sets of block nets would be installed and would remain in place throughout the work within the Dieringer Tailrace until water is diverted into the new channel. Work is anticipated to occur in years 2-4. The nets would be maintained daily throughout construction and remain in place outside the in-water work window unless water levels make maintenance impractical. If the nets must be removed, fish exclusion would occur at the beginning of the following in-water work window in any areas which had become accessible.

Isolation of the work area in the Dieringer Tailrace is anticipated to occur in two locations. One set of cofferdams would be constructed to isolate the area needed for the impact driving of bridge piles and placement of riprap around the abutments. A separate set of cofferdams would be placed around the length of channel to be filled. A super sack and/or sheetpile (maximum length 150 feet) cofferdam would be installed upstream of the in-water work area and then a cofferdam would be installed on the downstream side of the work area to prevent backwater into the work area. The area would then be dewatered. Once the cofferdams are in place, if necessary, a pipe would be used to convey water that releases on a slow, continual basis. A full bypass is not anticipated for the installation of the staging tracks bridges, as the flows will be low (generally 15-20 cubic feet per second (cfs)) in the channel during the work period. The contractor, in coordination with Cascade Water Alliance, would arrange multiple weeks with no planned additional water releases during the summer months. During this time, the contractor would install cofferdams, dewater, complete grading work, install riprap, and conduct pile driving. The placement of the cofferdams for the channel fill would only occur when water is being redirected into the new channel.

As per coordination with state agencies (Washington State Department of Ecology and WDFW) and Tribes (Puyallup and Muckleshoot), the staging tracks bridge crossing may be fitted with a permanent fish barrier downstream on the outlet end to prevent fish from accessing the powerhouse tail works (Lake Tapps outfall) upstream of the railroad. The final design of the barrier would be determined through this coordination. The pump system and cofferdams would be removed once the bridges are completed. Cofferdam removal is permitted outside of the approved in-water work window, provided that no sheetpile is removed using a vibratory pile driver and turbidity impacts are limited to 300 feet downstream of the in-water work area.

#9 Ditch

The entirety of the #9 Ditch, from upstream of the culvert under the existing BNSF railroad tracks to the mouth, would be fish excluded prior to any ditch work in accordance with WSDOT fish exclusion protocols (WSDOT 2016). Fish removal would consist of partially blocking or diverting flow from the upstream side of the work area and allowing any fish to volitionally leave downstream prior to complete isolation. A qualified biologist would then work to herd fish from either side of the culvert and set temporary isolation on either side of the culvert. Fish herded upstream of the culvert would be moved in buckets downstream of the isolation area. Fish would then be herded using block nets to the culvert under the existing trail where another temporary block would be placed. Fish would be herded the remaining length of the ditch to the White River. A temporary block net would be set in place to block fish while an electronic fish barrier is installed. The fish barrier would remain in place for the duration of work in the #9 Ditch which is anticipated to occur during years 2-4. The length of the fish-blocked area would be checked at the start of every in-water work window to make sure no fish have made it past the barrier.

Unnamed Fish Bearing Ditch
Fish exclusion for the unnamed fish bearing ditch would be conducted by a qualified biologist in accordance with WSDOT fish exclusion protocols (WSDOT). Fish removal would consist of partially blocking/diverting flow from the upstream side of the work area and allowing any fish to leave downstream on their own volition prior to complete isolation. A qualified biologist would then work to herd fish from either side of the culvert and set temporary isolation on either side of the culvert. Fish herded upstream of the culvert would be moved in buckets downstream of the isolation area. A diversion would be installed by placing a gravel super sack downstream of the culvert and one upstream. Water would be diverted with a pump system or gravity system if possible. The diversion would be removed once the extensions are complete.

Engineered Log Jams and Wood Revetments
Prior to installation of ELJs or wood revetments the area would be isolated and fish excluded. Fish removal would consist of partially blocking/diverting flow from the upstream side of the work area surrounding each ELJ/revetment and allowing fish to leave downstream on their own volition. Prior to completely isolating the work area, biologists would use block nets to herd any remaining fish out of the work area. Once the area is completely isolated with gravel super sack and/or sheetpile cofferdams and block nets installed tight to the banks, the area would be dewatered, and any remaining fish would be removed.

Off-Channel Habitat and Channel Reconnection
Fish removal would consist of partially blocking/diverting flow from the upstream side of the work area and allowing fish to leave downstream on their own volition. Prior to completely isolating the work area, qualified biologists would utilize block nets to herd any remaining fish out of in-water work area to be isolated. Once the area is completely isolated with gravel super sack and/or sheetpile cofferdams and block nets installed tight to the banks, the area would be dewatered, with any remaining fish removed.

The proposed worksite isolation would employ a maximum of approximately 1,400 feet of sheetpile:

feet	Sheetpile maximum length
300	ELJ isolation
700	revetment isolation
150	side channel isolation
90	bridges
150	Dieringer Tailrace
1390	Sum

Figure 4. Amount of Sheetpile to be used per project element

1.3.7 Best Management Practices and Minimization Measures

The following measures would be implemented as part of the project to avoid and minimize project impacts on listed species:

- Site and equipment preparation:
    - A spill prevention control, and countermeasures (SPCC) plan would be implemented to prevent fuels, lubricants, and other hazardous materials from entering the White River, Dieringer Tailrace, and adjacent wetlands.
    - Erosion control BMPs including silt fencing, straw (certified weed free), and catch basin sediment traps would be used and maintained throughout construction.
    - A temporary erosion and sediment control (TESC) plan and a stormwater pollution prevention plan (SWPP) would be developed.
    - Regular inspections of project BMPs would be conducted by a Certified Erosion and Sediment Control Lead (CESCL) in accordance with the National Pollution Discharge Elimination System (NPDES) Construction Stormwater General Permit (CSWGP) issued by the Washington State Department of Ecology (WSDOE).
    - To reduce turbidity outside of the isolated in-water work area, cofferdams, gravity bypasses, silt booms, and screened dewatering pumps would be utilized and maintained throughout construction. These BMPs would be incorporated into the final TESC plan and SWPPP. A Section 401 Water Quality Monitoring and Protection Plan (WQMPP) would also be approved by the WSDOE prior to construction. This plan would be designed to reduce turbidity impacts to the maximum extent possible. As part of this WQMPP, turbidity monitoring would be conducted at least twice a day during in-water work. Turbidity monitoring would be conducted using a calibrated turbidimeter.
    - All equipment would be checked daily for leaks and any necessary repairs would be made prior to the commencement of work.
    - Any equipment operating below the ordinary OHWM of the White River or the Dieringer Tailrace would use vegetable-based hydraulic fluids.

    - Access points would be designed to limit as much in-water work as possible.
- Construction methods and timing:
    - All in-water work would occur within the proposed in-water work window of July 1 to August 31, which has been determined through consultations with WDFW and the Puyallup Tribal Fisheries. Cofferdam installation and removal during the in-water work window will create turbidity impacts limited to 1000 feet downstream of the project area based on an extended area of mixing approved by the Washington State Department of Ecology. Cofferdam removal outside of the work window is permitted September 1 through November 30 with elevated turbidity limited to 300 feet downstream. To ensure compliance with state water quality standards, qualified personnel would be onsite during in-water work to monitor turbidity.
    - Sheetpile removal outside of the in-water work window would not use vibratory pile drivers.
    - All timber piles driven waterward of the OHWM would be driven in complete isolation. The piles would be driven with a vibratory pile driver as deep as possible, but some may require impact driving for most of the depth.
    - All steel piles supporting the bridges would be driven in isolation from flowing water.
    - All waste materials would be full contained and disposed of offsite in accordance with federal, state, and local laws.

1.3.8 Monitoring and Maintenance

Monitoring and long-term maintenance is proposed to occur following project completion to ensure the success of the habitat restoration and staging tracks operation. The following maintenance and monitoring objectives would occur once the project is completed:

- City of Sumner:
    - Perimeter flood and scour protection, including repair/replacement of buried rock reinforcement along forested bench
    - Weed control (Mechanical removal and chemical treatment if necessary) and adaptive replacement plantings of vegetative communities
    - Channel capacity review in light of ongoing aggradation of the White River
    - Vegetation management to avoid potential conflict with overhead power
    - Utility owner access to service power, sewer, water, communication, and gas facilities
    - Visual monitoring of the log structures once every two years to identify any issues with the cable lashings. If a cable lashing fully or partially fails, the City would cut or remove exposed cable. Fraying cable ends would not be allowed to remain in the water and cables which partially tether logs that would pose a risk to the overall wood structure or channel bank would be cut and all exposed cabling removed.
- BNSF
    - Maintaining drainage facilities to ensure they are functioning properly

- Maintaining the integrity of the embankment and ensuring the shoulder and side slope are not subject to erosion
- Ensuring function and unimpeded flow of the culverts crossing the BNSF right-of-way
- Ensure no locomotive fueling or maintenance occurs on the proposed staging tracks

1.4. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The action area includes areas where effects to the aquatic environment are likely. The Corps and applicant's Biological Evaluation identifies the aquatic action area as the upstream and downstream most extent of turbidity and noise effects. The Corps and the applicants estimate aquatic impacts would occur approximately 0.18 miles upstream of the furthest isolation area and approximately one mile downstream of the furthest downstream side channel connection in the White River as a result of turbidity and pile driving impacts. The aquatic action area would also include the Dieringer Tailrace and #9 ditch between the White River and the proposed track staging area. Action area extent based on noise impact was determined using a spreading loss model based on vibratory driving sheetpiles. The applicants determined that noise generated during vibratory sheetpile driving would become indistinguishable from background levels at approximately 0.29 miles from the proposed sheetpile installation areas. However, due to the sinuosity of the White River, land masses would attenuate elevated noise at approximately 0.18 miles. NMFS concurs with the action area described by the Corps and the applicants (Figure 5).

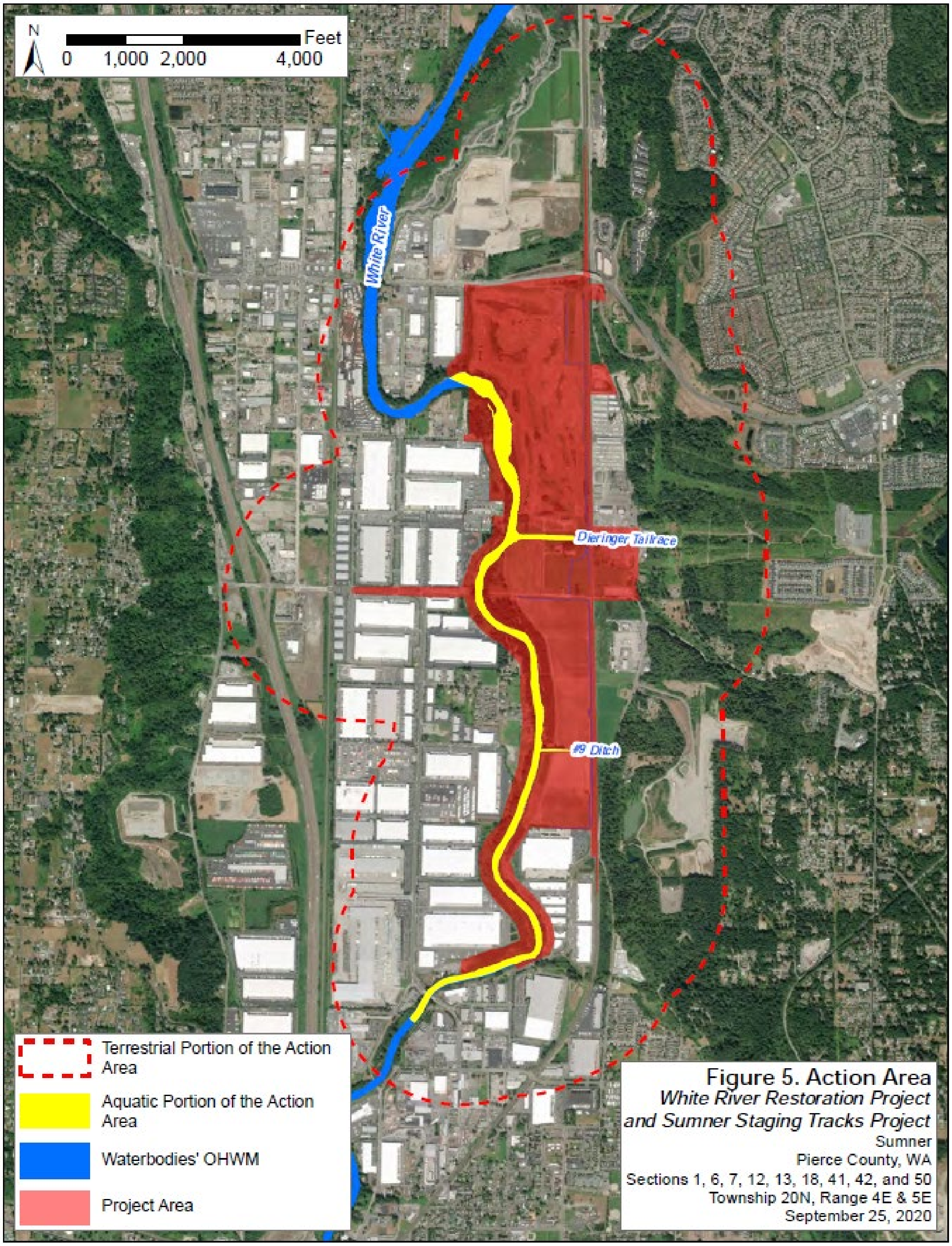

Figure 5. White River and Sumner Staging Tracks action area determined by the Corps and applicants. NMFS concurs with the action area extent depicted above, but notes that the action area also includes the 1 mile reach below the furthest downstream construction point, which is not depicted in the above figure (Widener & Associates 2020).

2. ENDANGERED SPECIES ACT BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species or to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The Corps determined the proposed action is not likely to adversely affect SRKW. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.11). NMFS also included an analysis of SRKW critical habitat given the effects to Chinook salmon, an important prey species (PBF) for SRKW.

2.1. Analytical Approach

This biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214, February 11, 2016).

The designations of critical habitat for PS Chinook salmon and PS steelhead uses the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR part 424) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

The following effects analysis of the proposed action on ESA-listed species and critical habitat was limited as finalized project designs have not yet been completed. Additionally, certain aspects of the project are dependent on site conditions at the time of construction; the White River is dynamic system changing and shifting annually and highly influenced by hydrologic conditions. Therefore, we made the following assumptions to complete the effects analysis:

- Impact driving would be required to install all timber piles;
- All timber piles installed below the existing OHWM would be driven while completely isolated in dry conditions;
- Steel piles supporting the bridges would be impact driven while completely isolated in dry conditions;
- 25% of ELJs would be isolated with sheetpile rather than gravel super sacks;
- 25% of revetment would be isolated with sheetpile rather than gravel super sacks;
- 25% of the perimeter required to be isolated for channel connections would require sheetpile; and
- Sheetpile would be installed during the in-water work window and could be removed
- All ELJs/revetments installed below OHWM would require some in-water work.

Finally, we assume that conservation measures and BMPs would implemented as described in the Proposed Action section above (section 1.3). These assumptions are conservative in that they represent the most harmful effects to listed species and critical habitat.

2.2. Rangewide Status of the Species and Critical Habitat

This Opinion examines the status of each species that is likely to be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" for the jeopardy analysis. The Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. Major ecological realignments are already occurring in response to climate change (IPCC WGII, 2022). Long-term trends in warming have continued at global, national and regional scales. Global surface temperatures in the last decade (2010s) were estimated to be 1.09 °C higher than the 1850-1900 baseline period, with larger increases over land ~1.6 °C compared to oceans ~0.88 (IPCC WGI, 2021). The vast majority of this warming has been attributed to anthropogenic releases of greenhouse gases (IPCC WGI, 2021). Globally, 2014-2018 were the 5 warmest years on record both on land and in the ocean (2018 was the 4th warmest) (NOAA NCEI 2022). Events such as the 2013-2016 marine heatwave (Jacox et al. 2018) have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality (IPCC WGII 2022). These two factors are often examined in isolation, but likely have interacting effects on ecosystem function.

Updated projections of climate change are similar to or greater than previous projections (IPCC WGI, 2021). NMFS is increasingly confident in our projections of changes to freshwater and marine systems because every year brings stronger validation of previous predictions in both physical and biological realms. Retaining and restoring habitat complexity, access to climate refuges (both flow and temperature) and improving growth opportunity in both freshwater and marine environments are strongly advocated in the recent literature (Siegel and Crozier 2020). Climate change is systemic, influencing freshwater, estuarine, and marine conditions. Other systems are also being influenced by changing climatic conditions. Literature reviews on the impacts of climate change on Pacific salmon (Crozier 2015, 2016, 2017, Crozier and Siegel 2018, Siegel and Crozier 2019, 2020) have collected hundreds of papers documenting the major themes relevant for salmon. Here we describe habitat changes relevant to Pacific salmon and steelhead, prior to describing how these changes result in the varied specific mechanisms impacting these species in subsequent sections.

Forests

Climate change will impact forests of the western U.S., which dominate the landscape of many watersheds in the region. Forests are already showing evidence of increased drought severity, forest fire, and insect outbreak (Halofsky et al. 2020). Additionally, climate change will affect tree reproduction, growth, and phenology, which will lead to spatial shifts in vegetation. Halofsky et al. (2018) projected that the largest changes will occur at low- and high-elevation forests, with expansion of low-elevation dry forests and diminishing high-elevation cold forests and subalpine habitats.

Forest fires affect salmon streams by altering sediment load, channel structure, and stream temperature through the removal of canopy. Holden et al. (2018) examined environmental factors contributing to observed increases in the extent of forest fires throughout the western U.S. They found strong correlations between the number of dry-season rainy days and the annual extent of forest fires, as well as a significant decline in the number of dry-season rainy days over the study period (1984-2015). Consequently, predicted decreases in dry-season precipitation, combined with increases in air temperature, will likely contribute to the existing trend toward more extensive and severe forest fires and the continued expansion of fires into higher elevation and wetter forests (Alizedeh 2021).

Agne et al. (2018) reviewed literature on insect outbreaks and other pathogens affecting coastal Douglas-fir forests in the Pacific Northwest and examined how future climate change may influence disturbance ecology. They suggest that Douglas-fir beetle and black stain root disease could become more prevalent with climate change, while other pathogens will be more affected by management practices. Agne et al. (2018) also suggested that due to complex interacting effects of disturbance and disease, climate impacts will differ by region and forest type.

Freshwater Environments

The following is excerpted from Siegel and Crozier (2019), who present a review of recent scientific literature evaluating effects of climate change, describing the projected impacts of climate change on instream flows:

Cooper et al. (2018) examined whether the magnitude of low river flows in the western U.S., which generally occur in September or October, are driven more by summer conditions or the prior winter's precipitation. They found that while low flows were more sensitive to summer evaporative demand than to winter precipitation, interannual variability in winter precipitation was greater. Malek et al. (2018), predicted that summer evapotranspiration is likely to increase in conjunction with declines in snowpack and increased variability in winter precipitation. Their results suggest that low summer flows are likely to become lower, more variable, and less predictable.

The effect of climate change on ground water availability is likely to be uneven. Sridhar et al. (2018) coupled a surface-flow model with a ground-flow model to improve predictions of surface water availability with climate change in the Snake River Basin. Projections using RCP 4.5 and 8.5 emission scenarios suggested an increase in water table heights in downstream areas of the basin and a decrease in upstream areas.

As cited in Siegel and Crozier (2019), Isaak et al. (2018), examined recent trends in stream temperature across the Western U.S. using a large regional dataset. Stream warming trends paralleled changes in air temperature and were pervasive during the low-water warm seasons of 1996-2015 (0.18-0.35°C/decade) and 1976-2015 (0.14-0.27°C/decade). Their results show how continued warming will likely affect the cumulative temperature exposure of migrating sockeye salmon *O. nerka* and the availability of suitable habitat for brown trout *Salmo trutta* and rainbow trout *O. mykiss*. Isaak et al. (2018) concluded that most stream habitats will likely remain suitable for salmonids in the near future, with some becoming too warm. However, in cases where habitat access is currently restricted by dams and other barriers salmon and steelhead will be confined to downstream reaches typically most at risk of rising temperatures unless passage is restored (FitzGerald et al. 2020, Myers et al. 2018).

Streams with intact riparian corridors and that lie in mountainous terrain are likely to be more resilient to changes in air temperature. These areas may provide refuge from climate change for a number of species, including Pacific salmon. Krosby et al. (2018), identified potential stream refugia throughout the Pacific Northwest based on a suite of features thought to reflect the ability of streams to serve as such refuges. Analyzed features include large temperature gradients, high canopy cover, large relative stream width, low exposure to solar radiation, and low levels of human modification. They created an index of refuge potential for all streams in the region, with mountain area streams scoring highest. Flat lowland areas, which commonly contain migration corridors, were generally scored lowest, and thus were prioritized for conservation and restoration. However, forest fires can increase stream temperatures dramatically in short time-spans by removing riparian cover (Koontz et al. 2018), and streams that lose their snowpack with climate change may see the largest increases in stream temperature due to the removal of temperature buffering (Yan et al. 2021). These processes may threaten some habitats that are currently considered refugia.

Marine and Estuarine Environments

Along with warming stream temperatures and concerns about sufficient groundwater to recharge streams, a recent study projects nearly complete loss of existing tidal wetlands along the U.S. West Coast, due to sea level rise (Thorne et al. 2018). California and Oregon showed the greatest threat to tidal wetlands (100%), while 68% of Washington tidal wetlands are expected to be submerged. Coastal development and steep topography prevent horizontal migration of most wetlands, causing the net contraction of this crucial habitat.

Rising ocean temperatures, stratification, ocean acidity, hypoxia, algal toxins, and other oceanographic processes will alter the composition and abundance of a vast array of oceanic species. In particular, there will be dramatic changes in both predators and prey of Pacific salmon, salmon life history traits and relative abundance. Siegel and Crozier (2019) observe that changes in marine temperature are likely to have a number of physiological consequences on fishes themselves. For example, in a study of small planktivorous fish, Gliwicz et al. (2018) found that higher ambient temperatures increased the distance at which fish reacted to prey. Numerous fish species (including many tuna and sharks) demonstrate regional endothermy, which in many cases augments eyesight by warming the retinas. However, Gliwicz et al. (2018) suggest that ambient temperatures can have a similar effect on fish that do not demonstrate this trait. Climate change is likely to reduce the availability of biologically essential omega-3 fatty acids produced by phytoplankton in marine ecosystems. Loss of these lipids may induce cascading trophic effects, with distinct impacts on different species depending on compensatory mechanisms (Gourtay et al. 2018). Reproduction rates of many marine fish species are also likely to be altered with temperature (Veilleux et al. 2018). The ecological consequences of these effects and their interactions add complexity to predictions of climate change impacts in marine ecosystems.

Perhaps the most dramatic change in physical ocean conditions will occur through ocean acidification and deoxygenation. It is unclear how sensitive salmon and steelhead might be to the direct effects of ocean acidification because of their tolerance of a wide pH range in freshwater (although see Ou et al. 2015 and Williams et al. 2019), however, impacts of ocean acidification and hypoxia on sensitive species (e.g., plankton, crabs, rockfish, groundfish) will likely affect salmon indirectly through their interactions as predators and prey. Similarly, increasing frequency and duration of harmful algal blooms may affect salmon directly, depending on the toxin (e.g., saxitoxin vs domoic acid), but will also affect their predators (seabirds and mammals). The full effects of these ecosystem dynamics are not known but will be complex. Within the historical range of climate variability, less suitable conditions for salmonids (e.g., warmer temperatures, lower streamflows) have been associated with detectable declines in many of these listed units, highlighting how sensitive they are to climate drivers (Ford 2022, Lindley et al. 2009, Williams et al. 2016, Ward et al. 2015). In some cases, the combined and potentially additive effects of poorer climate conditions for fish and intense anthropogenic impacts caused the population declines that led to these population groups being listed under the ESA (Crozier et al. 2019).

