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-2022-01905

August 1, 2023

Ralph J. Rizzo
Federal Highway Administration
711 S. Capitol Way, Suite 501
Olympia, Washington 98501

Todd Tillinger
Regulatory Branch Chief
U.S. Army Corps of Engineers
P.O. Box 3755
Seattle, Washington 98124-3755

Re: Reinitiation of Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the US 101 Elwha River Bridge Replacement Clallam County, Washington. (HUC 171100200514 Lake Adwell-Elwha River)

Dear Mr. Rizzo and Mr. Tillinger,

Thank you for your letter of August 2, 2022, requesting reinitiation of consultation with the 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 US 101 Elwha Bridge Replacement project. 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 (16 U.S.C. 1855(b)) for this action.

In the enclosed biological opinion, NMFS concludes that the proposed actions are not likely to jeopardize the continued existence of Puget Sound Chinook salmon and Puget Sound steelhead, and is not likely to destroy or adversely modify Puget Sound steelhead critical habitat. NMFS also concurred that potential effects to Pacific eulachon and Southern Resident Killer Whales would be insignificant or discountable. As required by section 7 of the ESA, NMFS has provided an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action and sets forth nondiscretionary terms and conditions that the FHWA must comply with to meet those measures. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of listed species.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) and concluded that the action would adversely affect the EFH of Pacific Coast Salmon. NMFS provided 3 conservation recommendations in section 3 of the attached document.

This action is funded in part by the Federal Highway Administration and is being carried out by the Washington State Department of Transportation. Additionally, the US Army Corps of Engineers is authorizing a fill permit and the project remediation plants are provided by the Olympic National Park.

Please contact Bonnie Shorin in the Central Puget Sound Branch of the Oregon/Washington Coastal Office at bonnie.shorin@noaa.gov or 360-995-2750 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

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

cc: Dave Molenaar – WSDOT
Jeff Dreier – WSDOT

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

State Route 101 Elwha River Bridge Replacement Project

NMFS Consultation Number: WCRO-2022-01905

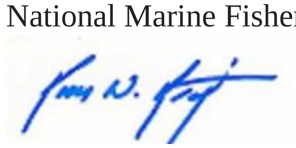
Action Agencies: Federal Highway Administration and US Army Corps of Engineers

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 steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Puget Sound Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	N/A	N/A
Pacific eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	N/A	N/A
Southern Resident Killer Whale (*Orcinus orca*)	Endangered	Yes	No	N/A	N/A

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	Yes	Yes

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: August 1, 2023

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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 the West Coast Regional Office in Lacey, Washington.

1.2. Consultation History

On March 2, 2018, NMFS provided a biological opinion (Opinion) (WCR-2017-7873) to replace the US 101 Elwha River Bridge in Clallam County, Washington. In the Opinion, only the Federal Highway Administration (FHWA) was identified as the consulting federal action agency. NMFS determined the proposed project would adversely affect, but not jeopardize the continued existence of Puget Sound (PS) Chinook salmon and PS steelhead and would not likely destroy or adversely modify PS steelhead critical habitat. PS Chinook salmon critical habitat is notably not included in this Opinion because critical habitat was not designated in the project action area. NMFS also concurred that the proposed project was not likely to adversely affect Pacific eulachon due to their unlikely presence in the action area. However, there would be an adverse effect on Essential Fish Habitat for Pacific salmon.

The project was not constructed and there have been significant design changes since the original consultation was completed; thus, triggering a reinitiation to evaluate the changes that were not previously addressed. The bridge replacement design and footprint remain as originally evaluated in the original consultation.

A summary of changes to the design includes:

- Three Engineered Log Jams (ELJs) upstream of the new bridge have been deleted.
- Twelve ELJs are added and will be installed downstream of the bridge as negotiated mitigation with the Lower Elwha Klallam Tribe (LEKT).

- All stormwater will now receive enhanced treatment instead of basic treatment.
- The US Army Corps of Engineers has been actively involved in advancing and permitting the project design and have been added as a Federal agency associated with the proposed project. The FHWA remains the lead Federal agency.

The NMFS, USFWS, FHWA, and WSDOT held four early coordination meetings (preBAs) after the design changes began to evolve in early 2021 and FHWA recognized they would require a reinitiation. These meetings were held on:

- February 20, 2020
- June 17, 2021
- December 16, 2021
- June 16, 2022

On August 9, 2022, NMFS received a BA and request to reinitiate formal consultation. Subsequently, the NMFS consulting biologist discovered Pacific eulachon and Southern Resident Killer Whales (SRKWs) were not included in the reinitiation request. They were informally consulted on in the original Opinion. FHWA agreed that this was an oversight. On October 14, 2022, FHWA provided an addendum to the BA that analyzed effects of the revised designs on Pacific eulachon and SRKWs and requested informal consultation for these two species. Critical habitat for SRKWs does not occur in the Elwha River; however, the lower four miles is designated critical habitat for Pacific eulachon. On October 19, 2022, NMFS sent an email to FHWA and US Army Corps of Engineers stating the consultation package was complete for formal consultation.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 FR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. As a result, the 2019 regulations are once again in effect, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-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). Under MSA, federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded or undertaken by a federal agency (50 CFR 600.910).