Climate change effects on salmon and steelhead

In freshwater, year-round increases in stream temperature and changes in flow will affect physiological, behavioral, and demographic processes in salmon, and change the species with which they interact. For example, as stream temperatures increase, many native salmonids face increased competition with more warm-water tolerant invasive species. Changing freshwater temperatures are likely to affect incubation and emergence timing for eggs, and in locations where the greatest warming occurs may affect egg survival, although several factors impact intergravel temperature and oxygen (e.g., groundwater influence) as well as sensitivity of eggs to thermal stress (Crozier et al. 2020). Changes in temperature and flow regimes may alter the amount of habitat and food available for juvenile rearing, and this in turn could lead to a restriction in the distribution of juveniles, further decreasing productivity through density dependence. For migrating adults, predicted changes in freshwater flows and temperatures will likely increase exposure to stressful temperatures for many salmon and steelhead populations, and alter migration travel times and increase thermal stress accumulation for ESUs or DPSs with early-returning (i.e. spring- and summer-run) phenotypes associated with longer freshwater holding times (Crozier et al. 2020, FitzGerald et al. 2020). Rising river temperatures increase the energetic cost of migration and the risk of *en route* or pre-spawning mortality of adults with long freshwater migrations, although populations of some ESA-listed salmon and steelhead may be able to make use of cool-water refuges and run-timing plasticity to reduce thermal exposure (Keefer et al. 2018, Barnett et al. 2020).

Marine survival of salmonids is affected by a complex array of factors including prey abundance, predator interactions, the physical condition of salmon within the marine environment, and carryover effects from the freshwater experience (Holsman et al. 2012, Burke et al. 2013). It is generally accepted that salmon marine survival is size-dependent, and thus larger and faster growing fish are more likely to survive (Gosselin et al. 2021). Furthermore, early arrival timing in the marine environment is generally considered advantageous for populations migrating through the Columbia River. However, the optimal day of arrival varies across years, depending on the seasonal development of productivity in the California Current, which affects prey available to salmon and the risk of predation (Chasco et al. 2021). Siegel and Crozier (2019) point out the concern that for some salmon populations, climate change may drive mismatches between juvenile arrival timing and prey availability in the marine environment. However, phenological diversity can contribute to metapopulation-level resilience by reducing the risk of a complete mismatch. Carr-Harris et al. (2018), explored phenological diversity of marine migration timing in relation to zooplankton prey for sockeye salmon *O. nerka* from the Skeena River of Canada. They found that sockeye migrated over a period of more than 50 days, and populations from higher elevation and further inland streams arrived in the estuary later, with different populations encountering distinct prey fields. Carr-Harris et al. (2018) recommended that managers maintain and augment such life-history diversity.

Synchrony between terrestrial and marine environmental conditions (e.g., coastal upwelling, precipitation and river discharge) has increased in spatial scale causing the highest levels of synchrony in the last 250 years (Black et al. 2018). A more synchronized climate combined with simplified habitats and reduced genetic diversity may be leading to more synchrony in the productivity of populations across the range of salmon (Braun et al. 2016). For example, salmon productivity (recruits/spawner) has also become more synchronized across Chinook populations from Oregon to the Yukon (Dorner et al. 2018, Kilduff et al. 2014). In addition, Chinook salmon have become smaller and younger at maturation across their range (Ohlberger 2018). Other Pacific salmon species (Stachura el al. 2014) and Atlantic salmon (Olmos et al. 2020) also have demonstrated synchrony in productivity across a broad latitudinal range.

At the individual scale, climate impacts on salmon in one life stage generally affect body size or timing in the next life stage and negative impacts can accumulate across multiple life stages (Healey 2011; Wainwright and Weitkamp 2013, Gosselin et al. 2021). Changes in winter precipitation will likely affect incubation and/or rearing stages of most populations. Changes in the intensity of cool season precipitation, snow accumulation, and runoff could influence migration cues for fall, winter and spring adult migrants, such as coho and steelhead. Egg survival rates may suffer from more intense flooding that scours or buries redds. Changes in hydrological regime, such as a shift from mostly snow to more rain, could drive changes in life history, potentially threatening diversity within an ESU (Beechie et al. 2006). Changes in summer temperature and flow will affect both juvenile and adult stages in some populations, especially those with yearling life histories and summer migration patterns (Crozier and Zabel 2006; Crozier et al. 2010, Crozier et al. 2019).

At the population level, the ability of organisms to genetically adapt to climate change depends on how much genetic variation currently exists within salmon populations, as well as how selection on multiple traits interact, and whether those traits are linked genetically. While genetic diversity may help populations respond to climate change, the remaining genetic diversity of many populations is highly reduced compared to historic levels. For example, Johnson et al. (2018), compared genetic variation in Chinook salmon from the Columbia River Basin between contemporary and ancient samples. A total of 84 samples determined to be Chinook salmon were collected from vertebrae found in ancient middens and compared to 379 contemporary samples. Results suggest a decline in genetic diversity, as demonstrated by a loss of mitochondrial haplotypes as well as reductions in haplotype and nucleotide diversity. Genetic losses in this comparison appeared larger for Chinook from the mid-Columbia than those from the Snake River Basin. In addition to other stressors, modified habitats and flow regimes may create unnatural selection pressures that reduce the diversity of functional behaviors (Sturrock et al. 2020). Managing to conserve and augment existing genetic diversity may be increasingly important with more extreme environmental change (Anderson et al. 2015), though the low levels of remaining diversity present challenges to this effort (Freshwater 2019). Salmon historically maintained relatively consistent returns across variation in annual weather through the portfolio effect (Schindler et al. 2015), in which different populations are sensitive to different climate drivers. Applying this concept to climate change, Anderson et al (2015) emphasized the additional need for populations with different physiological tolerances. Loss of the portfolio increases volatility in fisheries, as well as ecological systems, as demonstrated for Fraser River and Sacramento River stock complexes (Freshwater et al. 2019, Munsch et al. 2022).

2.2.1 Status of ESA-Listed Fish Species

For Pacific salmon, steelhead, and certain other listed fish species, we commonly use the four "viable salmonid population" (VSP) criteria (McElhany et al. 2000) to assess the viability of the populations that, together, constitute the species. These four criteria (spatial structure, diversity, abundance, and productivity) encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, populations can adapt to various environmental conditions and sustain in the natural environment.

"Spatial structure" refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. A population's spatial structure depends on quality and spatial configuration critical habitat, and the dispersal characteristics and dynamics of individuals in the population.

"Diversity" refers to the distribution of traits within and among populations. These range in scale from DNA sequence variation in single genes to complex life history traits (McElhany et al. 2000).

"Abundance" generally refers to the number adults in the naturally produced (i.e., the progeny of naturally spawning parents) in the environment (e.g., on spawning grounds).
"Productivity," as applied to viability factors, refers to the entire life cycle (i.e., the number of naturally-spawning adults produced per parent). When progeny replace or exceed the number of parents, a population is stable or increasing. When progeny fail to replace the number of parents, the population is declining. McElhany et al. (2000) use the terms "population growth rate" and "productivity" interchangeably when referring to production over the entire life cycle. They also refer to "trend in abundance," which is the manifestation of long-term population growth rate.

For species with multiple populations, once the biological status of a species' populations has been determined, we assess the status of the entire species using criteria for groups of populations, as described in recovery plans and guidance documents from technical recovery teams. Considerations for species viability include having multiple populations that are viable, ensuring that populations with unique life histories and phenotypes are viable, and that some viable populations are both widespread to avoid concurrent extinctions from mass catastrophes and spatially close to allow functioning as metapopulations (McElhany et al. 2000).

The summaries that follow describe the status of ESA-listed PS Chinook salmon and PS steelhead that occur within the action area. More detailed information on the status and trends of these listed resources, and their biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 1).

Status of Puget Sound Chinook Salmon

The PS Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160) (Table 1). NMFS adopted a recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (Shared Strategy for Puget Sound 2007) and a supplement by NMFS (2006). The recovery plan adopts ESU and population level viability criteria recommended by the Puget Sound Technical Recovery Team (PSTRT) (Ruckelshaus et al. 2002). The PSTRT's biological recovery criteria will be met when all of the following conditions are achieved:

- The viability status of all populations in the ESU is improved from current conditions, and when considered in the aggregate, persistence of the ESU is assured;
- Two to four Chinook salmon populations in each of the five biogeographical regions of the ESU achieve viability, depending on the historical biological characteristics and acceptable risk levels for populations within each region;
- At least one population from each major genetic and life history group historically present within each of the five biogeographical regions is viable;
- Tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations are functioning in a manner that is sufficient to support an ESU-wide recovery scenario; Production of Chinook salmon from tributaries to Puget Sound not identified as primary freshwater habitat for any of the 22 identified populations occurs in a manner consistent with ESU recovery; and
- Populations that do not meet the viability criteria for all VSP parameters are sustained to provide ecological functions and preserve options for ESU recovery.

<u>Spatial Structure and Diversity</u>: The Puget Sound Chinook salmon ESU includes all naturally spawning populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Straits of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington. The ESU also includes the progeny of numerous artificial propagation programs (NWFSC 2015). The PSTRT identified 22 extant populations, grouped into five major geographic regions, based on consideration of historical distribution, geographic isolation, dispersal rates, genetic data, life history information, population dynamics, and environmental and ecological diversity. The PSTRT distributed the 22 populations among five major biogeographical regions, or major population groups (MPG), that are based on similarities in hydrographic, biogeographic, and geologic characteristics.

Three of the five MPGs (Strait of Juan de Fuca, Georgia Basin, and Hood Canal) contain only two populations, both of which must be recovered to viability to recover the ESU (NMFS 2006b). Under the Puget Sound Salmon Recovery Plan, the Suiattle and one each of the early, moderately early, and late run-timing populations in the Whidbey Basin Region, as well as the

White and Nisqually (or other late-timed) populations in the Central/South Sound Region must also achieve viability (NMFS 2006b).

The Technical Recovery Team (TRT) did not define the relative roles of the remaining populations in the Whidbey and Central/South Sound Basins for ESU viability. Therefore, NMFS developed additional guidance which considers distinctions in genetic legacy and watershed condition, among other factors, in assessing the risks to survival and recovery of the listed species by the proposed actions across all populations within the PS Chinook salmon ESU. In doing so, it is important to take into account whether the genetic legacy of the population is intact or if it is no longer distinct within the ESU. Populations are defined by their relative isolation from each other and by the unique genetic characteristics that evolve, as a result of that isolation, and adaption to their specific habitats. If these populations still retain their historic genetic legacy, then the appropriate course, to ensure their survival and recovery, is to preserve that genetic legacy and rebuild those populations. Preserving that legacy requires both a sense of urgency and the actions necessary and appropriate to preserve the legacy that remains. However, if the genetic legacy is gone, then the appropriate course is to recover the populations using the individuals that best approximate the genetic legacy of the original population, reduce the effects of the factors that have limited their production, and provide the opportunity for them to readapt to the existing conditions.

In keeping with this approach, NMFS further classified PS Chinook salmon populations into three tiers based on a systematic framework that considers the population's life history and production and watershed characteristics (NMFS 2010) (Figure 6). This framework, termed the Population Recovery Approach, carries forward the biological viability and delisting criteria described in the Supplement to the Puget Sound Salmon Recovery Plan (Ruckelshaus et al. 2002; NMFS 2006b). The assigned tier indicates the relative role of each of the 22 populations comprising the ESU to the viability of the ESU and its recovery. Tier 1 populations are most important for preservation, restoration, and ESU recovery. Tier 2 populations play a less important role in recovery of the ESU. Tier 3 populations play the least important role. When we analyze proposed actions, we evaluate impacts at the individual population scale for their effects on the viability of the ESU. We expect that impacts to Tier 1 populations would be more likely to affect the viability of the ESU, as a whole, than similar impacts to Tier 2 or 3 populations, because of the relatively greater importance of Tier 1 populations to overall ESU viability and recovery. NMFS has incorporated this and similar approaches in previous ESA section 4(d) determinations and Opinions on Puget Sound salmon fisheries and regional recovery planning (NMFS 2005b; 2005d; 2008f; 2008e; 2010a; 2011a; 2013b; 2014b; 2015c; 2016f; 2017b; 2018c; 2019b; 2021e).

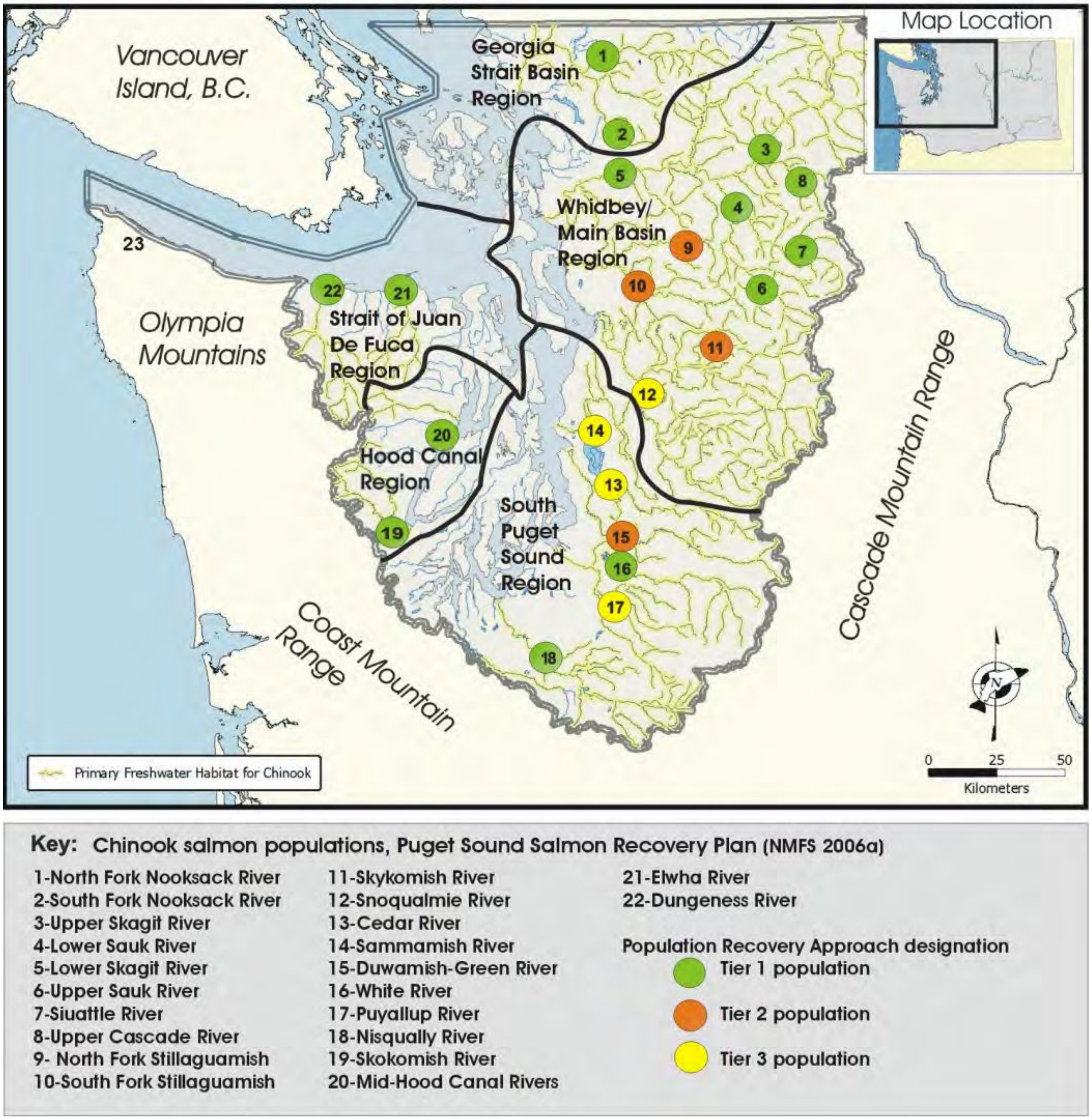

Figure 6. Puget Sound Chinook populations with tiered recovery designations.

The ESU also includes Chinook salmon from certain artificial propagation programs. Artificial propagation (hatchery) programs (26) were added to the listed Chinook salmon ESU in 2005, as part of the final listing determinations for 16 ESUs of West Coast Salmon and Final 4(d) Protective Regulations for Threatened Salmonid ESUs (70 FR 37160). In October of 2016, NMFS proposed revisions to the hatchery programs included as part of some Pacific salmon ESUs and steelhead DPSs listed under the ESA (81 FR 72759). NMFS issued its final rule in December of 2020, which includes 25 hatchery programs as part of the listed Puget Sound Chinook salmon ESU (85 FR 81822).

Since 1999, most PS Chinook salmon populations have mean natural-origin spawner escapement levels well below levels identified as required for recovery to low extinction risk. Long-term, natural-origin mean escapements for eight populations are at or below their critical thresholds.[6] Both populations in three of the five biogeographical regions are below or near their critical threshold: Georgia Strait, Hood Canal and Strait of Juan de Fuca. When hatchery spawners are included, aggregate average escapement is over 1,000 for one of the two populations in each of these three regions, reducing the demographic risk to the populations in these regions. Additionally, hatchery spawners help two of the remaining three of these populations achieve total spawner abundances above their critical threshold, reducing demographic risk. Nine populations are above their rebuilding thresholds,[7] seven of them in the Whidbey/Main Basin Region. In 2018 NMFS and the NWFSC updated the rebuilding thresholds for several key Puget Sound populations. These thresholds represent the Maximum Sustained Yield estimate of spawners based on available habitat. The new spawner-recruit analyses for several populations indicated a significant reduction in the number of spawners that can be supported by the available habitat when compared to analyses conducted 10 to 15 years ago. This may be due to further habitat degradation or improved productivity assessment or, more likely, a combination of the two. For example, the updated rebuilding escapement threshold for the Green River is 1,700 spawners compared to the previous rebuilding escapement threshold of 5,523 spawners[8]. So, although several populations are above the updated rebuilding thresholds, indicating that escapement is sufficient for the available habitat in many cases, the overall abundance has declined.

Measures of spatial structure and diversity can give some indication of the resilience of a population to sustain itself. Spatial structure can be measured in various ways, but here we assess the proportion of natural-origin spawners (wild fish) vs. hatchery-origin spawners on the spawning grounds (Ford, 2022).

Since 1990, there is a general declining population trend in the proportion of natural-origin spawners across the ESU (Table 3). While there are several populations that have maintained high levels of natural-origin spawner proportions, mostly in the Skagit and Snohomish basins, many others maintain high proportions of hatchery-origin spawners (Table 3). It should be noted that the pre-2005-2009 estimates of mean natural-origin fractions occurred prior to the widespread adoption of mass marking of hatchery produced fish. Estimates of hatchery and natural-origin proportions of fish since the implementation of mass marking are considered more robust. Several of these populations have long-standing or more recent conservation hatchery programs associated with them—North Fork (NF) and South Fork (SF) Nooksack, NF and SF Stillaguamish, White River, Mid-Hood Canal, Dungeness, and the Elwha. These conservation

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[6] After taking into account uncertainty, the critical threshold is defined as a point below which: (1) depensatory processes are likely to reduce the population below replacement; (2) the population is at risk from inbreeding depression or fixation of deleterious mutations; or (3) productivity variation due to demographic stochasticity becomes a substantial source of risk (NMFS 2000).

[7] The rebuilding threshold is defined as the escapement that will achieve Maximum Sustainable Yield (MSY) under current environmental and habitat conditions (NMFS 2000), and is based on an updated spawner-recruit assessment in the Puget Sound Chinook Harvest Management Plan, December 1, 2018. Thresholds were based on population-specific data, where available.

[8] The historic Green River escapement goal was established in 1977 as the average of estimated natural spawning escapements from 1965-1974. This goal does not reflect the lower productivity associated with the current condition of habitat. Reference the source for the historical objective from MUP (PSIT and WDFW 2017)(Green River MUP).

programs are in place to maintain or increase the overall abundance of these populations, helping to conserve the diversity and increase the spatial distribution of these populations in the absence of properly functioning habitat. With the exception of the Mid-Hood Canal program, these conservation hatchery programs culture the extant, native Chinook salmon stock in these basins. With the exception of the NF and SF Stillaguamish, the remainder of the populations included in these conservation programs are identified in NMFS (2006b) as essential for the recovery of the Puget Sound Chinook salmon ESU (Table 3).

Table 3. Five-year mean of fraction of natural-origin spawners[9] (sum of all estimates divided by the number of estimates) (Ford 2022).

Population	1995-1999	2000-2004	2005-2009	2010-2014	2015-2019
NF Nooksack R. spring	0.28	0.11	0.19	0.14	0.13
SF Nooksack R. spring	0.26	0.55	0.57	0.42	0.45
Low. Skagit R. fall	0.94	0.91	0.86	0.92	0.84
Up. Skagit R. summer	0.91	0.87	0.84	0.95	0.91
Cascade R. spring	0.98	0.92	0.89	0.94	0.86
Low. Sauk R. summer	0.94	0.97	0.95	0.91	0.98
Up. Sauk R. spring	0.99	1.00	0.98	0.97	0.99
Suiattle R. spring	0.99	0.97	0.99	0.99	0.97
NF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.43	0.45
SF Stillaguamish R. summer/fall	0.59	0.70	0.40	0.54	0.46
Skykomish R. summer	0.49	0.52	0.76	0.69	0.62
Snoqualmie R. fall	0.81	0.89	0.81	0.78	0.75
Sammamish R. fall	0.29	0.36	0.16	0.07	0.16
Cedar R. fall	0.61	0.59	0.82	0.78	0.71
Green R. fall	0.55	0.47	0.43	0.39	0.30
White R. spring	0.54	0.79	0.43	0.32	0.15
Puyallup R. fall	0.88	0.79	0.52	0.41	0.32
Nisqually R. fall	0.80	0.61	0.30	0.30	0.47
Skokomish R. fall	0.40	0.46	0.45	0.10	0.16
Mid-Hood Canal fall	0.76	0.79	0.61	0.33	0.89
Dungeness R. summer	1.00	0.32	0.43	0.25	0.25
Elwha R. fall	0.41	0.53	0.35	0.06	0.05

In addition, spatial structure, or geographic distribution, of the White, Skagit, Elwha,[10] and Skokomish populations has been substantially reduced or impeded by the loss of access to the upper portions of those tributary basins due to flood control activities and hydropower development. Habitat conditions conducive to salmon survival in most other watersheds have been reduced significantly by the effects of land use, including urbanization, forestry, agriculture, and development (NMFS 2005a; SSPS 2005; NMFS 2008c; 2008d; 2008b). It is

[9] Estimates of hatchery and natural-origin spawning abundances, prior to the 2005-2009 period are based on pre-mass marking of hatchery-origin fish and, as such, may not be directly comparable to the 2005-2009 forward estimates.
[10] Removal of the two Elwha River dams and restoration of the natural habitat in the watershed began in 2011.

likely that genetic and life history diversity has been significantly adversely affected by this habitat loss.

Between 1990 and 2021, the proportion of natural-origin spawners has trended downward across the ESU, with the Whidbey Basin the only MPG with consistently high fractions of natural-origin spawner abundance. All other MPG have either variable or declining spawning populations with high proportions of hatchery-origin spawners (NWFSC 2015; Ford 2022). Overall, the new information on abundance, productivity, spatial structure and diversity since the 2015 status review supports no change in the biological risk category (NWFSC 2015; Ford 2022).