The FHWA is providing funding for the proposed project, creating a nexus to the ESA. The US Army Corps of Engineers provides construction permits and, as a matter of convenience, the remediation native plants are proved by the Olympic National Park. The FHWA remains the lead Federal agency.

The FHWA and WSDOT propose to replace the existing US 101 Elwha River Bridge located at rivermile 7.75 with a new bridge on an adjacent alignment. The original design included three Engineered Log Jams (ELJs) directly upstream of the bridge, and multiple Best Management Practices to minimize or avoid adverse effects (e.g., BMPs require that all equipment be free of leaks and that refueling, maintenance, and staging occur at least 100 feet from a stream, and the BMPs require all hazardous material spills be cleaned up immediately; and to prevent fish entrainment in depressions formed by excavations, the channel bed and gravel borrow areas will be inspected and large depressions or voids will be filled with bulk bag streambed material to smooth unnatural grades).

Subsequent mitigation discussions with the Lower Elwha Klallam Tribe (LEKT) resulted in deleting the three ELJs but adding 12 ELJs downstream of the bridge. Approximately 60,000 square feet of streambed will be excavated to install the ELJs. Along with the ELJ redesign, FHWA and WSDOT also determined that stormwater could be treated with facilities that improves capturing metals instead of the original basic treatment that is only intended to detain sediments and separates oil from water. All other aspects of the bridge replacement project design remain consistent with the analysis described in the original consultation (WCR-2017-7873).

The LEKT have been surveying the project area for spawning steelhead weekly during the summer months of 2023 and none have been found as of July 11, 2023 (Dave Molenaar pers com 2023).

New construction components not addressed in the original Opinion include:

Twelve Engineer Log Jams (ELJs)

The original design included three ELJs located just upstream of the new bridge alignment. These have been removed from the design and replaced with 12 ELJs downstream of the new bridge. The relocation and increase of the ELJs resulted from discussions with the LEKT to offset previous riverine impacts to maintain the existing bridge footings. The ELJs are intended to create an anabranching diversity of aquatic habitats to support salmon spawning, rearing, and migration. Design details of the new ELJs are consistent with the original ELJs described in the original Opinion. Basically, each substantial ELJ consists of large conifer tree mats with interwoven smaller trees and brush all held in place by vertical logs pile driven or excavated into the substrate to a depth that will withstand hydraulic forces. Constructing the ELJs includes:

1. Identifying appropriate locations to have the highest degree of hydraulic affect and habitat value. Preliminary geotechnical soil sampling will help guide the decisions. The geotechnical activity was addressed in a separate programmatic process (WCR-2017-7332).

2. Grading temporary construction access roads to the 12 sites. The path will be determined by the contractor with guidance from WSDOT engineers and biologists and LEKT staff to minimize riparian impacts. The existing Opinion for bridge replacement included up to

2.69 acres of riparian impacts. The ELJs associated access roads will add another 1.29 acres of riparian impacts for a total of 3.98 acres.

  a. Some ELJs will be located on a mid-channel island requiring an access bridge approximately 150 feet long. It is anticipated that the bridge will be installed in sections with joint supports placed in the mainstem channel. Narrow braided side channels will likely only require single spanning bridges. Equipment will not drive through the standing or flowing water.

3. Each ELJ will be located adjacent to or partially in the active channel.

   a. The construction footprint will be isolated with Best Management Practices (BMPs). The expected BMP will be super sacks filled with native gravels from the adjacent river bars. The gravel will be left behind as each ELJ is completed.
   b. Each of the 12 ELJs is approximately 50 feet by 100 feet with the lower layers installed approximately 10 feet down in an excavated pit. The top of the ELJs will be approximately two feet above the surrounding gravel surface.
   c. Excavated gravel will be pushed back in around the ELJ to match the existing grade.

4. The bridges and access roads will be removed as the ELJ sites are completed and no longer needed.

5. It is anticipated two in-water work windows will be necessary to complete all 12 ELJs, constructed concurrent with the demolition of the existing bridge; however, the ELJs may be constructed independent of the bridge work. Each in-water work window is expected to occur from June 15 to August 31; however, this may be adjusted with early coordination between FHWA and NMFS. Work outside of the Ordinary High Water Mark (OHWM) may occur throughout the year.