Abundance and Productivity: The abundance of the PS Chinook salmon over time shows that individual populations have varied with increasing or decreasing abundance. Generally, many populations experienced increases in total abundance during the years 2000-2008, and more recently in 2015-2017, but general declines during 2009-2014, and a downturn again in the two most recent years available for the current status review, 2017-2018. Abundance across the Puget Sound ESU has generally increased since the last status review, with only 2 of the 22 populations (Cascade and North Fork and South Fork Stillaguamish) showing a negative percent change in the 5-year geometric mean natural- origin spawner abundances since the prior status review (Table 4). However, 15 of 20 populations with positive percent change in the 5-year geometric mean natural-origin spawner abundances since the prior status review have relatively low population abundances of <1000 fish, so some of these increases represent small changes in total abundance (Ford 2022). Also, given lack of high confidence in survey techniques, particularly with small populations, there is substantial uncertainty in quantifying fish and detecting trends in small populations (Gallagher et al. 2010).

Table 4. Extant PS Chinook salmon populations in each biogeographic region and percent change between the most recent two 5-year periods (2010-2014 and 2015-2019). Five-year geometric mean of raw natural-origin spawner counts. This is the raw total spawner estimate times the fraction natural-origin estimate, if available. In parentheses, 5-year geometric mean of raw total spawner estimates (i.e., hatchery and natural) are shown. A value only in parentheses means that a total spawner estimate was available but no (or only one) estimate of natural-origin spawners was available. The geometric mean was computed as the product of estimates raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right (Ford 2022).

Biogeographic Region	Population (Watershed)	2010-2014	2015-2019	Population trend (% change)
Strait of Georgia	**North Fork Nooksack River**	136 (1205)	137 (1553)	Positive 1% (29)
	South Fork Nooksack River	13 (35)	42 (106)	Positive 223% (203)
Strait of Juan de Fuca	**Elwha River**	71 (1349)	134 (2810)	Positive 89% (108)
	Dungeness River	66 (279)	114 (476)	Positive 73% (71)
Hood Canal	**Skokomish River**	136 (1485)	265 (2074)	Positive 95% (40)
	Mid Hood Canal River	80 (295)	196 (222)	Positive 145% (-25)
Whidbey Basin	Skykomish River	1698 (2462)	1736 (2806)	Positive 3% (14)
	Snoqualmie River	839 (1082)	856 (1146)	Positive 2% (6)
	North Fork Stillaguamish River	417 (996)	302 (762)	Negative 28% (-23)
	South Fork Stillaguamish River	34 (68)	37 (96)	Positive 9% (41)
	Lower Skagit River	1416 (1541)	2130 (2640)	Positive 50% (71)
	Upper Sauk River	854 (880)	1318 (1330)	Positive 54% (51)
	Lower Sauk River	376 (416)	635 (649)	Positive 69% (56)
	Suiattle River	376 (378)	640 (657)	Positive 70% (74)
	Upper Cascade River	298 (317)	185 (223)	Negative 38% (-30)
Central/South Puget Sound Basin	North Lake Washington/ Sammamish River	82 (1289)	126 (879)	Positive 54% (-32)
	Green/Duwamish River	785 (2109)	1822 (6373)	Positive 132% (202)
	Puyallup River	450 (1134)	577 (1942)	Positive 28% (71)
	White River	652 (2161)	895 (6244)	Positive 37% (189)
	Cedar River	699 (914)	889 (1253)	Positive 27% (37)
	Nisqually River	481 (1823)	766 (1841)	Positive 59% (1)

Trends in abundance over longer time periods are generally slightly negative. Fifteen-year trends in log natural-origin spawner abundance were computed over two time periods (1990-2005 and 2004- 2019) for each Puget Sound Chinook salmon population. Trends were negative in the latter period for 16 of the 22 populations and for four of the 22 populations (SF Nooksack, SF Stillaguamish, Green and Puyallup) in the earlier period. Thus, there is a general decline in natural-origin spawner abundance across all MPGs in the recent fifteen years. Upper Sauk and Suiattle (Whidbey Basin MPG), Nisqually (Central/South MPG) and Mid-Hood Canal (Hood Canal MPG) are the only populations with positive trends, though Mid-Hood Canal has an extremely low population size. Further, no change in trend between the two time periods was detected in SF Nooksack (Strait of Georgia MPG), Green and Nisqually (Central/South MPG). The average trend across the ESU for the 1990-2005 15-year time period was 0.03 (Figure 7). The average trend across the ESU for the later 15-year time period (2004-2019) was -0.02. The previous status review in 2015 (NWFSC 2015) concluded there were widespread negative trends for the total ESU despite that escapements and trends for individual populations were variable. The addition of the data to 2018 now also shows even more substantially either flat or negative trends for the entire ESU in natural-origin Chinook salmon spawner population abundances (Ford 2022).

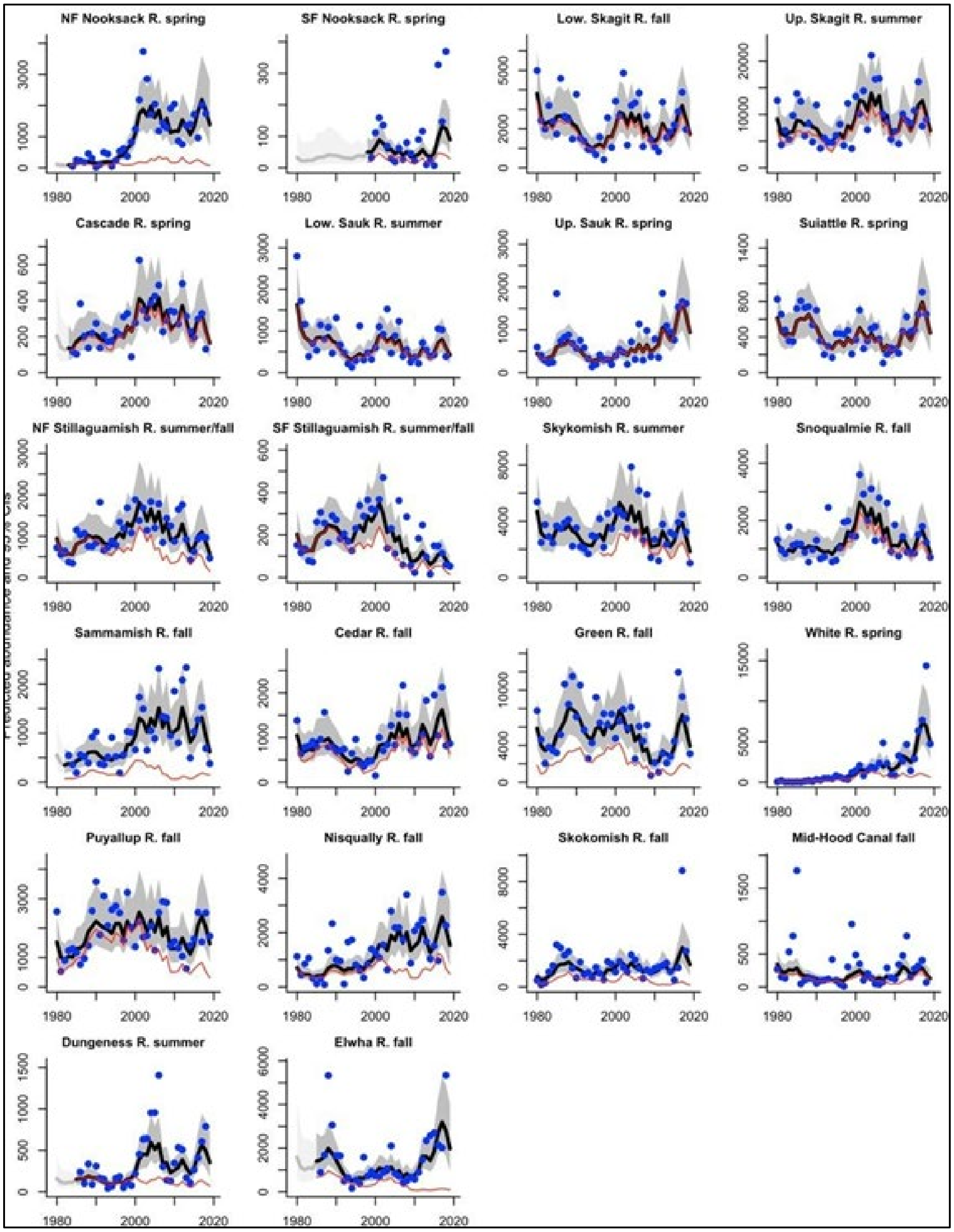


Figure 7. Smoothed trend in estimated total (thick black line, with 95 percent confidence internal in gray) and natural (thin red line) PS Chinook salmon population spawning abundance. In portions of a time series where a population has no annual estimate but smoothed spawning abundance is estimated from correlations with other populations the smoothed estimate is shown in light gray. Points show the annual raw spawning abundance estimates. For some trends the smoothed estimate may be influenced by earlier data points not included in the plot (Ford 2022).

Across the Puget Sound ESU, 10 of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980's. These include the North and South Forks Nooksack in the Strait of Georgia MPG, North and South Forks Stillaguamish and Skykomish in Whidbey Basin MPG, Sammamish, Green and Puyallup in the Central/South MPG, the Skokomish in the Hood Canal MPG, and Elwha in the Strait of Juan de Fuca MPG. Productivity in the Whidbey Basin MPG populations was above zero the mid-late 1990's, with the exception of Skykomish and North and South Forks Stillaguamish populations. White River population in the Central/South MPG was above replacement from the early 1980's to 2001, but has dropped in productivity consistently since the late 1980's. In recent years, only 5 populations have had productivities above zero. These are Lower Skagit, Upper Skagit, Lower Sauk, Upper Sauk, and Suiattle, all Skagit River populations in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in the 2015 Status Review (NWFSC 2015).

All Puget Sound Chinook salmon populations continue to remain well below recovery levels (Ford 2022). Most populations also remain consistently below the spawner-recruit levels identified by the TRT as necessary for recovery. Across the ESU, most native-origin populations have slightly increased in abundance since the last status review in 2016, but have small negative trends over the past 15 years (Figure 8). Productivity remains low in most populations. Hatchery-origin spawners are present in high fractions in most populations outside the Skagit watershed, and in many watersheds the fraction of spawner abundances that are natural-origin have declined over time. Habitat protection, restoration and rebuilding programs in all watersheds have improved stream and estuary conditions despite record numbers of humans moving into the Puget Sound region in the past two decades. Bi-annual four-year work plans document the many completed habitat actions that were initially identified in the Puget Sound Chinook salmon recovery plan. However, the expected benefits from restoration actions is likely to take years or decades to produce significant improvement in natural population viability parameters (see Roni et al. 2010).

Development of a monitoring and adaptive management program was required by NMFS in the 2007 Supplement to the Shared Strategy Recovery Plan (NMFS 2006b), and since the last review the Puget Sound Partnership has completed this, but this program is still not fully functional for providing an assessment of watershed habitat restoration/recovery programs, nor does it fully integrate the essentially discrete habitat, harvest and hatchery programs. A recent white paper produced by the Salmon Science Advisory Group, of the Puget Sound Partnership concludes there has been "a general inability of monitoring to link restoration, changes in habitat conditions, and fish response at large-scales" (PSP 2021). A number of watershed groups are in the process of updating their Recovery Plan Chapters and this includes prioritizing and updating recovery strategies and actions, as well as assessing prior accomplishments. Overall, recent information on PS Chinook salmon abundance and productivity since the 2016 status review indicates a slight increase in abundance but does not indicate a change in biological risk to the ESU despite moderate inter-annual variability among populations and a general decline in abundance over the last 15 years (Ford 2022).

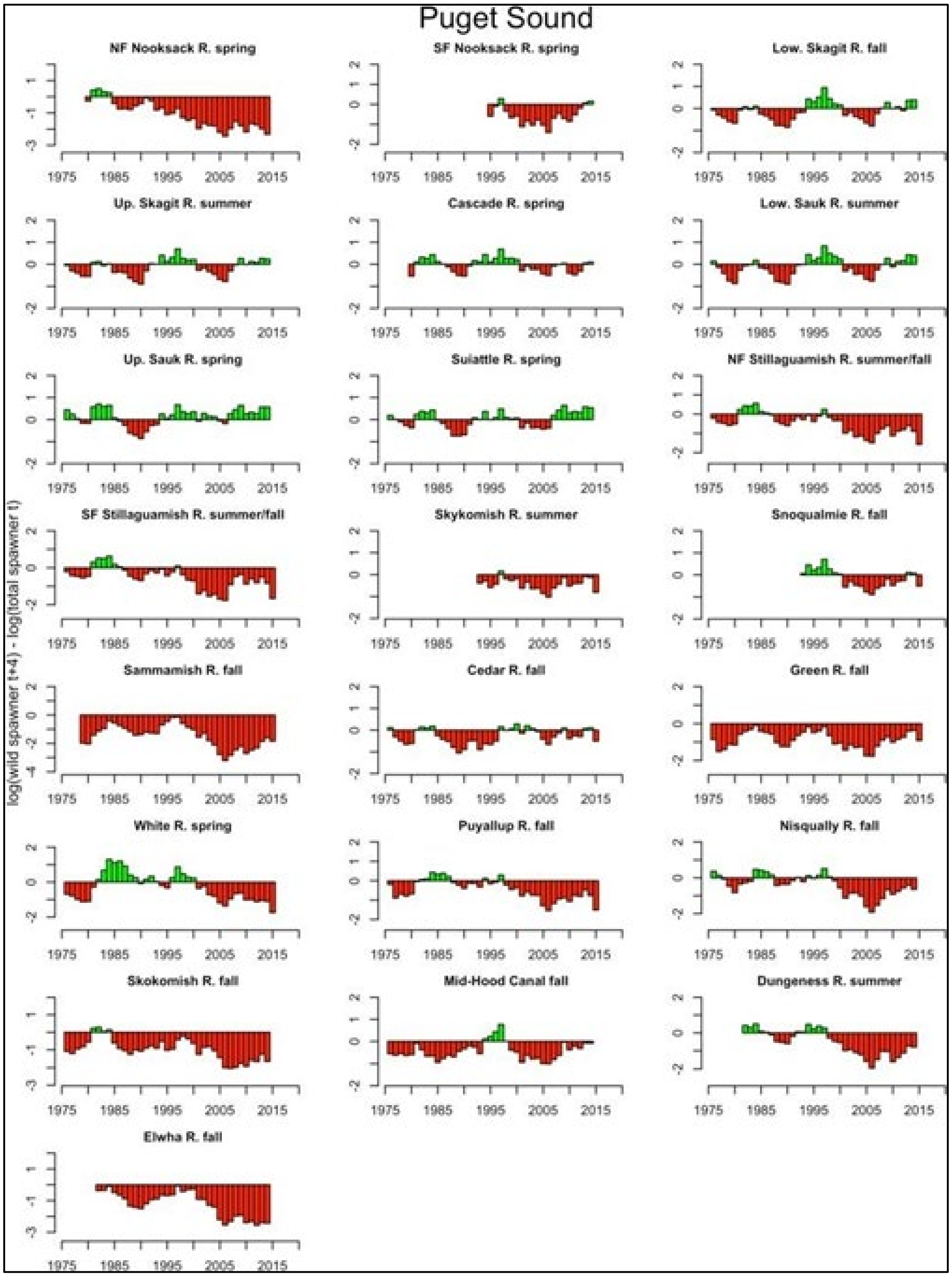


Figure 8. Trends in Chinook salmon population productivity, estimated as the log of the smoothed natural-origin spawning abundance in year t – smoothed natural-origin spawning abundance in year (t – 4) (Ford 2022).

Limiting Factors: Limiting factors for this species include:

- Degraded floodplain and in-river channel structure
- Degraded estuarine conditions and loss of estuarine habitat

- Riparian area degradation and loss of in-river large woody debris
- Excessive fine-grained sediment in spawning gravel
- Degraded water quality and temperature
- Degraded nearshore conditions
- Impaired passage for migrating fish
- Altered flow regime

PS Chinook Salmon Recovery Plan: Nearshore areas serve as the nursery for juvenile PS Chinook salmon. Riparian vegetation, shade and insect production, and forage fish eggs along marine shorelines and river deltas help to provide food, cover and thermoregulation in shallow water habitats. Forage fish spawn in large aggregations along shorelines with suitable habitat, which produce prey for juvenile PS Chinook salmon. Juvenile salmon commonly occupy "pocket estuaries" where freshwater inputs provide salinity gradients that make adjusting to the marine environment less physiologically demanding. Pocket estuaries also provide refugia from predators. As the juvenile salmon grow and adjust, they move out to more exposed shorelines such as eelgrass, kelp beds and rocky shorelines where they continue to grow and migrate into the ocean environment. Productive shoreline habitats of Puget Sound are necessary for the recovery of Puget Sound salmon (SSPS 2007).

The Puget Sound Recovery Plan (Volumes 1 and 2) includes specific recovery actions for each of the 22 extant populations of PS Chinook salmon. General protection and restoration actions summarized from the plan include:

- Aggressively protect functioning drift cells and feeder bluffs that support eelgrass bands and depositional features;
- Counties should pass strong regulations and policies limiting increased armoring of these shorelines and offering incentives for protection;
- Aggressively protect areas, especially shallow water/low gradient habitats and pocket estuaries, within 5 miles of river deltas;
- Protect the forage fish spawning areas;
- Conduct limited beach nourishment on a periodic basis to mimic the natural sediment transport processes in select sections where corridor functions may be impaired by extensive armoring;
- Maintain the functioning of shallow, fine substrate features in and near 11 natal estuaries for Chinook salmon (to support rearing of fry);
- Maintain migratory corridors along the shores of Puget Sound;
- Maintain the production of food resources for salmon;
- Maintain functioning nearshore ecosystem processes (i.e., sediment delivery and transport; tidal circulation) that create and support the above habitat features and functions;
- Increase the function and capacity of nearshore and marine habitats to support key needs of salmon;
- Protect and restore shallow, low velocity, fine substrate habitats along marine shorelines, including eelgrass beds and pocket estuaries, especially adjacent to major river deltas;

- Protect and restore riparian areas;
- Protect and restore estuarine habitats of major river mouths;
- Protect and restore spawning areas and critical rearing and migration habitats for forage fish;
- Protect and restore drift cell processes (including sediment supply, e.g., from feeder bluffs, transport, and deposition) that create and maintain nearshore habitat features such as spits, lagoons, bays, beaches.

Development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS Chinook salmon. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Status of Puget Sound Steelhead

The PS steelhead DPS was listed as a threatened species under the ESA on May 11, 2007 (72 FR 26722). Subsequent status assessments of the DPS after the ESA-listing decision have found that the status of PS steelhead regarding risk of extinction has not changed substantially (Ford et al. 2011a; NMFS 2016a) (81 FR 33468, May 26, 2016) (Ford, 2022). On October 4, 2019 NMFS published a Federal Register notice (84 FR 53117), announcing NMFS' intent to initiate a new 5-year status review for 28 listed species of Pacific salmon and steelhead and requesting updated information from the public to inform the most recent five-year status review. On March 24, 2020, NMFS extended the public comment period, from the original March 27, 2020, through May 26, 2020 (85 FR 16619). The NWFSC and the NMFS' WCR are currently preparing the final five-year status review documents.

The PS Steelhead TRT produced viability criteria, including population viability analyses (PVAs), for 20 of 32 demographically independent populations (DIPs) and three major population groups (MPGs) in the DPS (Hard et al. 2015). It also completed a report identifying historical populations of the DPS (Myers et al. 2015). The DIPs are based on genetic, environmental, and life history characteristics. Populations display winter, summer, or summer/winter run timing (Myers et al. 2015). The TRT concludes that the DPS is currently at "very low" viability, with most of the 32 DIPs and all three MPGs at "low" viability.
The designation of the DPS as "threatened" is based upon the extinction risk of the component populations. For a DIP to be considered viable, it must have at least an 85 percent probability of meeting the viability criteria, as calculated by Hard et al. (2015).

At the time of listing the Puget Sound steelhead Biological Review Team (BRT) considered the major risk factors associated with spatial structure and diversity of PS steelhead to be: (1) the low abundance of several summer run populations; (2) the sharply diminishing abundance of some winter steelhead populations, especially in south Puget Sound, Hood Canal, and the Strait of Juan de Fuca; and (3) continued releases of out-of-ESU hatchery fish from Skamania-derived summer run and Chambers Creek-derived winter run stocks (Hard et al. 2007; Hard et al. 2015). Loss of diversity and spatial structure were judged to be "moderate" risk factors (Hard et al. 2007). In 2011 the BRT identified degradation and fragmentation of freshwater habitat, with consequential effects on connectivity, as the primary limiting factors and threats facing the PS steelhead DPS (Ford et al. 2011a). The BRT also determined that most of the steelhead populations within the DPS continued to show downward trends in estimated abundance, with a few sharp declines (Ford et al. 2011a). The 2015 status review concurred that harvest and hatchery production of steelhead in Puget Sound were at low levels and not likely to increase substantially in the foreseeable future, thus these risks have been reduced since the time of listing. However, unfavorable environmental trends previously identified (Ford et al. 2011a) were expected to continue (Hard et al. 2015).

In this Opinion, where possible, the 2015 status review information is supplemented with information and other population specific data available considered during the drafting of the 2020 five-year status review for PS steelhead.

On December 27, 2019, we published a recovery plan for PS steelhead (84 FR 71379) (NMFS 2019a). The Puget Sound steelhead Recovery Plan (Plan) (NMFS 2019a) provides guidance to recover the species to the point that it can be naturally self-sustaining over the long term. To achieve full recovery, steelhead populations in Puget Sound need to be robust enough to withstand natural environmental variation and some catastrophic events, and they should be resilient enough to support harvest and habitat loss due to human population growth. The Plan aims to improve steelhead viability by addressing the pressures that contribute to the current condition: habitat loss/degradation, water withdrawals, declining water quality, fish passage barriers, dam operations, harvest, hatcheries, climate change effects, and reduced early marine survival. NMFS is using the recovery plan to organize and coordinate recovery of the species in partnership with state, local, tribal, and federal resource managers, and the many watershed restoration partners in the Puget Sound. Consultations, including this one, will incorporate information from the Plan (NMFS 2019a).

In the Plan, NMFS and the PSSTRT modified the 2013 and 2015 PSSTRT viability criteria to produce the viability criteria for PS steelhead, as described below:

- All three MPGs (North Cascade, Central-South Puget Sound, and Hood Canal-Strait of Juan de Fuca) (Figure 6) must be viable (Hard et al. 2015). The three MPGs differ substantially in key biological and habitat characteristics that contribute in distinct ways to the overall viability, diversity, and spatial structure of the DPS.
- There must be sufficient data available for NMFS to determine that each MPG is viable.

The Plan (NMFS 2019h) also established MPG-level viability criteria. The following are specific criteria are required for MPG viability:

- At least 50 percent of steelhead populations in the MPG achieve viability.
- Natural production of steelhead from tributaries to Puget Sound that are not identified in any of the 32 identified populations provides sufficient ecological diversity and productivity to support DPS-wide recovery.
- In addition to the minimum number of viable DIPs (50 percent) required above, all DIPs in the MPG must achieve an average MPG-level viability that is equivalent to or greater than the geometric mean (averaged over all the DIPs in the MPG) viability score of at

least 2.2 using the 1–3 scale for individual DIPs described under the DIP viability discussion in the PSSTRT Viability Criteria document (Hard et al. 2015). This criterion is intended to ensure that MPG viability is not measured (and achieved) solely by the strongest DIPs, but also by other populations that are sufficiently healthy to achieve MPG-wide resilience. The Plan allows for an alternative evaluation method to that in Hard et al. (2015) may be developed and used to assess MPG viability.

The Plan (NMFS 2019h) also identified specific DIPs in each of the three MPGs which must attain viability. These DIPs, by MPG, are described as follows:

For the **North Cascades MPG** eight of the sixteen DIPs in the North Cascades MPG must be viable. The eight (five winter-run and three summer-run) DIPs described below must be viable to meet this criterion:

- Of the eleven DIPs with winter or winter/summer runs, five must be viable:
- Nooksack River Winter-Run;
- Stillaguamish River Winter-Run;
- One from the Skagit River (either the Skagit River Summer-Run and Winter-Run or the Sauk River Summer-Run and Winter-Run);
- One from the Snohomish River watershed (Pilchuck, Snoqualmie, or Snohomish/Skykomish River Winter-Run); and
- One other winter or summer/winter run from the MPG at large.

The rationale for this is that there are four major watersheds in this MPG, and one viable population from each will help attain geographic spread and habitat diversity within core extant steelhead habitat (NMFS 2019h). Of the five summer-run DIPs in this MPG, three must be viable, representing each of the three major watersheds containing summer-run populations (Nooksack, Stillaguamish, Snohomish rivers). Therefore, the priority summer-run populations are as follows:

- South Fork Nooksack River Summer-Run;
- One DIP from the Stillaguamish River (Deer Creek Summer-Run or Canyon Creek Summer-Run); and
- One DIP from the Snohomish River (Tolt River Summer-Run or North Fork Skykomish River Summer-Run).

As described, these priority populations in the North Cascades MPG include specific, winter or winter/summer-run populations from the Nooksack, Stillaguamish, Skagit or Sauk, and Snohomish River basins and three summer-run populations from the Nooksack, Stillaguamish, and Snohomish basins. These populations are targeted to achieve viable status to support MPG viability. Having viable populations in these basins assures geographic spread, provides habitat diversity, reduces catastrophic risk, and increases life-history diversity (NMFS 2019h).

For the **Central and South Puget Sound MPG** four of the eight DIPs in the Central and South Puget Sound MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Green River Winter-Run;
- Nisqually River Winter-Run;
- Puyallup/Carbon rivers Winter-Run, or the White River Winter-Run; and
- At least one additional DIP from this MPG: Cedar River, North Lake Washington/Sammamish Tributaries, South Puget Sound Tributaries, or East Kitsap Peninsula Tributaries.

The rationale for this prioritization is that steelhead inhabiting the Green, Puyallup, and Nisqually River watersheds currently represent the core extant steelhead populations and these watersheds contain important diversity of stream habitats in the MPG.

For the **Hood Canal and Strait of Juan de Fuca MPG** four of the eight DIPs in the Hood Canal and Strait of Juan de Fuca MPG must be viable. The four DIPs described below must be viable to meet this criterion:

- Elwha River Winter/Summer-Run (see rationale below);
- Skokomish River Winter-Run;
- One from the remaining Hood Canal populations: West Hood Canal Tributaries Winter-Run, East Hood Canal Tributaries Winter-Run, or South Hood Canal Tributaries Winter-Run; and
- One from the remaining Strait of Juan de Fuca populations: Dungeness Winter-Run, Strait of Juan de Fuca Tributaries Winter-Run, or Sequim/Discovery Bay Tributaries Winter-Run.

The rationale for this prioritization is that the Elwha and Skokomish rivers are the two largest single watersheds in the MPG and bracket the geographic extent of the MPG. Furthermore, both Elwha and Skokomish populations have recently exhibited summer-run life histories, although the Dungeness River population was the only summer/winter run in this MPG recognized by the PSSTRT in Hard et al. (2015). Two additional populations, one population from the Strait of Juan de Fuca area and one population from the Hood Canal area, are needed for a viable MPG to maximize geographic spread and habitat diversity.

Lastly, the Plan (NMFS 2019h) also identified additional attributes, or characteristics which should be associated with a viable MPG.

- All major diversity and spatial structure conditions are represented, based on the following considerations:
- Populations are distributed geographically throughout each MPG to reduce risk of catastrophic extirpation; and
- Diverse habitat types are present within each MPG (one example is lower elevation/gradient watersheds characterized by a rain-dominated hydrograph and higher elevation/gradient watersheds characterized by a snow-influenced hydrograph).

Federal and state steelhead recovery and management efforts will provide new tools and data and technical analyses to further refine PS steelhead population structure and viability, if needed, and better define the role of individual populations at the watershed level and in the DPS. Future consultations will incorporate information from the Plan (NMFS 2019h).

Spatial Structure and Diversity: The PS steelhead DPS is the anadromous form of *O. mykiss* that occur in rivers, below natural barriers to migration, in northwestern Washington State that drain to Puget Sound, Hood Canal, and the Strait of Juan de Fuca between the U.S./Canada border and the Elwha River, inclusive. Non-anadromous ''resident'' *O. mykiss* occur within the range of PS steelhead but are not part of the DPS due to marked differences in physical, physiological, ecological, and behavioral characteristics (Hard et al. 2007). In October of 2016, NMFS proposed revisions to the hatchery programs included as part of Pacific salmon ESUs and steelhead DPSs listed under the ESA (81 FR 72759). NMFS issued its final rule in December of 2020 (85 FR 81822). This final rule includes steelhead from five artificial propagation programs in the PS steelhead DPS: the Green River Natural Program; White River Winter Steelhead Supplementation Program; Hood Canal Steelhead Supplementation Program; the Lower Elwha Fish Hatchery Wild Steelhead Recovery Program; and the Fish Restoration Facility Program. (85 FR 81822, December 17, 2020).

In 2013, the PSSTRT completed its evaluation of factors that influence the diversity and spatial structure VSP criteria for steelhead in the DPS. For spatial structure, this included the fraction of available intrinsic potential rearing and spawning habitat that is occupied compared to what is needed for viability[11]. For diversity, these factors included hatchery fish production, contribution of resident fish to anadromous fish production, and run timing of adult steelhead. Quantitative information on spatial structure and connectivity was not available for most PS steelhead populations, so a Bayesian Network framework was used to assess the influence of these factors on steelhead viability at the population, MPG, and DPS scales. The PSSTRT concluded that low population viability was widespread throughout the DPS and populations showed evidence of diminished spatial structure and diversity. Specifically, population viability associated with spatial structure and diversity was highest in the Northern Cascades MPG and lowest in the Central and South Puget Sound MPG (Puget Sound Steelhead Technical Recovery Team 2011). Diversity was generally higher for populations within the Northern Cascades MPG, where more variability in viability was expressed and diversity generally higher, compared to populations in both the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPG, where diversity was depressed and viabilities were generally lower (NWFSC 2015). Most PS steelhead populations were given intermediate scores for spatial structure and low scores for diversity because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (NWFSC 2015). The PSSTRT concluded that the Puget Sound DPS was at very low viability, considering the status of all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). For spatial structure there were a number of events that occurred in Puget Sound during the last review period (2015-2019) that are anticipated to improve status populations within several of the MPGs within the DPS.

Since the PSSTRT completed its 2013 review, the only additional spatial structure and diversity data that have become available have been estimates of the fraction of hatchery fish on the spawning grounds (NWFSC 2015). Since publication of the NWFSC report in 2015, reductions

[11] Where intrinsic potential is the area of habitat suitable for steelhead rearing and spawning, at least under historical conditions (Puget Sound Steelhead Technical Recovery Team 2011; PSSTRT 2013).

in hatchery programs founded from non-listed and out of DPS stocks (i.e., Skamania) have occurred. In addition, the fraction of out of DPS hatchery steelhead spawning naturally are low for many rivers (NWFSC 2015; NMFS 2016i; 2016h). The fraction of natural-origin steelhead spawners was 0.9 or greater for the 2005-2009 and 2010-2014 time periods for all populations where data were available, but the Snoqualmie and Stillaguamish Rivers. For 17 of 22 DIPs across the DPS, the five-year average for the fraction of natural-origin steelhead spawners exceeded 0.75 from 2005 to 2009; this average was near 1.0 for 8 populations, where data were available, from 2010 to 2014 (NWFSC 2015). However, the fraction of natural-origin steelhead spawners could not be estimated for a substantial number of DIPs during the 2010 to 2014 period, or for the most recent 2015 – 2019 timeframe (NWFSC 2015; 2020). In some river systems, such as the Green River, Snohomish/Skykomish Rivers, and the Stillaguamish Rivers these estimates were higher than some guidelines recommend (e.g., no more than 5percent hatchery-origin spawners on spawning grounds for isolated hatchery programs (HSRG 2009) over the 2005-2009 and 2010-2014 timeframes. The draft NWFSC viability risk assessment (Ford, 2022) states that a third of the 32 PS steelhead populations continue to lack monitoring and abundance data, and in most cases, it is likely that abundances are very low.

Early winter-run fish produced in isolated hatchery programs are derived from Chambers Creek stock in southern Puget Sound, which has been selected for early spawn timing, a trait known to be inheritable in salmonids.[12] Summer-run fish produced in isolated hatchery programs were historically derived from the Skamania River summer stock in the lower Columbia River Basin (i.e., from outside the DPS). The production and release of hatchery fish of both run types (winter and summer) may continue to pose risk to diversity in natural-origin steelhead in the DPS, as described in Hard et al. (2007) and Hard et al. (2015). However, the draft NWFSC viability risk assessment (Ford, 2022) states that risks to natural-origin PS steelhead that may be attributable to hatchery-related effects has decreased since the 2015 status review due to reductions in production of non-listed stocks, and the replacement with localized stocks. The three summer steelhead programs continuing to propagate Skamania derived stocks from outside of Puget Sound should be phased out completely by 2031 (NMFS 2019c; Ford, 2022). Lastly, annual reporting from the operators and current science suggest that risks remain at the same low to negligible levels as evaluated in 2016 and 2019 (NMFS 2016b; 2019c; 2019g; 2019h).

More information on PS steelhead spatial structure and diversity can be found in NMFS's PSSTRT viability report and NMFS's status review update on salmon and steelhead (NWFSC 2015) and recent viability risk assessment (Ford, 2022).

Abundance and Productivity: The viability of the PS steelhead DPS has improved somewhat since the Puget Sound Steelhead TRT concluded that the DPS was at very low viability, as were all three of its constituent MPGs, and many of its 32 DIPs (Hard et al. 2015). Increases in spawner abundance have been observed in a number of populations over the last five years; however, these improvements were disproportionately found within the South and Central Puget Sound and Strait of Juan de Fuca and Hood Canal MPGs, and primarily among smaller populations. The recent positive trends among winter-run populations in the White, Nisqually, and Skokomish rivers improve the demographic risks facing those populations. The abundance, productivity, spatial structure, and diversity of Elwha River steelhead winter and summer-runs

[12] The native-origin Chambers Creek steelhead stock is now extinct.

has dramatically improved following the removal of the Elwha River dams improved. Improvements in abundance have not been as widely observed in the Northern Puget Sound MPG. The declines of summer and winter-run populations in the Snohomish Basin are especially concerning. These populations figure prominently as sources of abundance for the MPG and DPS (NMFS 2019a). Additionally, the decline in the Tolt River summer-run steelhead population was especially alarming given that it is the only summer-run population for which we have abundance estimates. The demographic and diversity risks to the Tolt River summer-run DIP are very high. In fact, all summer-run steelhead populations in the North Cascades MPG are likely at a very high demographic risk. In spite of improvements in some areas, most populations are still at relatively low abundance levels, with about a third of the DIPs unmonitored and presumably at very low levels (Ford, 2022).

As described in the recovery plan, recovery targets were calculated using a two-tiered approach adjusting for years of low and high productivity (NMFS 2019a). Abundance information is unavailable for approximately one-third of the DIPs, disproportionately so for summer-run populations. In most cases where no information is available it is assumed that abundances are very low. Some population abundance estimates are only representative of part of the population (index reaches, etc.). Where recent five-year abundance information is available, 30 percent (6 of 20 populations) are less than 10 percent of their high productivity recovery targets (lower abundance target), 65 percent (13 of 20) are between 10 and 50 percent, and 5 percent (1 of 20) are greater than 50 percent of their low abundance targets (Table 5). A key element to achieving recovery is recovering a representative number of both winter- and summer-run steelhead populations, and the restoration of viable summer-run DIPs is a long-term endeavor (NMFS 2019a). Fortunately, the relatively rapid reestablishment of summer-run steelhead in the Elwha River does provide a model for potentially re-anadromizing summer-run steelhead sequestered behind impassable dams.

Table 5. Recent (2015-2019) 5-year geometric mean of raw wild spawner counts for Puget Sound steelhead populations and population groups compared with Puget Sound Steelhead Recovery Plan high and low productivity recovery targets (NMFS 2019). (SR) – Summer-run. Abundance is compared to the high productivity individual DIP targets. Colors indicate the relative proportion of the recovery target currently obtained: red (<10%), orange (10%>x<50%), yellow (50%>x<100%), green (>100%). "*" denotes an interim recovery target.

Major Population Group	Demographically Independent Population	Abundance (2015-2019)	Recovery Target	
			High Productivity	Low Productivity
Northern Cascades	Drayton Harbor Tributaries	N/A	1,100	3,700
	Nooksack River	1,906	6,500	21,700
	South Fork Nooksack River (SR)	N/A	400	1,300
	Samish River & Independent Tributaries	1,305	1,800	6,100
	Skagit River	7,181	15,000 *	
	Sauk River	N/A		
	Nookachamps River	N/A		
	Baker River	N/A		
	Stillaguamish River	487	7,000	23,400
	Canyon Creek (SR)	N/A	100	400
	Deer Creek (SR)	N/A	700	2,300
	Snohomish/Skykomish River	690	6,100	20,600
	Pilchuck River	638	2,500	8,200
	Snoqualmie River	500	3,400	11,400
	Tolt River (SR)	40	300	1,200
	North Fork Skykomish River (SR)	N/A	200	500
Central and South Sound	Cedar River	N/A	1,200	4,000
	North Lake Washington Tributaries	N/A	4,800	16,000
	Green River	1,282	5,600	18,700
	Puyallup/Carbon River	136	4,500	15,100
	White River	130	3,600	12,000
	Nisqually River	1,368	6,100	20,500
	East Kitsap Tributaries	N/A	2,600	8,700
	South Sound Tributaries	N/A	6,300	21,200
Strait of Juan de Fuca	Elwha River	1,241	2,619	
	Dungeness River	408	1,200	4,100
	Strait of Juan de Fuca Independent Tributaries	95	1,000	3,300
	Sequim and Discovery Bay Tributaries	N/A	500	1,700
	Skokomish River	958	2,200	7,300
	West Hood Canal Tributaries	150	2,500	8,400
	East Hood Canal Tributaries	93	1,800	6,200
	South Hook Canal Tributaries	91	2,100	7,100

There are a number of planned, ongoing, and completed actions that will likely benefit steelhead populations in the near term, but have not yet influenced adult abundance. Among these, the removal of the diversion dam on the Middle Fork Nooksack River, the Pilchuck Dam removal, passage improvements at Mud Mountain Dam, the ongoing passage program in the North Fork Skokomish River, and the planned passage program at Howard Hanson Dam. Dam removal in the Elwha River, and the resurgence of the endemic winter and summer-run steelhead populations have underscored the benefits of restoring fish passage. The Elwha River scenario is somewhat unique in that upstream habitat is in pristine condition and smolts emigrate into the Strait of Juan de Fuca and not Puget Sound or Hood Canal.

Improvements in spatial structure can only be effective if done in concert with necessary improvements in habitat. Habitat restoration efforts are ongoing, but land development and habitat degradation concurrent with increasing human population in the Puget Sound corridor may results in a continuing net loss of habitat. Recovery efforts in conjunction with improved ocean and climatic conditions have resulted in improved viability status for the majority of populations in this DPS; however, absolute abundances are still low, especially summer-run populations, and the DPS remains at high to moderate risk of extinction. However, since 2015, fifteen of the 21 populations indicate small to substantive increases in abundance.[13] Nevertheless, most steelhead populations remain small. From 2015 to 2019, nine of the 21 steelhead populations had fewer than 250 natural spawners annually, and 12 of the 21 steelhead populations had 500 or fewer natural spawners (Table 6).

[13] Nooksack River, Samish River/Bellingham Bays Tributaries, Skagit River, Stillaguamish River, Pilchuck River, Cedar River, Green River, Puyallup River, Nisqually River, White River, S. Hood Canal, Eastside Hood Canal Tributaries, Westside Hood Canal Tributaries, Skokomish River and Elwha River winter-run populations. The Skagit River and Elwha River summer-run steelhead are also showing increasing trends (Ford, 2022).

Table 6. Five-year geometric mean of raw natural spawner counts for Puget Sound steelhead. This is the raw total spawner count times the fraction natural estimate, if available. Percent change between the most recent two 5-year periods is shown on the far right. (W=winter run; S=summer run).

Biogeographic Region	Population	2010-2014	2015-2019	Population trend (% Change)
North Cascades	Samish R./ Bellingham Bay Tribs. (W)	748	1305	Positive (74)
	Nooksack R. (W)	1745	1906	Positive (9)
	Skagit R. (S and W)	6391	7181	Positive (12)
	Stillaguamish R. (W)	386	487	Positive (26)
	Snohomish/ Skykomish R. (W)	975	690	Negative (-29)
	Pilchuck R. (W)	626	638	Positive (2)
	Snoqualmie R. (W)	706	500	Negative (-29)
	Tolt R. (S)	108	40	Negative (-63)
Central/South Puget Sound Basin	N. Lake WA Tribs. (W)	-	-	-
	Cedar R. (W)	4	6	Positive (50)
	Green R. (W)	662	1289	Positive (95)
	White R. (W)	514	451	Negative (-12)
	Puyallup R. (W)	85	201	Positive (136)
	Carbon R. (W)	(290)	(735)	Positive (153)
	Nisqually R. (W)	477	1368	Positive (187)
Hood Canal/Strait of Juan de Fuca	S. Hood Canal (W)	69	91	Positive (32)
	Eastside Hood Canal Tribs (W)	60	93	Positive (55)
	Skokomish R. (W)	533	958	Positive (80)
	Westside Hood Canal Tribs (W)	138	150	Positive (9)
	Dungeness R. (S and W)	517	448	Negative (-13)
	Strait of Juan de Fuca Independents (W)	151	95	Negative (-37)
	Elwha R. (W)	680	1241	Positive (82)

Limiting factors. In our 2013 proposed rule designating critical habitat for this species (USDC 2013), we noted that the following factors for decline for PS steelhead persist as limiting factors:

- The continued destruction and modification of steelhead habitat
- Widespread declines in adult abundance (total run size), despite significant reductions in harvest in recent years
- Threats to diversity posed by use of two hatchery steelhead stocks (Chambers Creek and Skamania)

- Declining diversity in the DPS, including the uncertain but weak status of summer run fish
- A reduction in spatial structure
- Reduced habitat quality through changes in river hydrology, temperature profile, downstream gravel recruitment, and reduced movement of large woody debris
- In the lower reaches of many rivers and their tributaries in Puget Sound where urban development has occurred, increased flood frequency and peak flows during storms and reduced groundwater-driven summer flows, with resultant gravel scour, bank erosion, and sediment deposition
- Dikes, hardening of banks with riprap, and channelization, which have reduced river braiding and sinuosity, increasing the likelihood of gravel scour and dislocation of rearing juveniles

<u>PS steelhead Recovery Plan</u>: Juvenile Puget Sound steelhead are less dependent on nearshore habitats for early marine rearing than Chinook or Chum salmon; nevertheless, nearshore, estuarine, and shoreline habitats provide important features necessary for the recovery of steelhead. Puget Sound steelhead spend only a few days to a few weeks migrating through the large fjord, but mortality rates during this life stage are critically high (Moore et al. 2010; Moore and Berejikian 2017). Early marine mortality of Puget Sound steelhead is recognized as a primary limitation to the species' survival and recovery (NMFS 2019a). Factors in the marine environment influencing steelhead survival include predation, access to prey (primarily forage fish), contaminants (toxics), disease and parasites, migration obstructions (e.g., the Hood Canal bridge), and degraded habitat conditions which exacerbate these factors.

The PS steelhead recovery plan identifies ten ecological concerns that directly impact salmon and steelhead:

- Habitat quantity (anthropogenic barriers, natural barriers, competition);
- Injury and mortality (predation, pathogens, mechanical injury, contaminated food);
- Food (altered primary productivity, food-competition, altered prey species composition and diversity);
- Riparian condition (riparian condition, large wood recruitment);
- Peripheral and transitional habitats (side channel and wetland condition, estuary conditions, nearshore conditions);
- Channel structure and form (bed and channel form, instream structural complexity);
- Sediment conditions (decreased sediment quantity, increased sediment quantity);
- Water quality (temperature, oxygen, gas saturation, turbidity, pH, salinity, toxic contaminants);
- Water quantity (increased water quantity, decreased water quantity, altered flow timing); and
- Population-level effects (reduced genetic adaptiveness, small population effects, demographic changes, life history changes).

The Puget Sound steelhead recovery plan and its associated appendix 3 includes specific recovery actions for the marine environment. General protection and restoration actions summarized from the plan include:

- Continue to improve the assessments of harbor seal predation rates on juvenile steelhead;
- Remove docks and floats which act as artificial haul-out sites for seals and sea lions;
- Consistent with the MMPA, test acoustic deterrents and other hazing techniques to reduce steelhead predation from harbor seals;
- Develop non-lethal actions for "problem animals and locations" to deter predation;
- Increase forage fish habitat to increase abundance of steelhead prey;
- Remove bulkheads and other shoreline armoring to increase forage fish;
- Acquire important forage fish habitat to protect high forage fish production areas;
- Add beach wrack to increase forage fish egg survival;
- Protect and restore aquatic vegetation (e.g., eelgrass and kelp);
- Remove creosote pilings to reduce mortality of herring eggs;
- Increase the assessment of migratory blockages, especially the Hood Canal bridge, where differential mortality has been documented;
- Identify and remedy sources of watershed chemical contaminants (e.g., PBDEs and PCBs).

2.2.2 Status of Critical Habitats

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of essential physical and biological features (PFBs) throughout the designated areas. Critical habitat in the action area, which is expected to be adversely affected by the proposed action, includes PS Chinook salmon and PS steelhead critical habitat

Salmon and Steelhead Critical Habitat

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to each listed species they support. The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS's critical habitat analytical review teams (CHARTs) evaluated the quantity and quality of habitat features (for example, spawning gravels, wood and water condition, side channels), the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area (NOAA Fisheries 2005). Thus, even a location that has poor quality of habitat could be ranked with a high conservation value if it were essential due to factors such as limited availability (e.g., one of a very few spawning areas), a unique contribution of the population it served (e.g., a population at the extreme end of geographic distribution), or if it serves another important role (e.g., obligate area for migration to upstream spawning areas).

The physical or biological features of nearshore marine areas that would be affected by the proposed action include, ample forage, areas free of artificial obstructions, sufficient natural cover, and adequate water quality and quantity to support adult growth, sexual maturation, and migration as well as nearshore juvenile rearing. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow juvenile fish to grow and mature before migrating to the ocean.

CHART Salmon and Steelhead Critical Habitat Assessments: The CHART for each recovery domain assessed biological information pertaining to occupied habitat by listed salmon and steelhead, determine whether those areas contained PCEs essential for the conservation of those species and whether unoccupied areas existed within the historical range of the listed salmon and steelhead that are also essential for conservation. The CHARTs assigned a 0- to 3-point score for the PCEs in each HUC5 watershed for:

- Factor 1: Quantity,
- Factor 2: Quality—Current Condition,
- Factor 3: Quality—Potential Condition,
- Factor 4: Support of Rarity Importance,
- Factor 5: Support of Abundant Populations, and
- Factor 6: Support of Spawning/Rearing.

Thus, the quality of habitat in a given watershed was characterized by the scores for Factor 2 (quality—current condition), which considers the existing condition of the quality of PCEs in the HUC5 watershed; and Factor 3 (quality—potential condition), which considers the likelihood of achieving PCE potential in the HUC5 watershed, either naturally or through active conservation/restoration, given known limiting factors, likely biophysical responses, and feasibility.

Puget Sound Recovery Domain: Critical habitat has been designated in Puget Sound for PS Chinook salmon, PS steelhead, and Hood Canal Summer Run chum salmon (HCSRC). Major tributary river basins in the Puget Sound basin include the Nooksack, Samish, Skagit, Sauk, Stillaguamish, Snohomish, Lake Washington, Cedar, Sammamish, Green, Duwamish, Puyallup, White, Carbon, Nisqually, Deschutes, Skokomish, Duckabush, Dosewallips, Big Quilcene, Elwha, and Dungeness rivers and Soos Creek.