Enhanced Stormwater Treatment

The original Opinion addressed basic stormwater treatment throughout the project. Basic treatment includes sediment containment, oil/water separation, and flow control. This level of stormwater treatment has since been considered inadequate to protect aquatic ecosystems. All stormwater in the project limits will now pass through enhanced treatment facilities that, in addition to basic treatment capabilities, will bind dissolved metals and capture metal particles.

We considered, under the ESA, whether the proposed action would cause any other activities and determined that it would maintain the existing level of vehicular traffic in at the bridge location.

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).

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 FHWA determined the proposed action is not likely to adversely affect Pacific eulachon and Southern Resident Killer Whales (SRKWs) or their critical habitats.

NMFS does not agree that the proposed action is not likely to adversely affect Pacific eulachon because of the unknown effects of stormwater components, particularly 6-PPD-quinone, on this species. NMFS will take a conservative approach because of the emerging science on this chemical that has severe effects on some fish species. Therefore, NMFS considers the proposed project May Affect, is Likely to Adverse Effect Pacific eulachon.

Our concurrence that the proposed project is "Not Likely to Adversely Affect" SRKWs is documented in the Determinations section (Section 2.12).

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 also relies on the regulatory definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designation of critical habitat for Puget Sound 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 424.12) 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.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

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.
- Assumptions may be necessary to consider the presence of listed species in the project action area. All but the lower eight miles of the river have been isolated from anadromous fish for over 100 years. With the barrier dams removed the fish have access to the action area but reoccupation may be rapid or may take many years for consistent presence. This Opinion conservatively assumes rapid reoccupation of the action area by listed species.

2.2. Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. 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 current function of the essential PBFs that help to form that conservation value.

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 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, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself 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 habitat quality and spatial configuration, and the dynamics and dispersal characteristics 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 of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural 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 the 22 ESA-listed species, and their designated critical habitats, that occur within the geographic area of this proposed action and are considered in this opinion. 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).

Table 1. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register (FR) decision notices for ESA-listed species considered in this opinion. Listing status: 'T' means listed as threatened; 'E' means listed as endangered; 'P' means proposed for listing or designation.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Puget Sound	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Chum salmon *(O. keta)*			
Hood Canal summer-run	T 6/28/05; 70 FR 37160	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160
Steelhead (*O. mykiss*)			
Puget Sound	T 5/11/07; 72 FR 26722	2/24/16; 81 FR 9252	P 2/7/07; 72 FR 5648
Green sturgeon (*Acipenser medirostris*)			
Southern DPS	T 4/07/06; 71 FR 17757	10/09/09; 74 FR 52300	6/2/10; 75 FR 30714
Eulachon *(Thaleichthys pacificus)*			
Southern DPS	T 3/18/10; 75 FR 13012	10/20/11; 76 FR 65324	Not applicable

Status of PS Chinook Salmon

The Puget Sound Chinook salmon evolutionarily significant unit (ESU) was listed as threatened on June 28, 2005 (70 FR 37160). We adopted the recovery plan for this ESU in January 2007. The recovery plan consists of two documents: the Puget Sound salmon recovery plan (SSPS 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 (Table 6) 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.

Spatial Structure and Diversity. 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 (Ford, 2022). 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 (Table 2).

Between 1990 and 2014, 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).Overall, the new information on abundance, productivity, spatial structure and diversity since the 2010 status review supports no change in the biological risk category (Ford 2022).

Table 2. Extant PS Chinook salmon populations in each biogeographic region (Ruckelshaw et al 2002, Ford 2022)

Biogeographic Region	Population (Watershed)
Strait of Georgia	North Fork Nooksack River
	South Fork Nooksack River
Strait of Juan de Fuca	Elwha River
	Dungeness River
Hood Canal	Skokomish River
	Mid Hood Canal River
Whidbey Basin	Skykomish River
	Snoqualmie River
	North Fork Stillaguamish River
	South Fork Stillaguamish River
	Upper Skagit River
	Lower Skagit River
	Upper Sauk River
	Lower Sauk River
	Suiattle River
	Upper Cascade River
Central/South Puget Sound Basin	Cedar River
	North Lake Washington/ Sammamish River
	Green/Duwamish River
	Puyallup River
	White River
	Nisqually River