Critical habitat for PS Chinook salmon was designated on September 2, 2005 (70 FR 52630). Critical habitat includes 1,683 miles of streams, 41 square mile of lakes, and 2,182 miles of nearshore marine habitat in Puget Sounds. The Puget Sound Chinook salmon ESU has 61 freshwater and 19 marine areas within its range. Of the freshwater watersheds, 41 are rated high conservation value, 12 low conservation value, and eight received a medium rating. Of the marine areas, all 19 are ranked with high conservation value.

Critical habitat for PS steelhead was designated on February 24, 2016 (81 FR 9252). Critical habitat includes 2,031 stream miles. Nearshore and offshore marine waters were not designated for this species. There are 66 watersheds within the range of this DPS. Nine watersheds received a low conservation value rating, 16 received a medium rating, and 41 received a high rating to the DPS. Critical habitat for PS steelhead includes freshwater spawning sites, freshwater rearing sites, and freshwater migration corridors.

Critical habitat is designated for PS Chinook salmon in estuarine and nearshore areas. Designated critical habitat for PS steelhead does not include nearshore areas, as this species does not make extensive use of these areas during juvenile life stage.

The following discussion is general to salmon and steelhead critical habitat in the Puget Sound basin. More specific information for each individual species' critical habitat is presented after the general discussion.

Landslides can occur naturally in steep, forested lands, but inappropriate land use practices likely have accelerated their frequency and the amount of sediment delivered to streams. Fine sediment from unpaved roads has also contributed to stream sedimentation. Unpaved roads are widespread on forested lands in the Puget Sound basin, and to a lesser extent, in rural residential areas. Historical logging removed most of the riparian trees near stream channels. Subsequent agricultural and urban conversion permanently altered riparian vegetation in the river valleys, leaving either no trees, or a thin band of trees. The riparian zones along many agricultural areas are now dominated by alder, invasive canary grass and blackberries, and provide substantially reduced stream shade and large wood recruitment (SSPS 2007).

Diking, agriculture, revetments, railroads and roads in lower stream reaches have caused significant loss of secondary channels in major valley floodplains in this region. Confined main channels create high-energy peak flows that remove smaller substrate particles and large wood. The loss of side-channels, oxbow lakes, and backwater habitats has resulted in a significant loss of juvenile salmonid rearing and refuge habitat. When the water level of Lake Washington was lowered 9 feet in the 1910s, thousands of acres of wetlands along the shoreline of Lake Washington, Lake Sammamish and the Sammamish River corridor were drained and converted to agricultural and urban uses. Wetlands play an important role in hydrologic processes, as they store water that ameliorates high and low flows. The interchange of surface and groundwater in complex stream and wetland systems helps to moderate stream temperatures. Forest wetlands are estimated to have diminished by one-third in Washington State (FEMAT 1993; Spence et al. 1996; SSPS 2007).

Loss of riparian habitat, elevated water temperatures, elevated levels of nutrients, increased nitrogen and phosphorus, and higher levels of turbidity, presumably from urban and highway runoff, wastewater treatment, failing septic systems, and agriculture or livestock impacts, have been documented in many Puget Sound tributaries (SSPS 2007).
Peak stream flows have increased over time due to paving (roads and parking areas), reduced percolation through surface soils on residential and agricultural lands, simplified and extended drainage networks, loss of wetlands, and rain-on-snow events in higher elevation clear cuts (SSPS 2007). In urbanized Puget Sound, there is a strong association between land use and land cover attributes and rates of coho spawner mortality likely due to runoff containing contaminants emitted from motor vehicles (Feist et al. 1996). Recent studies have shown that coho salmon show high rates of pre-spawning mortality when exposed to chemicals that leach from tires (McIntyre et al. 2015). Researchers have recently identified a tire rubber antioxidant as the cause (Tian et al. 2020). Although Chinook salmon did not experience the same level of mortality, tire leachate is still a concern for all salmonids. Traffic residue also contains many unregulated toxic chemicals such as pharmaceuticals, polycyclic aromatic hydrocarbons (PAHs), fire retardants, and emissions that have been linked to deformities, injury and/or death of salmonids and other fish (Trudeau 2017; Young et al. 2018).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS salmon and steelhead populations in a number of river systems. The construction and operation of dams have blocked access to spawning and rearing habitat (e.g., Elwha River dams block anadromous fish access to 70 miles of potential habitat) changed flow patterns, resulted in elevated temperatures and stranding of juvenile migrants, and degraded downstream spawning and rearing habitat by reducing recruitment of spawning gravel and large wood to downstream areas (SSPS 2007). These actions tend to promote downstream channel incision and simplification (Kondolf 1997), limiting fish habitat. Water withdrawals reduce available fish habitat and alter sediment transport. Hydropower projects often change flow rates, stranding and killing fish, and reducing aquatic invertebrate (food source) productivity (Hunter 1992).

Juvenile mortality occurs in unscreened or inadequately screened diversions. Water diversion ditches resemble side channels in which juvenile salmonids normally find refuge. When diversion head gates are shut, access back to the main channel is cut off and the channel goes dry. Mortality can also occur with inadequately screened diversions from impingement on the screen, or mutilation in pumps where gaps or oversized screen openings allow juveniles to get into the system (WDFW 2009). Blockages by dams, water diversions, and shifts in flow regime due to hydroelectric development and flood control projects are major habitat problems in many Puget Sound tributary basins (SSPS 2007).

The nearshore marine habitat has been extensively altered and armored by industrial and residential development near the mouths of many of Puget Sound's tributaries. A railroad runs along large portions of the eastern shoreline of Puget Sound, eliminating natural cover along the shore and natural recruitment of beach sand (SSPS 2007).

Degradation of the near-shore environment has occurred in the southeastern areas of Hood Canal in recent years, resulting in late summer marine oxygen depletion and significant fish kills. Circulation of marine waters is naturally limited, and partially driven by freshwater runoff, which is often low in the late summer. However, human development has increased nutrient loads from failing septic systems along the shoreline, and from use of nitrate and phosphate fertilizers on lawns and farms. Shoreline residential development is widespread and dense in many places. The combination of highways and dense residential development has degraded certain physical and chemical characteristics of the near-shore environment (HCCC 2005; SSPS 2007).

In summary, critical habitat for salmon and steelhead throughout the Puget Sound basin has been degraded by numerous management activities, including hydropower development, loss of mature riparian forests, increased sediment inputs, removal of large wood, intense urbanization, agriculture, alteration of floodplain and stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, dredging, armoring of shorelines, marina and port development, road and railroad construction and maintenance, logging, and mining. Changes in habitat quantity, availability, and diversity, and flow, temperature, sediment load and channel instability are common limiting factors in areas of critical habitat. As mentioned above, development of shoreline and estuary areas of Puget Sound is expected to continue to adversely impact the quality of marine habitat for PS salmonids. Projected changes in nearshore and estuary development based on documented rates of developed land cover change in Bartz et al. (2015) show that between 2008 and 2060, an additional 14.7 hectares of development of shoreline areas and 204 hectares of estuary development can be expected.

Salmon and Steelhead Critical Habitat

The PS recovery domain CHART for PS Chinook salmon (NOAA Fisheries 2005) determined that only a few watersheds with PCEs for Chinook salmon in the Whidbey Basin (Skagit River/Gorge Lake, Cascade River, Upper Sauk River, and the Tye and Beckler rivers) are in good-to-excellent condition with no potential for improvement. Most HUC5 watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement.

As mentioned previously, numerous factors have led to the decline of PS Chinook salmon including overharvest, freshwater and marine habitat loss, hydropower development, and hatchery practices, as mentioned in Section 2.2.1, above. Adjustments can, and have been made in the short term to ameliorate some of the factors for decline. Harvest can be adjusted on yearly or even in-season basis. Since PS Chinook salmon were listed, harvest in state and federal fisheries has been reduced in an effort to increase the number of adults returning to spawning grounds. Likewise, hatchery management can, and has been adjusted relatively quickly when practices are detrimental to listed species. To address needed improvements in hydropower, NMFS has issued biological Opinions with reasonable and prudent alternatives to improve fish passage at existing hydropower facilities. Unlike the other factors, however, loss of critical habitat quality is much more difficult to address in the short term. Once human development causes loss of critical habitat quality, that loss tends to persist for decades or longer. The condition of critical habitat will improve only through active restoration or natural recovery following the removal of human infrastructure. As noted throughout this Opinion, future effects of climate change on habitat quality throughout Puget Sound are expected to be negative.

Habitat utilization by Chinook salmon and steelhead in the Puget Sound area has been historically limited by large dams and other manmade barriers in a number of drainages, including the Nooksack, Skagit, White, Nisqually, Skokomish, and Elwha river basins (Appendix B in NMFS (2015a)). In addition to limiting habitat accessibility, dams affect habitat quality through changes in river hydrology, altered temperature profile, reduced downstream gravel recruitment, and the reduced recruitment of large woody debris. Such changes can have significant negative impacts on salmonids (e.g., increased water temperatures resulting in decreased disease resistance) (Spence et al. 1996; McCullough 1999). However, over the past several years modifications have occurred to existing barriers, which have reduced the number of basins with limited anadromous access to historical habitat. The completion of the Elwha and Glines Canyon Dam removals occurred in 2014. The response of fish populations to this action is still being evaluated. It is clear; however, that Chinook salmon and steelhead are accessing much of this newly available habitat. Passage operations have begun on the North Fork Skokomish River to reintroduce steelhead above Cushman Dam, although juvenile collection efficiency is still relatively low, and further improvements are anticipated. Similarly, improvements in the adult fish collection facility at Mud Mountain Dam (White River basin) are near completion, with the expectation that improvements in adult survival will facilitate better utilization of habitat above the dam (NMFS 2014b). The recent removal of the diversion dam on the Middle

Fork Nooksack Dam (16 July 2020) and the Pilchuck River Dam (late 2020) will provide access to important headwater salmonid spawning and rearing habitats. Similarly, the proposed modification of Howard Hanson Dam for upstream fish passage and downstream juvenile collection in the longer term (NMFS 2019f) will allow winter steelhead to return to historical habitat (Ford 2022).

2.3. Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

2.3.1 Baseline Condition of the White River

The project area is located within the White River Basin. The White River originates from the Emmons and Fryingpan glaciers on the north face of Mount Rainier (Marks et al. 2021). The White River drains approximately 494 square miles and flows 77 miles from its source to its confluence with the Puyallup River (Marks et al. 2021). Within the project area, the White River meanders generally in a southern direction to the Puyallup River confluence approximately 2.6 miles south of the project area. Because of its glacial origins, the White River transports a tremendous volume of bed load material contributing to the dynamic nature of the system. The high sediment loads are responsible for the braided channel morphology characteristics in the upper basin and large amounts of glacial till cause fine sediments to accumulate throughout the river and keeps turbidity levels high relative to other streams. Turbidity tends to be greatest during the summer when glacial melt is the highest, however, turbidity can also be elevated during the winter following high flow events. Climate change is expected to cause turbidity to increase as the glaciers continue to melt and retreat. The White River is listed as an impaired waterbody for pH, temperature, and instream flow (WSDOE 2016b). The majority of precipitation in the White River basin occurs during the winter months (WSDOE 2016a) and annually averages approximately 30-40 inches in the greater Tacoma area and over 120 inches in the Cascade Mountains. The mean annual air temperature is approximately 50ºF (Zulauf, et. al., 1979; Puyallup Tribe of Indians 2016). The White River is influenced by a variety of land use types including industrial and private forests, recreational areas, and developed residential and industrial areas. Road density in timber production areas are high, around 6 miles per square mile. High road density can lead to increases in sedimentation, landslides, slope failures, changes in hydrology, and culverts preventing upstream migration in affected drainages (Marks et al. 2014).

Flows within the White River are regulated by Mud Mountain Dam (RM 29.6), which is a flood control facility; water is stored behind Mud Mountain Dam only when flows reach flood levels, otherwise the White River flows through the dam normally[14]. Mud Mountain Dam is an impassable fish barrier preventing salmon and steelhead from reaching important upstream spawning habitat. The Corps operates a fish trap near Buckley where migrating salmon and

[14] https://www.nws.usace.army.mil/Missions/Civil-Works/Locks-and-Dams/Mud-Mountain-Dam/

steelhead are captured, trucked, and released upstream of Mud Mountain Dam to spawn. A diversion near Buckley, Washington diverts water from the White River to Lake Tapps. Water is then released from Lake Tapps back to the White River through the Dieringer Tailrace (RM 3.6).

2.3.2 Baseline Condition of the Action Area

The project is located on the lower White River a few miles upstream of its confluence with the Puyallup River. In total, the project covers approximately 467 acres. Current land use in the project area includes a 160-acre golf course, 113 acres of agricultural land, and 194 acres consisting of the White River and surrounding riparian corridor, undeveloped land, and existing BNSF and city right-of-way (Figure 9). Directly south of the former golf course is the Dieringer Tailrace and approximately 103 acres of agricultural land. Existing BNSF railroad tracks run along the eastern edge of the project and the Summer Link Trail runs adjacent to the shoreline area for the majority of the project area. The majority of the project area is zoned as light manufacturing (M-1), with a section zoned as a resource protection district (RES) (City of Sumner 2016). Existing impervious surfaces include golf cart pathways, parking lots, a section of the Sumner Link trail, 148th Avenue E, and a section of 24th Street E.

The lower White River flows through the project area between river mile (RM) 2.6 and 4.3. The White River flows southwest through the project area before joining with the Puyallup River. The project area includes the Cascade Water Alliance Dieringer Tailrace that outlets into the White River at RM 3.6, as well as the #9 Ditch which originates east of the railroad and flows into a multibranched ditch network west of the railroad. The project is within Water Resource Inventory Area (WRIA) 10: Puyallup/White, Hydraulic Unit Code (HUC) 171100140204.

Soils in the area consist mainly of Snohomish silty clay loam and Puyallup fine sandy loam. Western hemlock (*Tsuga heterophylla*) are the major vegetation feature in the area (Franklin and Dyrness 1973). Although, historically, the project area included a mature conifer forest with western hemlock, Douglas fir (*Pseudotsuga menziesii*), and western red cedar (*Thuja plicata*). However, most of these old stands have been decimated by logging and agriculture. Current vegetation along the waterway channels consists primarily of Himalayan blackberry (*Rubus armeniacus*), reed canarygrass (*Phalaris arundinacea*), Japanese knotweed *(Polygonum cuspidatum*), and shrubby willows (*Pacific* and *Salix spp.*). Within the golf course, vegetation consists of Bermuda grass (*Cynodon dactylon*), Jeffery pine (*Pinus jeffreyi*) and patches of reed canarygrass.

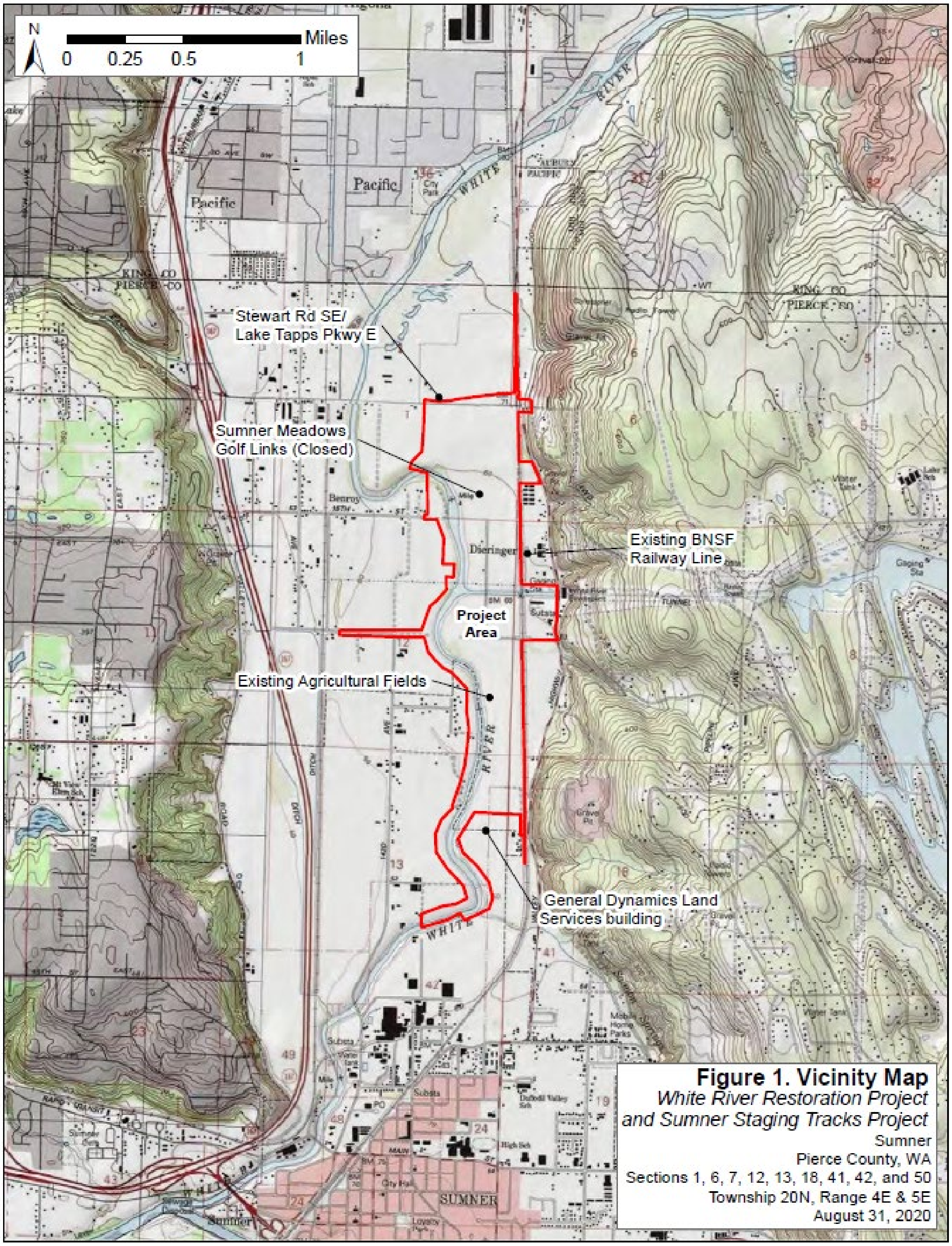


Figure 9. Existing features and conditions within the project area (Widener & Associated 2020).

2.3.3 Salmonid Populations in the Action Area

White River Spring Chinook

Fall and spring Chinook salmon are both present in the White River basin. White River spring Chinook salmon are one of the only remaining spring Chinook salmon stocks in the Puget Sound

(WDFW et al. 1996 *in* Marks et al. 2021) and are vital to recovering the PS Chinook salmon ESU. Fall Chinook salmon are ubiquitous throughout the Puyallup River, Carbon River, and Lower White River. The White River does not have a fall Chinook salmon hatchery program so the fall Chinook salmon entering the White River are usually hatchery strays from Puyallup River hatcheries. Chinook salmon captured in the Corps Buckley trap and transported above Mud Mountain Dam were low from 1960 until the 1990's (Figure 10). In 2000, adult and jack Chinook salmon captured at the Buckley trap increased substantially, peaking in 2017 with over 15,000 captured and transported. However, as demonstrated in the most recent Northwest Fisheries Science Center viability report (Ford 2022) the high spring Chinook salmon abundances observed in recent years is due in large part to hatchery supplementation, illustrated by declining productivity since 2000 (Figure 9, right panel). While high returns of both fall and spring run Chinook salmon is encouraging from a recovery stand point, low productivity indicates factors such as limited habitat and poor survival are preventing recovery of natural origin fish.

The majority of Chinook salmon spawning occurs in Boise Creek and upstream of Mud Mountain Dam in Huckleberry Creek, Greenwater River, and Clearwater River. Spawning below the Buckley trap in the lower White River is far less common as much of the suitable spawning reaches (approximately 5 miles) between the Buckley trap (RM 24.3) and the Dam are inaccessible (Marks et al. 2021). Spawning is uncommon at or downstream of the project site. Chinook salmon rear throughout the White River and are known to rear within the project area (Marks et al. 2016; WDFW 2018).

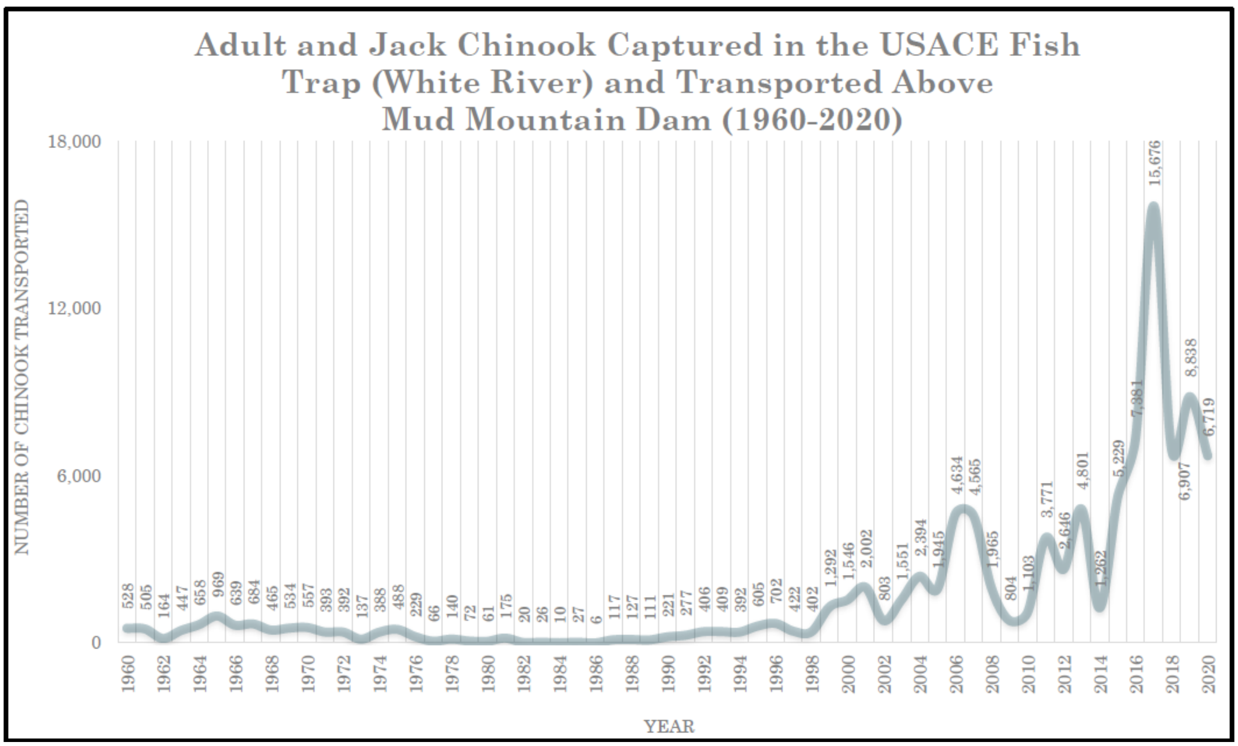


Figure 10. Adult and jack spring and fall Chinook salmon captured at the Corps fish trap and transported above Mud Mountain Dam from 1960 to 2020 (Adapted from Marks et al. 2021).