Abundance and Productivity. Total abundance in the ESU over the entire time series shows that individual populations have varied in increasing or decreasing abundance. Several populations (North and South Fork Nooksack, Sammamish, Green, White, Puyallup, Nisqually, Skokomish, Dungeness, and Elwha Rivers) are dominated by hatchery returns. Generally, many populations experienced increases in total abundance during the years 2000–08, and more recently in 2015–17, but general declines during 2009–14, and a downturn again in the two most-recent years, 2017–18. Abundance across the Puget Sound Chinook salmon ESU has generally increased since the last status review, with only two of the 22 populations (Cascade River and North and South Fork Stillaguamish Rivers) showing a negative percentage change in the five-year geometric mean natural-origin spawner abundances since the prior status review. Fifteen of the remaining 20 populations with positive percentage changes since the prior status review have relatively low natural spawning abundances (<1,000 fish), so some of these increases represent small changes in total abundance. Given lack of high confidence in survey techniques, particularly with small populations, there remains substantial uncertainty in detecting trends in small populations. Productivity in the Puget Sound Chinook salmon ESU has been variable across the time period (1980–2018). Across the Puget Sound Chinook salmon ESU, ten of 22 Puget Sound populations show natural productivity below replacement in nearly all years since the mid-1980s. These include the North and South Fork Nooksack Rivers (Strait of Georgia MPG), North and South Fork Stillaguamish and Skykomish Rivers (Whidbey Basin MPG), Sammamish, Green, and Puyallup Rivers (Central/South Sound MPG), Skokomish River (Hood Canal MPG), and Elwha River (Strait of Juan de Fuca MPG). Productivity in the Whidbey Basin MPG populations was above zero in the mid-to-late 1990s, with the exception of the Skykomish and North and South Fork Stillaguamish River populations. The White River population in the Central/South Sound MPG was above replacement from the early 1980s to 2001, but has dropped in productivity consistently since the late 1980s. In recent years, only five populations have had productivities above zero. These are Lower and Upper Skagit, Lower and Upper Sauk, and Suiattle Rivers in the Whidbey Basin MPG. This is consistent with, and continues the decline reported in, the 2015 status review (NWFSC 2015, 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

Status of PS Steelhead

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 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. Hard (2015), identify several criteria for the viability of the DPS, including that a minimum of 40 percent of summer-run and 40 percent of winter-run populations historically present within each of the MPGs must be considered viable using the VSP-based criteria. 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 (2015).

On December 27, 2019, we published a recovery plan for PS steelhead (84 FR 71379) (NMFS 2019). The proposed plan indicates that within each of the three MPGs, at least fifty percent of the populations must achieve viability, *and* specific DIPs must also be viable:

Central and South Puget Sound MPG: 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.

Hood Canal and Strait of Juan de Fuca MPG: Elwha River Winter/Summer-Run; 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.

North Cascades MPG: Of the eleven DIPs with winter or winter/summer runs, five must be viable: One from the Nooksack River Winter-Run; One from the 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.

Of the five summer-run DIPs in this MPG, three must be viable representing in each of the three major watersheds containing summer-run populations (Nooksack, Stillaguamish, Snohomish Rivers); 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)

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. The DPS also includes six hatchery stocks that are considered no more than moderately diverged from their associated natural-origin counterparts: Green River natural winter-run; Hamma Hamma winter-run; White River winter-run; Dewatto River winter-run; Duckabush River winter-run; and Elwha River native winter-run (USDC 2014). Steelhead are the anadromous form of *Oncorhynchus mykiss* that occur in rivers, below natural barriers to migration, in northwestern Washington State (Ford 2011). 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).

DIPs can include summer steelhead only, winter steelhead only, or a combination of summer and winter run timing (e.g., winter run, summer run or summer/winter run). Most DIPs have low viability criteria scores for diversity and spatial structure, largely because of extensive hatchery influence, low breeding population sizes, and freshwater habitat fragmentation or loss (Hard et al. 2007). In the Central and South Puget Sound and Hood Canal and Strait of Juan de Fuca MPGs, nearly all DIPs are not viable (Hard 2015). More information on PS steelhead spatial structure and diversity can be found in NMFS' technical report (Hard 2015).

Abundance and Productivity The long-term abundance of adult steelhead returning to many Puget Sound rivers has fallen substantially since estimates began for many populations in the late 1970s and early 1980s; however, in the nearer term, there has been a relative improvement in abundance and productivity. Of the 20 datasets analyzed, abundance trends were available for seven of the eight winter-run DIPs in the Hood Canal & Strait of Juan de Fuca MPG; for five of the eight winter-run DIPs in the Central & South Puget Sound MPG; and for seven of the 11 winter-run DIPs, but only one of the five summer-run DIPs, in the Northern Cascades MPG. One-third of the populations lack monitoring and abundance data; in most cases it is likely that abundances are very low (Ford 2022).

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

2.2.2 Status of Critical Habitats for Fishes

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 throughout the designated areas. These features are essential to the conservation of the listed species because they support one or more of the species' life stages (*e.g*., sites with conditions that support spawning, rearing, migration and foraging).

Salmon and Steelhead

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC_5) in terms of the conservation value they provide to each listed species they support.[1] 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 freshwater spawning and incubation sites, include water flow, quality and temperature conditions and suitable substrate for spawning and incubation, as well as migratory access for adults and juveniles (Table 3). These features are essential to conservation because without them the species cannot successfully spawn and produce offspring. The physical or biological features of freshwater migration corridors associated with spawning and incubation sites include water flow, quality and temperature conditions supporting larval and adult mobility, abundant prey items supporting larval feeding after yolk sac depletion, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

[1] The conservation value of a site depends upon "(1) the importance of the populations associated with a site to the ESU [or DPS] conservation, and (2) the contribution of that site to the conservation of the population through demonstrated or potential productivity of the area" (NOAA Fisheries 2005).

Table 3. Primary constituent elements (PCEs) of critical habitats designated for ESA-listed salmon and steelhead species considered in the opinion and corresponding species life history events.

Primary Constituent Elements Site Type	Primary Constituent Elements Site Attribute	Species Life History Event
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing

CHART Salmon and Steelhead Critical Habitat Assessments

The CHART for each recovery domain assessed biological information pertaining to occupied 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 HUC_5 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 HUC_5 watershed; and Factor 3 (quality – potential condition), which considers the likelihood of achieving PCE potential in the HUC_5 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, HC summer-run chum salmon, LO sockeye salmon, southern green sturgeon, and for eulachon. 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.

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 which 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).

Dams constructed for hydropower generation, irrigation, or flood control have substantially affected PS Chinook salmon 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 headgates 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 2019). 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 (Hood Canal Coordinating Council 2005; SSPS 2007).

In summary, critical habitat 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.

The PS recovery domain CHART (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 HUC_5 watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or a high potential for improvement (Table 4).

Table 4. **Puget Sound Recovery Domain:** Current and potential quality of HUC_5 watersheds identified as supporting historically independent populations of ESA-listed Chinook salmon (CK) and chum salmon (CM) (NOAA Fisheries 2005).[2] Watersheds are ranked primarily by "current quality" and secondly by their "potential for restoration."

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC_5 Code(s)	Listed Species	Current Quality	Restoration Potential
Strait of Georgia and Whidbey Basin #1711000xxx			
Skagit River/Gorge Lake (504), Cascade (506) & Upper Sauk (601) rivers, Tye & Beckler rivers (901)	CK	3	3
Skykomish River Forks (902)	CK	3	1
Skagit River/Diobsud (505), Illabot (507), & Middle Skagit/Finney Creek (701) creeks; & Sultan River (904)	CK	2	3
Skykomish River/Wallace River (903) & Skykomish River/Woods Creek (905)	CK	2	2
Upper (602) & Lower (603) Suiattle rivers, Lower Sauk (604), & South Fork Stillaguamish (802) rivers	CK	2	1
Samish River (202), Upper North (401), Middle (402), South (403), Lower North (404), Nooksack River; Nooksack River (405), Lower Skagit/Nookachamps Creek (702) & North Fork (801) & Lower (803) Stillaguamish River	CK	1	2
Bellingham (201) & Birch (204) bays & Baker River (508)	CK	1	1
Whidbey Basin and Central/South Basin #1711001xxx			
Lower Snoqualmie River (004), Snohomish (102), Upper White (401) & Carbon (403) rivers	CK	2	2
Middle Fork Snoqualmie (003) & Cedar rivers (201), Lake Sammamish (202), Middle Green River (302) & Lowland Nisqually (503)	CK	2	1
Pilchuck (101), Upper Green (301), Lower White (402), & Upper Puyallup River (404) rivers, & Mashel/Ohop(502)	CK	1	2
Lake Washington (203), Sammamish (204) & Lower Green (303) rivers	CK	1	1
Puyallup River (405)	CK	0	2

[2] On January 14, 2013, NMFS published a proposed rule for the designation of critical habitat for LCR coho salmon and PS steelhead (USDC 2013). A draft biological report, which includes a CHART assessment for PS salmon, was also completed (NMFS 2012). Habitat quality assessments for PS steelhead are out for review; therefore, they are not included on this table.