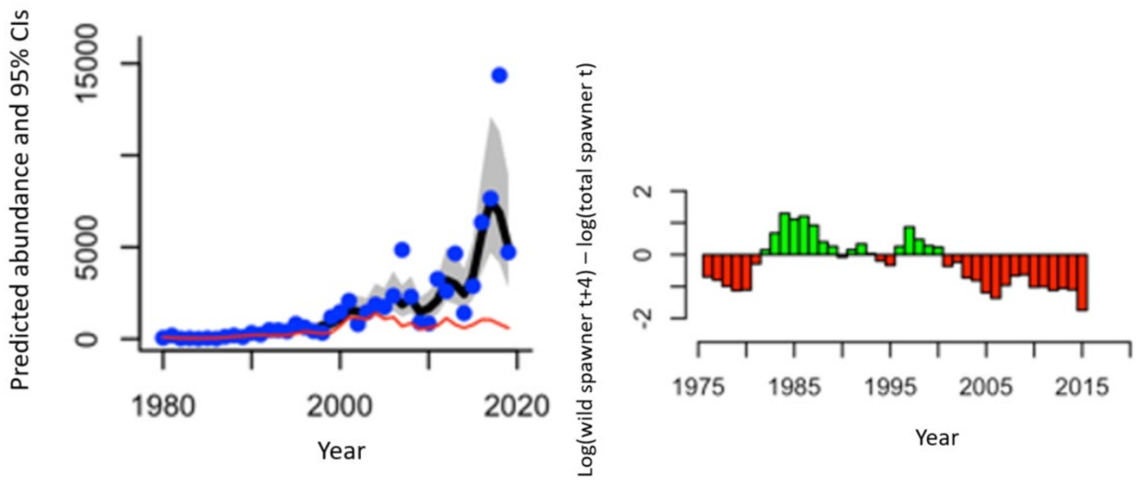
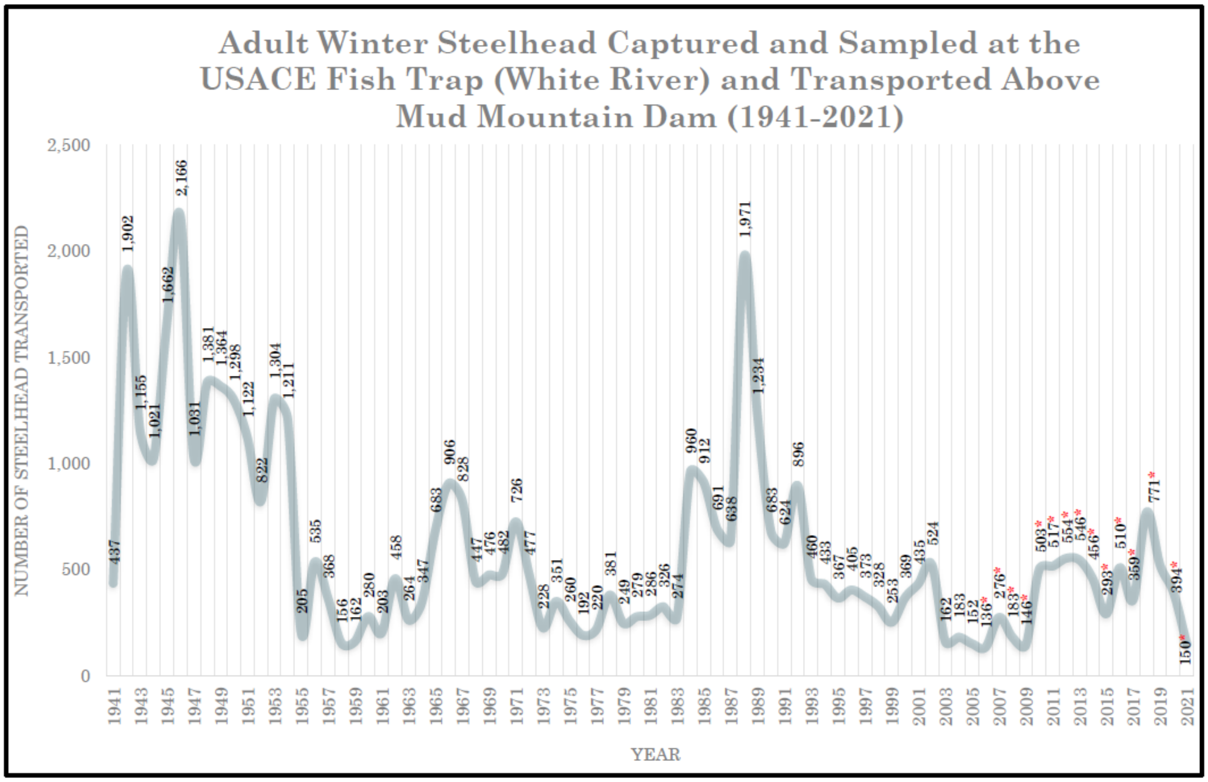


Figure 11. *Left Panel*: Smoothed trends in estimated total (thick black line, with 95% confidence interval in grey) and natural (thin red line) spawner abundance of White River Spring Chinook salmon. *Right Panel:* Annual trends in White River spring Chinook salmon productivity calculated as the difference of the log of the smoothed natural origin spawning abundance in year *t* and the smoothed natural origin spawning abundance in year *t – 4* (Figures adapted from Ford 2022).

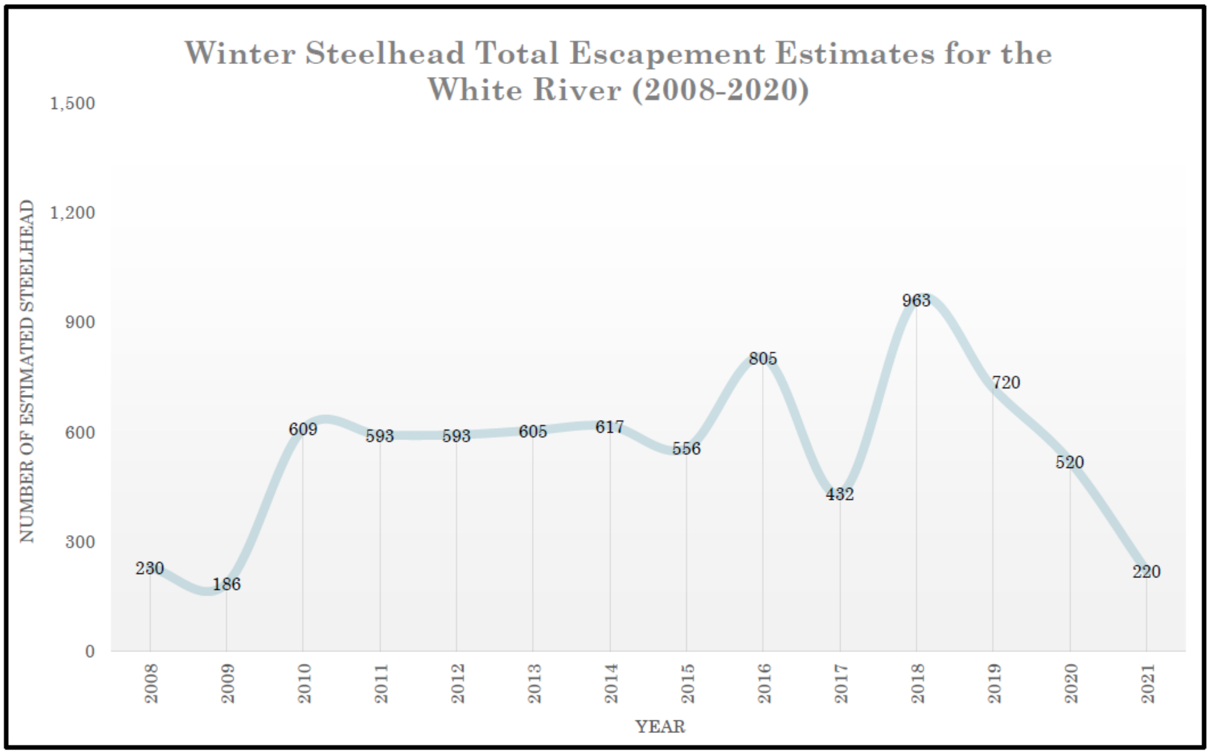
White River Winter Steelhead

The majority of steelhead returning the White River are winter run fish with a few summer run strays from the Green or Skykomish rivers (Marks et al. 2021). Adult winter steelhead captured at the Corps fish trap and transported above Mud Mountain Dam have remained below 1,000 fish since the early 1990's (Figure 10). Similarly, total adult escapement estimates have been low and declining since 2008. Most recently in 2021, winter steelhead escapement was estimated at 220 adults. Adult abundance estimates for both natural and hatchery origin fish have been increasing since 2010 (Figure 11, left panel) and productivity has remained mostly positive since 2005 (Figure 11, right panel). However, abundance remains well below recovery goals; the most recent five-year geometric mean abundance is 130 compared to a recovery goal of 3,600 – 12,000, depending on productivity (Ford 2022). Steelhead have been observed spawning above Mud Mountain Dam in Boise Creek and the Clearwater and Greenwater rivers well upstream of the project site; spawning is uncommon at or downstream of the project site.



The graph above details the number of steelhead transported above Mud Mountain Dam. *Additional steelhead captured in the trap since 2006 have been utilized as brood-stock for the White River steelhead supplementation project. See Appendix G or following page for the breakdown of steelhead returns.

Figure 12. Adult winter steelhead captured at the Corps fish trap and transported above Mud Mountain Dam from 1941-2021 (Adapted from Marks et al. 2021).



Estimated steelhead escapement totals were calculated and provided by WDFW biologists. Escapement and total run size was determined by utilizing both PTF White River tributary and mainstem spawning escapement data, and Buckley trap capture/sampling data.

Figure 13. Winter steelhead total escapement estimates for the White River from 2008 to 2021. Escapement was estimated using Puyallup Tribal Fisheries tributary and mainstem spawning escapement data and Buckley trap capture/sampling data (Adapted from Marks et al. 2021).

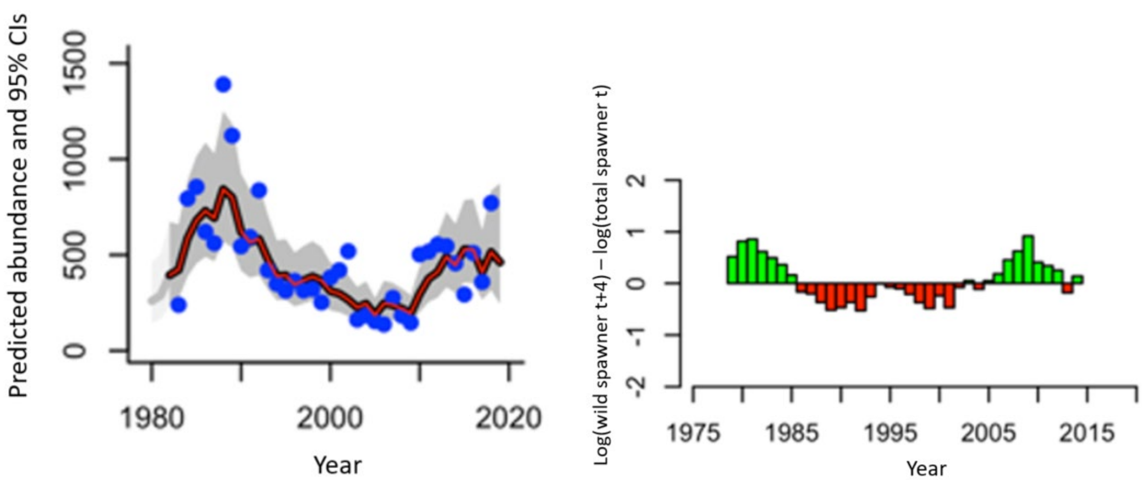


Figure 14. *Left Panel*: Smoothed trends in estimated total (thick black line, with 95% confidence interval in grey) and natural (thin red line) spawner abundance of White River winter steelhead. *Right Panel:* Annual trends in White River winter steelhead productivity calculated as the difference of the log of the smoothed natural origin spawning abundance in year *t* and the smoothed natural origin spawning abundance in year *t – 4* (Figures adapted from Ford 2022).

2.3.4 Critical Habitat in the Action Area

Within the action area critical habitat is designated for both PS Chinook salmon and steelhead along the mainstem White River and the Dieringer Tailrace. Critical habitat for both species would be affected by the project in both the White River and Dieringer Tailrace. Specific PBFs that would be affect by the action included water quality and quantity, floodplain connectivity, forage, natural cover, and substrate.

The action area is considered migration and rearing habitat for PS Chinook salmon and for PS steelhead. The features of critical habitat for rearing and migration include:

1. Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. These features are essential to conservation because without them juveniles cannot access and use the areas needed to forage, grow, and develop behaviors (*e.g.*, predator avoidance, competition) that help ensure their survival.
2. Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival. These features are essential to conservation because without them juveniles cannot use the variety of habitats that allow them to avoid high flows, avoid predators, successfully compete, begin the behavioral and physiological changes needed for life in the ocean, and reach the ocean in a timely manner. Similarly, these features are essential for adults because they allow fish in a non-feeding condition to successfully swim upstream, avoid predators, and reach spawning areas on limited energy stores.
3. Freshwater spawning sites with water quantity and quality conditions and substrate to support adult spawning, egg incubation, and alevin growth and development.

While Chinook salmon and steelhead have been documented using the White River within the project area (WDFW 2018), the majority of the area has suboptimal rearing habitat for salmonids. In fact, most of the White River below RM 11 is highly channelized due to bank stabilization and has poor rearing habitat. Bank stabilization structures have also eliminated most connectivity of the floodplain with the main channel. The project reach is single channel with very little instream refugia, limited riparian habitat providing shade or cover, and lacks large wood, boulders, and undercut banks (Kerwin 1999). The simplicity of the channel also degrades the migration corridor for adults and juveniles. Limited suitable spawning substrate exists in the project reach and spawning habitat is severely limited downstream of RM 11. Water quality with the project reach can be seasonally poor. In the late fall, when Chinook salmon typically spawn, water temperatures exceed optimal conditions (Barreca 2002; WDOE 2002). Additionally, the project reach is 303(d) listed for pH, dissolved oxygen, and temperature (WDOE 2016b). Neither spring nor fall Chinook salmon have been documented spawning with the project reach (WDFW 2018). Steelhead spawning has not been observed in the project reach either.

2.4. Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

After the application of all minimization and conservation measures described in Section 1.3, the proposed action would still result in adverse effects that cannot be avoided. Likely effects include short-term construction impacts, and long-term impacts of the proposed structural changes.

Temporary effects associated with construction that are reasonably certain to occur include fish handling/exclusion prior to construction, turbid conditions, and habitat area reductions. Intermittent effects include stormwater discharge from new impervious and pervious surfaces associated with the staging tracks.

The long-term effects of the project that are reasonably certain to occur include improved habitat quality and quantity through floodplain restoration, side channel connection and creation, increased habitat complexity via ELJs/revetments, and substrate, and improved riparian and upland function from extensive revegetation. We expect rearing, spawning, and migration habitat quality and quantity to improve over the long-term as a result of the proposed action.

2.4.1 Effects on Critical Habitat

Critical habitat for PS Chinook salmon and PS steelhead is designated within the action area and would be impacted by temporary and enduring effects of the proposed action. NMFS reviews the proposed actions effect on critical habitat by examining how the PBFs of critical habitat would be altered, the duration of such changes, and the influence of these changes on the potential for the habitat to serve the conservation values for which it was designated.

PBFs of freshwater habitat for Chinook salmon and steelhead include floodplain connectivity, forage, natural cover, water quality and quantity, and substrate. The freshwater environment supports adult and juvenile life stages of PS Chinook salmon and PS steelhead including migrating spawners, migrating, rearing, and growing juveniles, spawning adults, and incubating eggs.

The proposed action would occur for five years with in-water work occurring between July 1 and August 31 except for the removal of sheetpile. Floodplain grading, channel construction and relocation, ELJ and wood revetment installation, culvert removal and replacement and extension, riparian and upland planting, trail relocation, and bridge replacement would affect PBFs in the following ways:

Temporary Effects during Construction

Water Quality

Turbidity and Dissolved Oxygen – The proposed action would degrade water quality in the White River, Dieringer Tailrace, #9 ditch, and newly constructed floodplain habitats including side channels by temporarily elevating suspended sediments and turbidity and decreasing dissolved oxygen. Specific components of the action include filling and relocating channels, grading and excavating the floodplain, installing ELJs, wood revetments, and rock roughness features, and culvert installation and extension. We expect turbidity increases to be most prevalent when work is completed in-water or below the OHWM during the in-water work window. We do not expect water quality degradations to extend further than 1-mile downstream of the most downstream construction point on the main stem White River. Cofferdam removal within the work window is proposed as well as outside of the approved in-water work window provided that no sheetpile is removed using a vibratory pile driver and turbidity impacts are limited to 300 feet downstream of the active in-water work area.

Turbidity, suspended sediments, and DO are expected to return to baseline condition within a matter of days after work ceases. Conservation measures and BMPs described in the proposed action (*see* section 1.3 Proposed Action) would ensure water quality degradation is minimized.

Effects on Physical Habitat and Prey Base

Designated critical habitat for PS Chinook salmon and PS steelhead would experience temporary declines in forage and prey communities. However, over the long-term the project would increase forage habitat for both species as a result of increased habitat complexity (e.g., ELJs, rock roughness features, etc.), increased habitat quantity (e.g., floodplain connectivity, side channel reconnection, etc.), and expanded and revegetated riparian and upland areas.

Areas where sediment is disturbed by proposed pile installation, excavation, and sheetpile wall installation, would disturb and diminish benthic and forage prey communities. In areas where suspended sediment settles on the bottom smothering can occur and disrupt benthic and some forage communities. The speed of recovery is determined by the intensity of the disturbance; the greater the disturbance the longer the recovery time (Dernie et al., 2003). Additionally, the ability of a disturbed site to recolonize is affected by whether or not adjacent communities can re-seed the affected area. Thus recovery can range from several weeks to many months.

Forage habitat is a component of the freshwater rearing PBF for both salmon and steelhead. The proposed action would negatively affect benthic macro-invertebrate prey availability by crushing or displacing them during installation of ELJs and revetments, excavating and grading portions of the floodplain, and installing rock roughness features. However, given the dynamic nature of the White River we expect these disturbed areas to recovery fairly quickly once construction is completed. In addition, suspended sediment can settle on bottom substrate and smother benthic communities. However, given the proposed conservation measures and construction BMPs we expect suspended sediments to be contained within a 1-mile section downstream of the construction site. Moreover, we do not expect suspended sediments to reach levels high enough to smother large areas of invertebrate habitats. Disturbance of forage habitat would force rearing juvenile Chinook salmon and steelhead to utilize other areas up or downstream of the project until construction is completed and the area recovers. This is discussed in more detail in Section 2.4.2 (Effects on Species).

The temporal extent of disruptions to benthic feeding would be longer, as benthic invertebrate populations within the excavation area would be absent or reduced until the new surface layer is fully recolonized. Benthic food items would also be temporarily reduced by excavation of material, and from sediment suspended during construction activities. The loss of prey in the project area would be temporary, and once turbidity would subsides, benthic macroinvertebrates from outside the affected area would return. The effects on benthic productivity and availability of prey items are likely to last several hours to days after construction is completed until sediments in the area are recolonized.

Based on the foregoing analysis, effects on food items are likely to have minor, localized effects on juvenile salmonids rearing in the action area for a period of months following project construction. Short term change in prey availability and the disturbance to the benthic community at the site would not alter generally available feeding opportunities for salmonids elsewhere in the river. It is unlikely that the proposed action would result in measureable changes to the forage community over the long term.

Migration Corridor

Juvenile and adult Chinook salmon and steelhead migration corridors in the mainstem White River would be temporarily reduced while portions of the channel are isolated to accommodate ELJ, wood revetment, and large rock installations. While the in-water work window avoids peak migration timing for both juvenile and adult lifestages, juvenile steelhead and Chinook salmon as well as adult Chinook salmon may be present in low abundances while areas are isolated. In total a maximum of 8 acres of the White River would be isolated during ELJ and wood revetment installation. However, all 8 acres would not be isolated simultaneously. Given that numerous of the proposed ELJs and all wood revetments would be installed along the channel margins we expect the juvenile migratory corridor would be disproportionately affected because they may be forced into deeper water. When juvenile salmonids temporarily leave the relative safety of the shallow water, their predation risk increases. This increased risk will likely affect a very small number of juveniles as at any one time a relatively small proportion of the lower White River and will be unavailable for rearing.

Intermittent Effect

Stormwater Discharge

Modifications to impervious and pervious surfaces would occur as part of the proposed action. One acre of existing PGIS would be removed as part of the action and 3.7 acres of new PGIS would be installed to serve as an access road for the staging tracks. An additional 4.6 acres of NPGIS would also be installed and would receive very little vehicle traffic (<1 vehicle per month). All stormwater would be treated via retention and infiltration.

Because 100% of stormwater originating from the project site would be treated via retention and infiltration it is unlikely that harmful contaminants would enter the White River from the project site. Additionally, given that vehicle use would be limited at the site accumulation of pollutants would be primarily from surrounding land use and atmospheric deposition. Therefore, we expect effects of stormwater runoff to critical habitat and listed species to be insignificant.

Enduring Effects

Enduring effects of the action include increased habitat quantity and complexity and improved habitat quality for rearing and migrating White River Chinook salmon and steelhead. The long-term or enduring effects of the proposed action include permanent reconnection with vital floodplain and off channel habitat, increased rearing habitat throughout the channel including river margins, and an overall increase in channel complexity.

ELJs, wood revetments, and large boulders would be installed throughout the lower White River project area. These new features would be installed in-water, along newly connected side channels, and in the reconnected and lowered floodplain. ELJs, revetments, and boulders would change the hydraulic characteristics of the channel dispersing flow, promoting sediment retention, and creating additional mesohabitat features. Wood revetments and ELJ would provide stability along channel margins preventing lateral erosion and channel incision. Installation of these features would increase the number and depth of low velocity pools, which are ideal habitats for rearing juveniles and can provide velocity refuge for migrating adults. Bank stabilization using artificial materials such as riprap can reduce the quality of edge habitat and subsequently the survival, behavior, and distribution of juvenile salmonids that would otherwise rear near stream margins. Beamer and Henderson (1998) reported a reduction in juvenile rearing density of 5 to 10 times between natural forested banks and riprapped banks. Beechie et al. (2006) reported that modified banks lacked backwater areas, and pools created by eddies. Due to lower habitat diversity fish are found at much lower densities and diversity in riprap areas than in natural areas (Bolton and Shellberg 2001). In other words, higher species diversity and abundances are found in areas with natural banks due to the greater diversity of habitat features (Beamer and Henderson 1998).

Peters et al. (1998) compared seasonal fish densities in Washington at sites with various bank stabilization structures. They surveyed common bank stabilization methods and found that sites stabilized with large wood consistently had higher fish densities in spring, summer, and winter than sites without any stabilization structures (Peters et al. 1998). Lower fish densities are consistently associated with riprap shorelines. Use of ELJs and complex wood revetments is expected to increase fish densities by creating complex habitat features. The addition of large wood is also expected to promote sorting and deposition of alluvium that could be suitable for spawning (depending on proximal sources) and would provide immediate physical habitat for rearing Chinook salmon and steelhead.

While there are harmful temporary effects associated with installing these channel and floodplain features, over the long term installation of ELJs, wood revetments, and boulders would benefit listed PS Chinook salmon and PS steelhead.

Excavation and lowering of the floodplain would reconnect the channel to important refuge areas currently inaccessible to juvenile fish. Reconnection to the floodplain would drastically increase habitat complexity features by creating access to side channel area where fish can take refuge in low velocity areas. Habitat complexity is the key factor related to success of species during and after floods (Pearsons et al. 1992; Letcher and Terrick 1998; Bischoff and Wolter, 2001; Schwartz and Herricks 2005). Important habitat features such as pools, floodplains, and gravel bars are formed following flood events (Bischoff and Wolter 2001). Fish residing in reaches with complex habitats were more resilient to flood events losing fewer fish and boasting higher species diversity and abundance than simple reaches (Pearsons et al. 1992). Juvenile fish are particularly vulnerable to strong flows associated with floods because of their limited swimming ability and small size (Pearsons et al. 1992). Valuable habitat used by juveniles during floods includes inundated floodplains which serve as nurseries (Bischoff and Wolter 2001). Hayman et al. (1996) demonstrated that natural and unaltered floodplains have twice the amount of channel habitat than isolated floodplains. Indeed, floodplain habitats provide among the most productive juvenile salmon and steelhead rearing areas (Sommer et al. 2001; Sommer et al. 2004; Jeffres et al. 2008).

The proposed action would also revegetate riparian and upland areas throughout the project site that would over time provide a source of large wood for future recruitment to downstream reaches. Similarly, improved and newly created riparian habitat would increase allocthonous organic material input to the channel while also providing shade and cover along river and stream margins.

Finally, reconnection of side channels, relocation of the Dieringer Tailrace, and culvert extension/replacements would improve and increase off channel rearing habitat availability for juvenile salmonids.

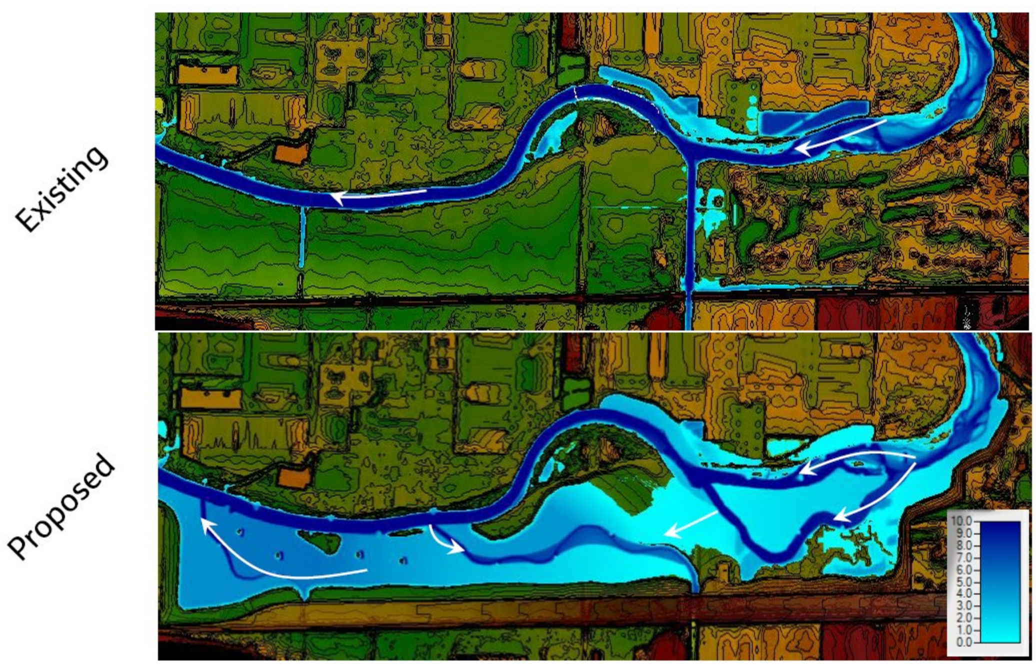


Figure 15. Floodplain inundation at 8,000 cfs under existing and proposed conditions. Figure provided during a presentation to the Services on February 3, 2022 by City of Sumner and BNSF.

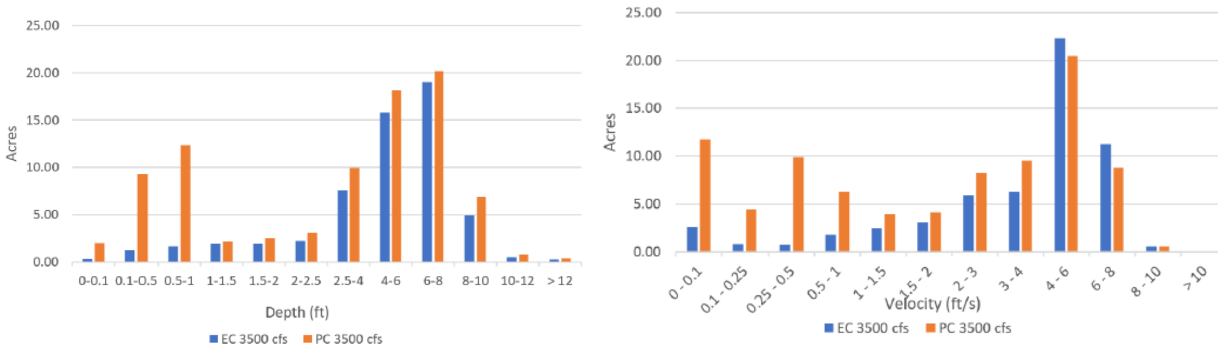


Figure 16. Total acres of depths (left) and velocities (right) at 3,500 cfs under proposed and existing conditions.

Summary of Effects to Critical Habitat

Effects of the proposed action on PS Chinook salmon and PS steelhead habitat include temporary degradations of water quality from elevated turbidity, short-term and small-scale disruption of the juvenile migratory corridor by worksite isolation, and enduring beneficial effects in the form of improved habitat quality and increased habitat quantity for juvenile and adult lifestages.

2.4.2 Effects on Species

Effects on listed species is a function of (1) the numbers of animals exposed to habitat changes or effects of an action; (2) the duration, intensity, and frequency of exposure to those effects; and (3) the life stage at exposure.

As noted above, the project has temporary, intermittent, and enduring effects. Our exposure and response analysis identifies the multiple life stages of listed species that use the action area, and whether they would encounter these effects, as different life-stages of a species may not be exposed to all effects, and when exposed, can respond in different ways to the same habitat perturbations.

While implementation of the White River Restoration and Sumner Staging Track projects would have some negative influence on critical habitat and individual Chinook salmon and steelhead, the project is expected to have an overall long term positive effect on salmonid habitat in the action area.

Period of Exposure and Species Presence

Listed PS Chinook salmon and PS steelhead may not be exposed to all effect of the proposed action. The in-water work window minimizes the likelihood of certain lifestages being exposed to elevated in-water noise, suspended sediments, and capturing and handling (Table 7). Juvenile, adult, and migratory lifestages of both species would be exposed to long-term beneficial effects from the instream and floodplain restoration components of the project including increased habitat quality, quantity, and complexity.

Table 7. Expected presence of listed salmonids in the White River project area.

<table>
<tr><th>Species</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>IWWW*</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Spring Chinook</td><td></td><td></td><td colspan="3">Adult Migration</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Juvenile Migration</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Fall Chinook</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="5">Adult Migration</td><td></td></tr>
<tr><td colspan="8">Juvenile Migration</td><td></td><td></td><td></td><td></td></tr>
<tr><td rowspan="2">Winter Steelhead</td><td colspan="4">Adult Migration</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td></td><td></td><td></td><td colspan="4">Juvenile Migration</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

*IWWW = in-water work window

Puget Sound Chinook Salmon – White River Population

Juvenile PS Chinook salmon generally emigrate from freshwater natal areas to estuarine and nearshore habitats from January to April as fry, and from April through August as larger sub-yearlings. The proposed in-water work window is July 1 through August 30 which overlaps with the tail end of juvenile outmigration timing (Table 7). Therefore, it is likely that juveniles would be actively moving through the project area during the in-water work window and exposed to project effects.

Spring Chinook salmon adults enter freshwater as early as March or April and begin spawning in August and September (Marks et al. 2021). Fall Chinook salmon begin their migration up the Puyallup River in early June and continue moving through the system, including the White River, as late as November (Marks et al. 2021). The majority of fall run fish spawn between September and October (Marks et al. 2021). Given the in-water work window, it is unlikely that spring Chinook salmon would be present in the project area and exposed to effects of the action. However, given adult fall Chinook salmon migration timing it is likely that some individuals would be present in the action area and exposed to the effects of the action.

Puget Sound Steelhead – White River Population

White River winter steelhead enter freshwater beginning in January and continue through late spring (June). Winter run steelhead typically spawn between April and May in White River tributaries including Boise Creek, Clearwater River, and Greenwater River (Marks et al. 2021), which are all upstream of the project site. It is unlikely that winter steelhead would be present in the action during in-water work.

Juvenile steelhead generally begin their downstream migration in April and July (Berger et al. 2011) after rearing in freshwater for 1-4 years. It is likely that outmigrating juvenile steelhead would be present in the action area during in-water work and exposed to short-term project effects. Similarly, rearing juveniles may also be present in the action area, although given the distance of the site to spawning areas it is unlikely that rearing steelhead would be present in high abundances.

Temporary Effects during Construction

Response to Degraded Water Quality

Turbidity

Many activities under the proposed action have the potential to increase sediment mobilization including in-channel construction (ELJ, wood revetment, and large rock installation and floodplain grading) and installation and removal of sheetpile for worksite isolation. Suspended sediment concentrations increase rapidly with the onset of instream work and recede markedly once work is complete (Reid and Anderson 1998). The effects of suspended sediment, which contributes to turbidity, on fish have been well documented in research literature and range from beneficial to lethal. Moderate turbidity levels (35 to 150 Nephelometric Turbidity Units [NTUs]) can provide cover and accelerate foraging rates in juvenile salmonids (Gregory and Northcote 1993). Higher turbidity concentrations can cause physiological stress and inhibit growth and survival. Direct mortality can occur at very high concentrations and/or extended durations of suspended solids (Newcombe and Jensen 1996). Fish would be exposed to increased sediment mobilization by restoration activities with the BMPs minimizing the potential impacts of suspended sediment (*see* Section 1.3 - Proposed Action).

In particular, the installation and removal of sheetpile and spring high flows in recently restored floodplain areas are likely to produce erosion and increased turbidity levels in excess of background conditions for hours to days. Following in-stream construction activities like the installation of sheetpile and when flows initially come in contact with restored floodplain and channel areas, fish within approximately 500 feet downstream of the site may experience adverse effects from increased turbidity. Salmonids are highly mobile and are able avoid intense turbidity, but we assume that some juvenile Chinook salmon and steelhead would not vacate these reaches and would thus be exposed to turbidity levels capable of causing stress and decreased feeding until turbidity returns to background conditions. These temporary effects are not expected to change the growth or fitness of any fish because these effects are expected to be brief. However, the short-term small scale increases in turbidity are likely to result in behavioral effects, such as dispersing salmonids from established territories, and likely to cause increasing interspecific and intraspecific competition, as well as temporarily increasing predation risk for a small number of affected juveniles.

Response to Elevated In-water Noise

The proposed action includes installation of both timber piles and sheetpiles using impact and vibratory driving methods; all timber piles are assumed to require impact driving during installation. Timber piles installed below the existing OHWM would be driven in isolated mostly dry conditions reducing sound pressure levels (SPL) and effects to fish. Pile driving would occur for up to five 10-hour days a week during the in-water work window period.

Pile driving can cause high levels of underwater sound. This noise from impact pile driving can injure or kill fish and alter behavior (Turnpenny et al. 1994; Turnpenny and Nedwell 1994; Popper 2003; Hastings and Popper 2005). Death from barotrauma can be instantaneous or delayed up to several days after exposure. Even when not enough to kill fish, high sound levels can cause sublethal injuries. Fish suffering damage to hearing organs may suffer equilibrium problems, and may have a reduced ability to detect predators and prey (Turnpenny et al. 1994; Hastings et al. 1996). Hastings (2007) determined that a cumulative Sound Exposure Level (cSEL) as low as 183 dB (re: 1 µPa2-sec) was sufficient to injure the non-auditory tissues of juvenile spot and pinfish with an estimated mass of 0.5 grams.

Cumulative SEL is a measure of the sound energy integrated across all of the pile strikes. The Equal Energy Hypothesis, described by the NMFS (2007b), is used as a basis for calculating cumulative SEL. The number of pile strikes is estimated per continuous work period. This approach defines a work period as all the pile driving between 12-hour breaks. NMFS uses the practical spreading model to calculate transmission loss. In 2008, the Fisheries Hydroacoustic Working Group (FHWG) developed interim criteria to minimize potential impacts to fishes (FHWG 2008). The interim criteria identify the following thresholds for the onset of physical injury using peak sound pressure level (SPL) and cSEL:

- Peak SPL: levels at or above 206 dB from any hammer strike; and
- cSEL: levels at or above 187 dB for fish sizes of 2 grams or greater, or 183 dB for fish smaller than 2 grams.

Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994; Hastings et al. 1996). Popper et al. (2005) found temporary threshold shifts in hearing sensitivity after exposure to cSELs as low as 184 dB. Temporary threshold shifts reduce the survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success.

With regard to vibratory driving and noise from construction vessels, the behavioral effects from anthropogenic sound exposure remains poorly understood for fishes, especially in the wild. NMFS applies a conservative threshold of 150 dB rms (re 1 µPa) to assess potential behavioral responses of fishes from acoustic stimuli. Fewtrell (2003) observed fish exposed to air gun noise exhibited alarm responses from sound levels of 158 to 163 dB (re 1 µPa). More recently, Fewtrell and McCauley (2012) exposed fishes to air gun sound between 147-151 dB SEL and observed alarm responses in fishes.

The above-discussed criteria specifically address fish exposure to impulsive sound. Stadler and Woodbury (2009) make it clear that the thresholds likely overestimate the potential for impacts on fish from non-impulsive sounds (e.g., vibratory pile driving). Non-impulsive sounds have less potential to cause adverse effects in fish than impulsive sounds. Impulsive sources cause short bursts of sound with very fast rise times and the majority of the energy in the first fractions of a second. Whereas, non-impulsive sources cause noise with slower rise times and sound energy that is spread across an extended period of time; ranging from several seconds to many minutes in duration.

The applicant provided a noise analysis in the submitted biological evaluation that estimates aquatic noise resulting from vibratory driving would return to background levels within approximately 328 feet from each sheetpile driving location (see Appendix E in Widener & Associates 2020). The proposed action also include vibratory and impact driving timber piles during ELJ and revetment installation. Noise generated while driving timber piles using a vibratory hammer would be less than the noise generated during sheetpile installation. While all timber pile impact driving would occur in isolated and mostly dry conditions, noise can transfer through wet substrate to adjacent river areas. Thus, we assume that impact pile driving of wood piles would result in some noise related effect in exposed individuals.

In-water work windows are generally designed to prevent work from occurring during peak presence of salmonids, but do not guarantee that exposure will not occur. We cannot estimate the number of individuals from any species that would experience adverse effects from underwater sound, nor predict the specific responses among the fish exposed. Not all exposed individuals would experience adverse effects, some would experience sublethal effects, such as temporary threshold shifts, some merely behavior responses such as startle. In summary, we find that adverse effects from elevated noise from vibratory driving of sheetpile and impact driving of wood piles would be likely to result in physical injury up to and including death of a small number of exposed individuals.

Response to Habitat Alterations

Instream habitat would be temporarily unavailable and altered while new features including ELJs, wood revetments, and large rock features are constructed.

Temporary Loss of Habitat Due to Work Area Isolation

ELJs and complex wood revetments would require instream areas to be isolated prior to construction to preclude fish presence prior to construction. This would limit the area available for juvenile fish to occupy within the project footprint and would force juvenile Chinook salmon and steelhead to move up or downstream to available suitable habitat. Over the course of the project a maximum total of 8 acres (approximately 3.2 acres for ELJs and 4.09 acres for wood revetments) would be inaccessible while instream features are installed, although this would occur over time and the 8 acres would not be inaccessible simultaneously. While it is likely that Chinook salmon and steelhead would be present in the White River when work area exclusion would occur, the in-water work window ensures that abundances would be low. Additionally, suitable habitat exists up and downstream of the project site that displaced fish could easily relocate to until construction is completed. As we expect densities of juveniles in the construction area to be low, we expect juveniles to move to other areas without increased competition. Displacement would, however, cause juveniles to extend more energy to reach suitable habitat and likely increasing exposure to predation. Given the in-water work window, proximity of additional habitat, and that the maximum 8 acres of isolated areas would not occur simultaneously, we find the risk of adverse effects to be limited to increased predation affecting some of the small number of juveniles that would be temporarily displaced.

Temporary Reduction in Forage and Habitat Due to Excavation and ELJ/Revetment Installation

Excavation during floodplain restoration, channel relocation, and ELJ and wood-revetment installation would temporarily reduce forage opportunities for juvenile fish by disturbing sediments and benthic communities. The proposed action would negatively affect benthic macro-invertebrate prey availability by crushing or displacing them during construction. We expect most of the areas where ELJs and wood revetments would be installed would include forage habitat for juvenile salmonids. Disturbance of forage habitat would force rearing juvenile Chinook salmon and steelhead to utilize other areas up or downstream of the project until construction is completed and the area recovers. However, given the dynamic nature of the White River and the availability of macroinvertebrates from adjacent areas we expect these disturbed areas to recovery fairly quickly once construction is completed.

Response to Strike and Crush During Large Rock Feature Installation

One hundred cubic yards of large boulders would be placed below OHWM throughout the main White River channel using an excavator situated on bank. Fish present in the area would be at risk of being struck or crushed during rock placement. However, we find that risk to be highly unlikely as a qualified biologist would be present to monitor rock placement and ensure fish are not present when the rocks are set in the channel. Therefore, we find the risk of striking or crushing fish during large rock installation to be extremely unlikely and thus discountable.

Response to Fish Exclusion Measures

The Corps and applicants have proposed to isolate specific areas during construction in order to prevent fish from being exposed to harmful effects from excavation, pile placement, large wood installation, and placement of large rocks and dolosse. The majority of fish exclusions would utilize herding using block and kick nets; electrofishing would only be used when absolutely necessary. Capture and handling induced stress can increase plasma levels of cortisol and glucose, decrease growth, decrease reproductive capabilities, increase vulnerability to predation, and increase the likelihood of mortality. While fish exclusion and work area isolation is meant as a conservation measure to ensure fish are not present during construction, it is highly likely that if fish are handled, injury and/or mortality will occur.

Electrofishing significantly increases the chance of harm, injury, or mortality. Electrofishing can cause a suite of effects ranging from disturbance to mortality. The amount of unintentional mortality attributable to electrofishing varies widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Most studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 millimeters in length (Dalbey et al. 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish are subjected to a lower voltage gradient than larger fish (Sharber and Carothers 1988) and may, therefore, be subject to lower injury rates (Thompson et al. 1997). The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Dwyer and White 1997). Continuous direct current (DC) or low-frequency (30 hertz) pulsed DC have been recommended for electrofishing (Dalbey et al. 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Sharber et al. 1994, Dalbey et al. 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey et al. 1996, Ainslie et al. 1998). These studies indicate that although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey et al. 1996).

We expect that most fish (mainly juveniles) present prior to exclusionary measures would be successfully removed or herded outside of the construction footprint into other areas. However, any fish not moved out of the isolation areas during relocation operations would be subject to mechanical injury or death from electrofishing. Although numerous measures would be employed to minimize this risk. For example, the in-water work window (July 1 – August 31) minimizes exposure as high densities of adult or juvenile PS Chinook salmon or PS steelhead are unlikely. Additionally, preconstruction surveys by qualified biologist would also minimize exposure risk..

Nevertheless, fish exclusion, handling, and relocation would result in adverse effects to exposed PS Chinook salmon and PS steelhead. If juvenile fish are present at the time of work, any juvenile fish that cannot be successfully captured and removed because they are undetected (i.e. juveniles may burrow into substrate to avoid capture) would be killed when dewatering, filling/grading of the channel, installing ELJs, revetments, or large rocks, or installing/retrofitting culverts occurs.

Intermittent Effects

Intermittent effects to listed fish species include stormwater discharges from the project area to the White River. As described in section 2.4.1 (Effects on Critical Habitat) no untreated stormwater would be discharged into the aquatic environment once the project is completed. The action includes stormwater treatment measures that ensure all runoff would be fully infiltrated into the new constructed riparian and forested areas before discharge. In addition, very little new PGIS is proposed as part of the action and thus we expect the volume of generated contaminated stormwater to be minimal. Moreover, we expect most contaminants to originate outside of the project footprint via atmospheric deposition or surrounding land use. Although, some pollutants originating from motor vehicles would accumulate on PGIS within the project area. However, we do not expect stormwater discharges to result in measurable degradations to water quality, and find the effects are therefore insignificant to listed fish species.

Enduring Effects

Response to Habitat Alterations

The proposed action would result in numerous enduring beneficial habitat effects for adult and juvenile Chinook salmon and steelhead lifestages for many years following completion of the project. The proposed project would significantly increase the quantity of complex habitat within the White River by reconnecting the floodplain, creating side channels, and installing ELJs, complex wood revetments, and large rock features. Floodplain excavation and grading and side channel creation would create a substantial amount of new off channel habitat for rearing juvenile Chinook salmon and steelhead. A total of 13 acres of side channels would be constructed creating an expansive network of foraging and refuge habitat for juveniles. Currently, in the project area, the White River lacks side channels, backwaters, and wetland habitat where juvenile Chinook salmon and steelhead could find winter rearing habitat. A lack of floodplain and channel structure diversity impacts winter rearing because high flow events can displace and even kill juveniles. Similarly, lack of complex habitat features limits predatory and low flow refugia and forage habitat during the summer. The shallow water areas along floodplains, side channels, and alcoves/backwaters would also benefit invertebrate production and improve forage opportunities for rearing juveniles (Goodman et al. 2012; Beechie et al. 2014). The proposed project would ultimately increase floodplain connectivity, reactivate channel migration across flood plains, and improve riparian and aquatic diversity and complexity for anadromous salmonids throughout the action area. Lateral migration of the channel is important for producing undercut banks, creating side channels, and recruiting woody debris and gravel to the channel (Spence et al. 1996); all are habitat features that promote productivity and would lead to increases in carrying capacity for the lower White River.

While ELJ and complex wood revetments are meant to protect and stabilize banks from erosion, these bioengineered approaches would also reduce fine sediment input, provide natural cover, and increase recruitment of riparian vegetation. These methods are expected to create streambanks that would resist lateral erosion while providing complex rearing, feeding, and sheltering habitat for Chinook salmon and steelhead. The proposed bio-engineered approach (e.g., ELJs, complex wood revetments, etc.) would improve habitat conditions relative to the current channelized state and we expect substantially more juvenile salmonids would be able to successfully rear in the project footprint after installation of bioengineered bank stabilization structures is completed.

Riparian, upland forest, and wetland restoration actions would also provide numerous enduring benefits to listed species. Benefits include increased large wood recruitment, new allocthonous organic inputs, augmented and new stream shading, improved water quality, reduced erosion and fine sediment input, and improved streambank stability. Riparian plantings combined with ELJs and complex wood revetment would likely result in enhanced localized natural sediment recruitment and accumulation that would encourage streambank function and development of habitat features. Increased riparian, forest, and wetland areas would also improve water quality by increasing infiltration potential and ensuring more pollutants are removed before discharging into the White River.

Summary of Effects to Species

Adverse effects of the proposed action on listed fish species are expected to be single event, short-term, abate once construction is completed, and small-scale. They include death from fish handling related to fish exclusionary measures (8 acres of in-stream habitat not all at the same time spread out over multiple years of construction), increased risk of predation related to increased turbidity and fish having to leave isolated areas, and physical injury from elevated in-water noise during installation of work area isolation structures. Over the long term, the project dramatically improves habitat quality and substantially increases habitat quantity for adult and juvenile PS Chinook salmon and steelhead. Expected benefits include increases in rearing habitat availability and quality, improved water quality benefiting all lifestages in the action area, and improved connectivity of the main channel to the floodplain, riparian, and forested areas.

Effects to Population Viability

We assess the importance of habitat effects in the action area to the species by examining the relevance of those effects to the characteristics of VSP. The characteristics of VSPs are sufficient abundance, population growth rate (productivity), spatial structure, and diversity. While these characteristics are described as unique components of population dynamics, each characteristic exerts significant influence on the others. For example, declining abundance can reduce spatial structure of a population; and when habitats are less varied, then diversity among the population declines. We expect a temporary negative effect from the proposed action on the survival of juvenile PS Chinook salmon and juvenile PS steelhead. We expect populations from the White River basin to be present in the action area and impacted by the proposed action.