Current PCE Condition	Potential PCE Condition
3 = good to excellent	3 = highly functioning, at historical potential
2 = fair to good	2 = high potential for improvement
1 = fair to poor	1 = some potential for improvement
0 = poor	0 = little or no potential for improvement

Watershed Name(s) and HUC$_5$ Code(s)	Listed Species	Current Quality	Restoration Potential
Hood Canal #1711001xxx			
Dosewallips River (805)	CK/CM	2	1/2
Kitsap – Kennedy/Goldsborough (900)	CK	2	1
Hamma Hamma River (803)	CK/CM	1/2	1/2
Lower West Hood Canal Frontal (802)	CK/CM	0/2	0/1
Skokomish River (701)	CK/CM	1/0	2/1
Duckabush River (804)	CK/CM	1	2
Upper West Hood Canal Frontal (807)	CM	1	2
Big Quilcene River (806)	CK/CM	1	1/2
Deschutes Prairie-1 (601) & Prairie-2 (602)	CK	1	1
West Kitsap (808)	CK/CM	1	1
Kitsap – Prairie-3 (902)	CK	1	1
Port Ludlow/Chimacum Creek (908)	CM	1	1
Kitsap – Puget (901)	CK	0	1
Kitsap – Puget Sound/East Passage (904)	CK	0	0
Strait of Juan de Fuca Olympic #1711002xxx			
Dungeness River (003)	CK/CM	2/1	1/2
Discovery Bay (001) & Sequim Bay (002)	CM	1	2
Elwha River (007)	CK	1	2
Port Angeles Harbor (004)	CK	1	1

Eulachon Critical Habitat

Eulachon critical habitat is designated in two discrete locations in the Puget Sound domain: the lower 4 miles of the Elwha River, and the lower 2 miles of the Quinault River. In both locations the critical habitat serves migration and spawning values. (76 FR 65324; 10/20/11). The lateral extent of critical habitat as the width of the stream channel defined by the ordinary high water line, as defined by the USACE in 33 CFR 329.11. Each specific area extends from the mouth of the specific river or creek (or its associated estuary when applicable) upstream to a fixed location.

The physical and biological features essential for conservation of eulachon in freshwater and estuarine areas include: (1) Spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation; and (2) migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding. The activities that may affect PBFs of critical habitat in the Quinault are pollution from point and nonpoint sources, and in-water construction, including channel modifications and diking. These are also noted as concerns for the Elwha, and while the designation documents also identify dams as a point affecting PBFs for eulachon CH, subsequent to the designation the Glines and Elwha dams were removed, re-establishing habitat processes and potential access to larger areas for spawning.

2.3. 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 original Opinion action area was defined by terrestrial noise from demolishing the existing bridge removal, building the new bridge and the 3 upstream ELJs. The upstream ELJs have since been deleted from the design and FHWA plans to continue with the bridge replacement but add 12 ELJs downstream of the bridge. The extent of the action area in the original Opinion was defined by construction noise and included an aquatic zone of influence. Subsequently, stormwater components, particularly 6-PPD-Quinone, defines the furthest extent of the action area that conservatively extends the entire length of the Elwha River from the project limits to the confluence with marine water in the Strait of Juan de Fuca, Salish Sea. The most visible effect in the action area will be temporary upstream backwatering (1,300 feet) from the bridge construction/removal cofferdams and turbidity from demolishing the existing bridge and installing the ELJs. Episodic pulses of turbidity will occur up to 1,800 feet downstream of the in-water work. Thus, the upstream backwater effect and turbidity from the furthest downstream ELJ will affect the entire wetted width of the river for approximately 4,000 lineal feet of the Elwha River over two in-water work seasons.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The environmental baseline has remained consistent with the description included in the original Opinion (WCR-2017-7873) and is incorporated by reference here.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

Based on the information provided and developed during the consultation, the proposed project is likely to result in permanent and temporary effects, including: 1) injury or death from fish exclusion, 2) modified habitat areas, 3) increase in overwater structure water and 4) water quality diminishment from turbidity caused by in-channel work (installation/removal of temporary cofferdams and ELJ excavation) and associated water quality impairment (stormwater runoff from the road/bridge structure).

2.5.1 Effects on Listed Species

Fish Handling and Exclusion

The proposed construction actions below the OHWM will take place for 1 week for each bridge demolition phase (2 weeks total) during the June 15 to August 31, in-water work window, when low numbers of juvenile and no adult Chinook salmon or steelhead are likely to be in the Elwha River in the action area (NWFSC 2015). Eulachon adults enter the Elwha as early as January, but also have been documented March through June (Shaffer et al 2007, Gustafson et al 2022). The in-water work area from which fish will be salvaged will be temporarily isolated. It includes 110,000 square feet during phase 1 and 30,000 square feet during phase 2. The total area to be isolated is approximately 140,000 square feet for the bridge demolition. Approximately 200,000 square feet of the Elwha River will be isolated to install ELJs. Before dewatering areas behind the cofferdams, fish will be captured and removed from the area to be dewatered. The fish capture/relocation is included in the project to avoid or minimize injury or death to fish due to dewatering.

Fish handling and transport, while intended to reduce the number of fish exposed to construction effects, is itself reasonably certain to harm some juvenile salmonids, disrupt their normal behavior, and cause short-term stress, fatigue, and some injury and mortality, even though it will be conducted by a qualified fish biologist. Studies indicate stress is revealed by increased plasma levels of cortisol and glucose (Hemre and Krogdahl 1996; Sharpe *et al.* 1998). Even short-term, low intensity handling may cause reduced predatory avoidance for up to 24 hours (Wedemeyer 1972; Olla *et al.* 1995). While injury and death due to handling stress from nets and seines is expected to be lower than that for electrofishing, poor, improper, or careless handling after capture can result in as much mortality, stress, and injury as electrofishing (Barrett and Grossman 1988).

Electrofishing involves passing an electrical current through water containing fish to stun them, making them easier to locate and remove from the worksite. The process can cause a suite of effects on fish, ranging from disturbance or fright behavior and temporary immobility, to physical injury or death resulting from accidental contact with the electrodes. Electrofishing stresses are cumulative when added to existing environmental stresses, increasing mortality due to stress and fatigue directly or indirectly through greater susceptibility to predators, disease, and parasites (Snyder 2003).

The amount of unintentional mortality attributable to electrofishing can vary widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. The long-term effects electrofishing has on both juveniles and adult salmonids is not well understood, but a few studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey *et al.* 1996; Thompson *et al.* 1997; Ainslie *et al.* 1998). Those studies indicate that, although some fish suffer spinal injury, few die as a result. Injured fish may suffer short-term, long-term, or lifetime handicaps that affect their behavior, health, growth, or reproduction, which could impact community structure and population size (Snyder 2003). Injury and mortality among salmonids will affect juveniles. All life stages of eulachon are not expected to occur in the construction footprint or turbidity mixing zone and will not be exposed to electrofishing.

Habitat Modification

Project Site Dewatering - The project will dewater an area of approximately 140,000 square feet in two phases to demolish the existing bridge. NMFS anticipates temporary changes to instream flow upstream, within, and downstream of the project site during the two-phased demolition of the existing bridge. Fish not successfully captured and removed as described above would be exposed, and respond to several habitat conditions:

Stream flow diversion and dewatering could harm individual rearing salmonids by concentrating or stranding them in residual wetted areas or entrapping them within the interstices of channel substrate where they may not be seen by fish relocation personnel. Juvenile salmonids that avoid capture in the project work area will likely die due to desiccation, thermal stress, or crushing. Because fish relocation efforts are expected to be effective at removing fish from the area. NMFS expects that the number of juvenile Chinook salmon and steelhead that may be missed/ left within the dewatered area and die as a result will be very low.

Dewatering operations may also affect aquatic food sources that Chinook salmon and steelhead use for forage. Benthic aquatic macroinvertebrates, an important food source for salmonids, are likely to be killed or their abundance reduced when the river is dewatered (Cushman 1985). Because river flow diversions and dewatering will be temporary because construction activities will be short-term (fewer than 3 months), we expect rapid recolonization (2 weeks to 2 months) of disturbed areas by macroinvertebrates following the removal of all cofferdams (Merz and Chan 2005). Because the channel will not be completely dewatered, the activities are short-term, and macroinvertebrate populations from areas adjacent to the project footprint would contribute to recovery, macroinvertebrate recolonization should occur more quickly than 2 months. This suggests that prey will reestablish shortly after fish are able to return to the rewetted area. During the reduction of benthic prey, juvenile salmonids are expected to have sufficient food from upstream sources (via drift) and detrital prey. Therefore, Chinook salmon and steelhead are not anticipated to be exposed to a reduction in overall prey abundance from the temporary reduction in aquatic macroinvertebrates as a result of dewatering activities. Adult eulachon are semelparous and are not likely to be affected by loss of prey. Larval eulachon consume their egg sacs while drifting toward the estuary; when they sac is depleted they begin consuming prey, and thus also unlikely to be affected by prey reduction.

Loss of Habitat - The project will directly affect the Elwha riverbed through the installation and removal of construction access pads and the excavation of material from gravel bars. The temporary construction access pads will cover approximately 29,500 square feet of streambed, elevating the area so equipment can operate above the water surface (up to a 2-year flow event at elevation 195 feet). The temporary construction access pads will be composed of 6-man riprap (54- to 60-inch-diameter angular rock) and "choked" with streambed gravel that is used to fill the interstitial spaces in the riprap foundation to solidify the structure. The choking material will be excavated from nearby gravel bars, impacting an additional 8,000 square feet of river substrate.