Abundance: The specific amount of death, injury, or reduction in fitness of individual fish cannot be estimated from temporary adverse effects, with the exception of fish handling. However, based on the short-term and small-scale nature of construction-related effects, we expect very few fish to be adversely affected or killed. The long term effects are expected to be beneficial to both White River Chinook salmon and steelhead and would cause density and abundance to increase appreciably over time in correlation to habitat quantity increases.

Productivity: We do not expect short term decreases in productivity to occur as a result of the proposed action. Productivity would likely increase over the long-term once construction is complete due to the increase in accessible floodplain habitat, rearing habitat throughout the project area, and improved riparian and upland connectivity. Habitat improvements would likely incrementally increase survival of rearing and migrating juveniles thus slightly improving adult return rates and overall productivity of the White River.

Spatial Structure: We do not expect the proposed action to significant alter the spatial structure of the PS Chinook salmon ESU or PS steelhead DPS. However, we do expect the restoration effort would slightly alter the spatial structure of the White River Chinook salmon and steelhead populations by increasing juvenile carrying capacity in the lower White River, thus expanding the spatial extent in which juveniles can rear and grow before migrating to the ocean.

Diversity: We do not expect the proposed action to impact the diversity of the PS Chinook salmon ESU or PS steelhead DPS.

2.5. Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation [50 CFR 402.02]. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. The project is an infrastructure project that is expected to last for several decades. Climate change effects described as a baseline condition in section 2.3 are expected to increase over that time. Anticipated climate effects on abundance and distribution of PS Chinook salmon and PS steelhead include a wide variety of climate impacts. The greatest risks would likely occur during incubation, when eggs are vulnerable to high mortality due to increased flooding and variability in seasonal flow (Ward et al. 2015). Crozier et al. (2019) identified early life stages such as incubating eggs as highly sensitive when exposed to more variable hydrologic regimes. Crozier et al (2019) also predicted that 8% of spawning habitat would change from snow-dominated to transitional, and 16% would change from transitional to rain-dominated. These projections suggest that winter flooding would become more common, directly affecting incubating eggs. Stream temperature ranks high in the extent of change expected, which could increase pre-spawn mortality in low-elevation tributaries (Cristea and Burges 2010). Rising temperatures during late spring and summer may also impact Chinook salmon juveniles in estuary and riverine habitats. Most Puget Sound estuaries already surpass optimal summer rearing temperatures, and the expectation of additional warming would further degrade already degraded habitat (Crozier et al 2019, Appendix S3).

The current condition of ESA-listed species and designated critical habitat within the action area are described in the Status of the Species and Critical Habitat (2.2) and the Environmental Baseline (2.3) sections above. The contribution of non-federal activities to those conditions include past and on-going forest management, agriculture, urbanization, road construction, water development, and restoration activities in the action area. Those actions are driven by a combination of economic conditions that characterized traditional natural resource-based industries, general resource demands associated with settlement of local and regional population centers, and the efforts of conservation groups dedicated to restoration and use of natural amenities, such as cultural inspiration and recreational experiences.

NMFS is unaware of any specific future non-federal activities that are reasonably certain to affect the action area. However, NMFS is reasonably certain that future non-federal actions such as those previously mentioned are all likely to continue and increase in the future as the human population continues to grow across the region. Continued habitat loss and degradation of water quality from development and chronic low-level inputs of non-point source pollutants will likely continue into the future as population projections suggest that human numbers in the greater Puget Sound region will increase by two million in the next 30 years (Levin 2020; PSRC 2018). The effects of climate change may also intensify the consequences of water quality effects associated with human population growth, as shifting acidity, salinity, and water temperatures modify food both bioaccumulation and food webs (Alava et al. 2018).

As mentioned above, human populations are expected to increase within the Puget Sound region, and if population growth trends remain relatively consistent with recent trends, we can anticipate future growth at approximately 1.5 percent per year. The human population in the PS region increased from about 1.29 million people in 1950 to about 3.84 million in 2014, and is expected to reach nearly 5 million by 2040 (Puget Sound Regional Council 2020). As of the date of this Opinion, the human population in the Puget Sound Region is roughly 4.2 million, slightly exceeding projections. Thus, future private and public development actions are reasonably certain to continue in and around Puget Sound. As the human population continues to grow, demand for agricultural, commercial, and residential development and supporting public infrastructure is also reasonably certain to grow. We believe the majority of environmental effects related to future growth will be linked to these activities, in particular land clearing, associated land-use changes (i.e., from forest to impervious, lawn or pasture), increased impervious surface, and related contributions of contaminants to area waters. Land use changes and development of the built environment that are detrimental to salmonid habitats are reasonably certain to continue under existing regulations. Though the existing regulations minimize future potential adverse effects on salmon habitat, as currently constructed and implemented, they still allow systemic, incremental, additive degradation to occur.

The intensity of these influences depends on many social and economic factors, and therefore is difficult to predict. Further, the adoption of more environmentally acceptable practices and standards may gradually reduce some negative environmental impacts over time. Interest in restoration activities has increased as environmental awareness rises among the public. State, tribal, and local governments have developed plans and initiatives to benefit ESA-listed PS Chinook salmon and PS steelhead within many Puget Sound watersheds. However, the implementation of plans, initiatives, and specific restoration projects are often subject to political, legislative, and fiscal challenges that increase the uncertainty of their success.

The cumulative effects associated with continued development in the action area are reasonably certain to have ongoing adverse effects on the populations of listed species addressed in this Opinion. Only improved, low-impact development actions together with increased numbers of restoration actions, watershed planning, and recovery plan implementation would be able to address growth related impacts into the future. To the extent that non-federal recovery actions are implemented and offset ongoing development actions, adverse cumulative effects may be minimized, but will probably not be completely avoided.

2.6. Integration and Synthesis

The Integration and Synthesis section is the final step in assessing the risk that the proposed action poses to species and critical habitat. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

Status: The two species of ESA-listed fish addressed in this Opinion that are likely to be adversely affected by this proposed action are listed as threatened, based on low abundance and productivity, and reductions in spatial structure and diversity. Many of the same listing factors and limiting factors affect both salmon and steelhead, including loss and degradation of important habitats (e.g., spawning areas, off channel and side channel rearing areas). Many of the limiting factors are systemic, affecting critical habitat negatively, even in areas with high conservation value.

Baseline: Similar to areas designated as critical habitat, the environmental baseline within the action area has been degraded by the multiple effects of urbanization, agriculture, forestry, water diversion, and road building and maintenance.

Cumulative Effects: The most significant cumulative effects are from the continued conversion of land and intensifying development is stormwater-associated pollutant load, and climate change. Given that state and federal laws regulate point and nonpoint discharges, we anticipate that much of the new stormwater would be captured and treated, limiting the amount of pollutants intermittently entering the stream to low levels; however the additive nature of this perturbation, even in small amounts, is expected to be negative over time. Climate change is also expected to have a negative effect over time on habitat values.

Project Effects: The effect of the proposed action includes both positive and negative, permanent and temporary effects, as described above. Negative effects are mostly short-term and construction related whereas positive effects would result from the substantial increase in floodplain and rearing habitat quality and quantity. The timing of work overlaps with the migration of adult and juvenile PS Chinook salmon lifestages in the White River, but given the in-water work window, it is unlikely that either lifestage would be in the direct footprint of the project in high abundances. Given the beneficial long-term effects of the restoration project, NMFS expect PS Chinook salmon and PS steelhead abundance, productivity, and carrying capacity to improve. We evaluate the addition of the project effects to this baseline, factoring status and these cumulative effects, by species and critical habitat, below.

2.6.1 Salmon and Steelhead Critical Habitat

At the designation scale, the quality of PS Chinook salmon and PS steelhead critical habitat is generally poor with only a small amount of freshwater habitat remaining in good condition. Most freshwater critical habitat for these species is degraded but nonetheless maintains a high importance for conservation of the species, based largely on its restoration potential, and the essential life history purpose it supports. Degradation of freshwater critical habitat quality is a limiting factor for these species. Development of Puget Sound watersheds are expected to continue to adversely impact the quality of critical habitat PBFs for PS Chinook salmon and PS steelhead, designation wide.

The effects of the proposed action on critical habitat, considered with cumulative effects and added to the baseline, are in the long-term likely to be incrementally positive improving critical habitat for a large portion of the lower White River. In summary, the status of critical habitat for PS Chinook salmon and steelhead is poor and baseline conditions are impaired and poor, however the project benefits critical habitat by improving habitat quality and increasing habitat quantity. Numerous PBFs within the action area would be improved in the long-term including water quality, prey conditions for juvenile salmonid growth, maturation, and fitness, as well as migration corridors for adults. The project would overall appreciably increase the conservation role of critical habitat at the ESU or DPS scale.

2.6.2 PS Chinook Salmon

PS Chinook salmon are currently listed as threatened with generally negative recent trends in status. Widespread negative trends in natural-origin spawner abundance across the ESU have been observed since 1980. Productivity remains low in most populations, and hatchery-origin spawners are present in high fractions in most populations outside of the Skagit watershed. Available data now shows that most populations have increased in abundance over the last evaluation period (NWFSC 2015; Ford 2022) (see section 2.2.1, Status of ESA-Listed Fish Species). However, most populations are consistently below the spawner-recruit levels identified by the recovery plan for this ESU. The population that would be affected by the proposed action is White River Chinook salmon.

As described in Sections 2.2 and 2.3, White River Chinook salmon abundance have been well below recovery goals for the last 20 year and productivity has been negative since the 1970's. PS Chinook salmon were recently evaluated by Ford 2022 to be at moderate risk of extinction. Based on the best available information, the scale of the direct and indirect negative effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would be too small-scale and short-term to cause significant negative effects on any of the characteristics of a viable salmon population (abundance, productivity, distribution, or genetic diversity). In fact, when evaluated together with the long-term positive effects, we expect the overall long-term effects of the project, to increase abundance, productivity, and carrying capacity by improving habitat quality and increasing habitat quantity. As individual population viability improves, the viability of the diversity strata and ESU would improve as well.

2.6.3 PS Steelhead

The long-term abundance trend of the PS steelhead DPS is negative, especially for native-origin spawners. The extinction risk for most DIPs is estimated to be moderate to high, and the DPS is currently considered "not viable." Reduced or eliminated accessibility to historically important habitat, combined with degraded conditions in available habitat due to land use activities appear to be the greatest threats to the recovery of PS steelhead. Fisheries activities also continue to impact this species.

The PS steelhead populations most likely to occur in the project would be winter steelhead from the White River basin. Adults are typically present in the White River during the winter of their upstream migration and juveniles during the spring and early summer of their outmigration. No documented spawning exists in the lower White River. The Green, Puyallup, Carbon, and White River winter steelhead populations are an integral component to the core MPG of the southern Puget Sound DPS (NMFS 2019). Current abundance of White River winter steelhead remain well below recovery goals and significant recovery efforts would be needed to attain recovery of these populations. Many of the measures identified in the PS steelhead recovery plan are included in the White River Restoration and BNSF Staging Tracks proposed action.

The scale of the direct and indirect negative effects of the proposed action, when considered in combination with the degraded baseline, cumulative effects, and the impacts of climate change, would not result in effects likely to significantly reduce abundance or productivity of White River steelhead. Moreover, in the long term, based on the significant habitat improvements, we expect the proposed action would improve abundance, productivity, and would move the White River steelhead population closer to recovery goals.

2.7. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon or PS steelhead or destroy or adversely modify their designated critical habitat.

2.8. Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.8.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

- Incidental take in the form of injury or death due to capture and handling during work area isolation/fish exclusion.

- Incidental take in the form of injury or death from noise during sheetpile and impact wood pile driving.

- Incidental take in the form of harm from diminished water quality (turbidity, suspended sediments, etc.).

- Incidental take of juveniles in the form of injury or death from displacement related to worksite isolation.

The distribution and abundance of fish that occur within an action area are affected by habitat quality, competition, predation, and the interaction of processes that influence genetic, population, and environmental characteristics. These biotic and environmental processes interact in ways that may be random or directional and may operate across far broader temporal and spatial scales than are affected by the proposed action. Thus, the distribution and abundance of fish within the action area cannot be attributed entirely to habitat conditions, nor can NMFS precisely predict the number of fish that are reasonably certain to be injured or killed if their habitat is modified or degraded by the proposed action.

Therefore, we cannot predict with meaningful accuracy the number of PS Chinook salmon and PS steelhead that are reasonably certain to be injured or killed by exposure to any of these stressors. Additionally, NMFS knows of no device or practicable technique that would yield reliable counts of individuals that experience these impacts. In such circumstances, NMFS uses the casual link established between the activity and the likely extent and duration of changes in habitat conditions to describe the extent of take as a numerical level of habitat disturbance. The most appropriate surrogates for take are action-related parameters that are directly related to the magnitude of the expected take. The exception being capture and handling. Qualified biologists would have the capability to monitor injury and mortality rates during fish exclusion efforts and report those rates at the completion of the project.

For this proposed action, the potential for occurrences of injury or death from capture and handling and elevated noise is directly related to the total area isolated prior to construction. Similarly, harm from being exposed to degraded water quality is directly related to the amount and duration of in-water work.

Injury or death from capture and handling –Work area isolation is a conservation measure intended to reduce adverse effects from in-water work activities. However, capture is a form of take, and the exclusion and relocation efforts can cause injury or death. Due to the uncertainty in potential abundance and density we relied on a maximum possible density within the project location. In the Biological Assessment (Widener and Associates 2020) it was estimated that between 974 and 23,507 juveniles may pass through the action area during the in-water work window based on historical outmigration estimates from WDFW and Puyallup Tribal Fisheries. Therefore, we estimate that no more than 5,000 juvenile (including smolts) PS Chinook salmon and 5,000 juvenile (including smolts) PS steelhead that would be captured and handled annually, in each of the4 years, during the isolation and relocation efforts. (Adults would not be handled as part of this effort, but would be allowed to volitionally leave the area before any fish exclusion activities are completed). If the number of juvenile PS Chinook salmon or PS steelhead captured and handled exceeds the above numbers then the amount of take would be exceeded, and the reinitiation provisions of this Opinion would be triggered. The Corps must notify NMFS within 24 hours if work area isolation take is exceeded.

Harm from elevated noise – PS Chinook salmon (juvenile) and PS steelhead (juvenile) would be exposed to construction-related noise resulting from driving (and removing) sheetpiles and impact driving of wood piles in isolated mostly dry river bed and bank area. Disruption of normal feeding and migration, and injury and death can occur from exposure to elevated sound. An appropriate and measurable surrogate for take associated with elevated noise is the length of sheetpile installed and the number of wood piles driven. Pile driving is not permitted outside of the in-water work window. Additionally, any pile driving occurring outside of the work window would cause take to be exceeded, and the reinitiation provisions of this Opinion would be triggered. Finally, any impact driving that occurs in a manner not analyzed in this Opinion (e.g., not isolated) would trigger the reinitiation provisions of this Opinion.

Harm from degraded water quality – PS Chinook salmon (juvenile and adult) and PS steelhead (juvenile), would be exposed to degraded water quality. Habitat modified temporarily by suspended solid and contaminants would injure fish by impairing normal patterns of behavior including rearing and migrating in the action area and causing potential health effects. Because injury to individuals can occur when exposed to high levels of suspended sediment, or as a result of avoiding areas affected with high levels of sediment, the extent of take is measured as the anticipated area where suspended sediment would exceed background levels. Therefore, the maximum extent of take is defined by the turbidity impacts which are limited to 1,000 feet downstream of the project area during the work window and to 300 feet during the extended work window for sheetpile removal. Exceeding these areal indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Injury or death from displacement relate to worksite isolation - PS Chinook salmon (juvenile and adult) and PS steelhead (juvenile), would be temporarily displaced from rearing habitat associated with worksite isolation. Displacing juveniles is likely to result in an increase in predation based on increased path length and some individuals having to find less favorable habitat. An appropriate and measurable surrogate for take associated with displacement is the area rendered temporarily inaccessible to rearing. Therefore, the maximum extent of take is defined by the maximum of 8 acres of habitat proposed to be isolated for construction. Exceeding these areal indicator for extent of take would trigger the reinitiation provisions of this Opinion.

Table 8 summarized the amount and extent for each of the pathways outlined above.

Table 8. Incidental take pathways and associated indicators of the amount or extent of incidental take.

Incidental Take Pathway	**Amount or Extent of Incidental Take**
Injury or death of juveniles due to capture and handling during work area isolation/fish exclusion	PS Chinook salmon: 5,000 juvenile (including smolts) and PS steelhead: 5,000 juvenile (including smolts) annually, for up to 4 years, during isolation and relocation efforts.
Injury or death from elevated noise associated with vibratory sheetpile driving and impact pile driving.	Length of sheetpile installed shall not exceed 1400 feet and number of wood piles driven in isolated work area should not exceed 1,196 (=930 + 266).
Harm or death related to increased turbidity and elevated suspended sediments.	Elevated turbidity shall not exceed an area of 1,000 feet downstream of project area during in-water work window and 300 feet between September 1 and November 30.
Incidental take of juveniles in the form of injury or death from displacement related to worksite isolation.	Temporary worksite isolation shall not exceed 8 acres of habitat.

2.8.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.8.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02).

1. The Corps and the applicants shall minimize incidental take of listed species resulting from work area isolation and fish removal (handling, capture, and electrofishing).

2. The Corps and the applicants shall minimize incidental take of listed species resulting from elevated noise.

3. The Corps and the applicants shall minimize incidental take of listed species resulting from suspended sediments during in-water work.

4. The Corps and the applicants shall implement monitoring and reporting programs to confirm that the RPMs are implemented as required and take exemption for the proposed action is not exceeded, and that the terms and conditions are effective in minimizing incidental take.

2.8.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1 (work area isolation and fish removal):
    a. Take all appropriate steps to minimize the amount and duration of handling during work area isolation, fish capture, release, and exclusion operations, including the following:
        i. Corps fish biologists, their subordinate staff, or certified contractors must conduct all fish capture, handling, and electrofishing operations, unless approved in writing by NMFS.
        ii. Conduct a spawner/redd survey prior to starting work to ensure spawning adults or redds are not present in the work area.
        iii. If adults are present in the work areas allow fish to leave volitionally before beginning fish capture activities.

iv. Follow NMFS's electrofishing guidelines (NMFS 2000) when capturing fish using electrofishing equipment. These guidelines are available from the NMFS West Coast Region, Protected Resources Division, Portland, Oregon.[15]
v. Cease fish handling/work that requires fish handling when water temperatures exceed 17.5 degrees Celsius, and/or air temperatures exceed 75 degrees Fahrenheit. Work may resume when temperatures fall below these measurements.
vi. ESA-listed fish must be handled with extreme care, keeping fish in water to maximum extent possible during capture and transfer procedures to prevent the added stress of out-of-water handling.
vii. Water quality conditions must be adequate in tanks, buckets, or in sanctuary nets that hold water to transport fish by providing circulation of clean, cold water, using aerators to provide DO, and minimizing holding times. DO and temperature should be periodically monitored in transport containers.
viii. Fish must be released into a safe location as quickly as possible, and as near as possible to the capture sites.

2. The following terms and conditions implement RPM 2 (noise):
   a. Utilize gravel supersacks whenever possible so as to minimize the use of sheetpiles for work area exclusion measures.

3. The following terms and conditions implement RPM 3 (suspended sediments):
   a. Pause work if turbidity exceeds Washington State water quality standards an extends past the 1,000 feet elevated turbidity zone (300 for during extended in-water work window for sheetpile removal) and allow conditions to return to background conditions before starting work again.
   b. Provide results of turbidity monitoring to NMFS (see T&C5)

4. The following terms and conditions implement RPM 4 (monitoring and reporting):
   a. The Corps shall report the following information to NMFS (at projectreports.wcr@noaa.gov, refer to: WCRO-2021-01064) annually 60 days after the in-water window closes:
      i. Total number of impact pile strikes;
      ii. Results from turbidity monitoring;
      iii. Total number of fish captured, relocated, injured, and killed during fish exclusion/work area isolation as well duration of electrofishing efforts;
   b. 30 days prior to construction provide copies of the Ecology approved WQMPP, TESC, and SWPPP to NMFS (at projectreports.wcr@noaa.gov, refer to: WCRO-2021-01064).

2.9. Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding

[15] https://media.fisheries.noaa.gov/dam-migration/electro2000.pdf

discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

- No conservation recommendations are included with this Opinion

2.10. Reinitiation of Consultation

This concludes formal consultation for the White River Restoration Project and Sumner Staging Tracks Project.

As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

2.11. "Not Likely to Adversely Affect" Determinations

2.11.1 Southern Resident Killer Whales

The Corps determined that the proposed action was not likely to adversely affect SRKW or adversely modify their critical habitat. NMFS concurs with the Corps' determination.

Given the location of the project, SRKW would not be exposed to direct effects of the action (e.g., degraded water quality or noise) and are therefore discountable. Similarly, given the expected beneficial effects of the restoration component of the action on White River Chinook salmon we expect beneficial effects to SRKW prey PBFs via Chinook salmon. The benefits of the action would improve PS Chinook salmon rearing and migration habitat within the White River potentially leading to increases in spring Chinook salmon survival and abundance over the long-term, ultimately benefiting SRKW critical habitat via prey PBF.

3. MAGNUSON–STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the Coprs and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The waters and substrates of the project site are designated as freshwater EFH for various life-history stages of Pacific Coast salmon. Freshwater EFH for Pacific Coast Salmon is identified and described in Appendix A to the Pacific Coast salmon fishery management plan (PFMC 2014), and consists of four major components: (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat.

Those components of freshwater EFH for Pacific Coast Salmon depend on habitat conditions for spawning, rearing, and migration that include: (1) water quality (e.g., dissolved oxygen (DO), nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity (e.g., large woody material, pools, aquatic and terrestrial vegetation, etc.); (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition.

As part of Pacific Coast Salmon EFH, five Habitat Areas of Particular Concern (HAPCs) have been defined: 1) complex channels and floodplain habitats; 2) thermal refugia; 3) spawning habitat; 4) estuaries; and 5) marine and estuarine submerged aquatic vegetation. The action area provides no known HAPCs.

3.2. Adverse Effects on Essential Fish Habitat

The ESA portion of this document (Sections 1 and 2) describes the proposed action and its adverse effects on ESA-listed species and critical habitat, and is relevant to the effects on EFH.

Adverse effects to EFH for Pacific salmon (Chinook salmon, pink salmon, and coho salmon) mirror those effects on critical habitats previously described in section 2.4.1 above. The proposed project construction would have construction-related, episodic and temporary/mid-term adverse effects on water quality and habitat access. Over the several year construction period, actions would include work site isolation and driving piles in EFH in the White River. A maximum of 8 acres of the White River would be isolated during ELJ and wood revetment installation spread out over the multi-year construction period. Worksite isolation would limit EFH availability for the duration of construction/worksite isolation. Long-term effects would be beneficial based on increased quality and quantity of floodplain habitat providing more EFH space.

3.3. Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the intermediate impact of the proposed action on EFH.

To reduce adverse impacts on water quality and habitat access, the Corps should:

1. Limit the extent and duration of increased turbidity as much as possible; and
2. Minimize size/are of work site isolation as much as possible.

Fully implementing these EFH conservation recommendations would protect designated EFH, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the Corps must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of the measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects [50 CFR 600.920(k)(1)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the Opinion addresses these

DQA components, documents compliance with the DQA, and certifies that this Opinion has undergone pre-dissemination review.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps. Other interested users could include the City of Sumner, BNSF, recreational fishing groups, conservation groups, and Treaty Tribes. Individual copies of this Opinion were provided to the Corps. The document will be available at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2 Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

4.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR part 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this Opinion contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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