The placement and excavation of rock, and the presence of in-water structures will reduce the production of benthic and epibenthic macroinvertebrates on which juvenile Chinook salmon and steelhead feed. The placement and excavation of rock for the temporary construction access pads and permanent installation of two piers to support the bridge are expected to cause mortality of or reduce the abundance of benthic aquatic macroinvertebrates. Effects to aquatic macroinvertebrates from smothering will be temporary, and the river will return to natural contours following the completion of construction. Macroinvertebrates are expected to rapidly recolonize disturbed areas (within approximately 2 weeks to 2 months) (Merz and Chan 2005).

The presence of two piers will permanently impact approximately 314 square feet of habitat. However, the project will also remove two existing piers that affect approximately 1,408 square feet of habitat, for a net reduction in effect on benthic habitat of 1,094 square feet. The benthic macroinvertebrate production within the project area is expected to increase when the project is complete. The amount of forage material available for juvenile salmonids is, therefore, expected to return to at least pre-project conditions. The temporary reduction in prey base is likely not enough to cause physiological effects on listed fish.

Riparian Habitat Alteration - Vegetation will be removed from 6.7 acres, of which 4.0 acres is within the riparian buffer and may affect aquatic habitat and species. Indirect effects associated with the removal of riparian vegetation can result in increased water temperatures (Mitchell 1999; Opperman and Merenlender 2004) and decreased water quality (Lowrance *et al.* 1985; Welsch 1991), attributable to a loss of shade and cover over the active channel. However, the loss of vegetation as a result of the proposed action is expected to be temporary because 3.6 acres of native riparian vegetation and 0.7 acre of roadside vegetation will be replanted to minimize impacts from project construction. Vegetation will be planted on 3-foot centers and monitored to ensure survival of 80 percent of planted material over 3 years.

Functional riparian vegetation will be absent from approximately 600 feet along the shoreline on both banks (1,200 feet total) for a period of approximately 6 years (1 year for construction and 5 years for the vegetation to mature). The riparian habitat on both banks outside the immediate project vicinity is forested with native vegetation, and NMFS believes that the absence of mature vegetation for a small portion of the reach is unlikely to significantly impact rearing and migrating salmonids.

Habitat Gain - ELJs will occupy approximately 60,000 square feet of the Elwha River channel migration zone. The intent of the ELJs is to create channel complexity, increase foraging areas, and refugia where little or none currently exists. Apart from disturbance during construction, the ELJs are wholly beneficial to all life histories but particularly for juvenile salmonids. The ELJ locations and designs are intended to function collectively as the Elwha River channel matures. Flows and channels will adjust to the ELJs as if it were a natural accumulation of large logs that historically would occur in the river. Initial streambed scouring is expected around the leading edge and sides of each ELJ but is expected to stabilize after the first season of high flows.

Additionally, removing the existing piers out of the channel opens up 1,408 square feet of migration, spawning, and rearing habitat each life stage of salmonids. Combined improvements of habitat in the project footprint will support increased productivity of Chinook salmon, steelhead, and eulachon.

Overwater Coverage/Shade

The area of overwater coverage of the new bridge will be approximately 15,710 square feet, an increase of 6,190 square feet over the existing condition. Overwater structures can cause delays in migration for Puget Sound Chinook salmon and steelhead from disorientation, fish school dispersal (resulting in loss of refugia), and altered migration routes around the structures (Simenstad *et al.* 1999). A study on the effects of overwater shading on migrating juvenile salmon showed that bridges delay some migrating smolts (Bloch *et al.* 2009). These delays were typically short in duration as the smolts would migrate towards the shoreline before continuing their downstream migration. However, many predatory species prefer habitat under bridges and the delay in salmonid migration may increase of the number of predators and/or predator success (Bloch *et al.* 2009), which could slightly increase mortality of listed fish in the Elwha.

The presence of overwater structures may also reduce the production of benthic and epibenthic macroinvertebrates by reducing light transmission and decreasing primary production through shading. A WSDOT (2009) study on light transmission under the State Route 520 Lake Washington Bridge found that low, wide bridge decks create deep shade in the area underneath the bridge decks and have little to no vegetation growing beneath them. In contrast, higher, narrower bridge decks can let a significant amount of light beneath the deck, and vegetation cover (including trees and dense shrubs) can be quite high in those areas. Overall, the study determined that bridge heights of about 24 feet or higher have relatively minor impacts on vegetation in terms of total cover, and higher bridges can support a diverse range of vegetation (WSDOT 2009). The proposed bridge structure over the Elwha River will have an elevation of 32 to 42 feet over the wetted portion of the channel, and an elevation of 23 feet over the riverbanks.

While the proposed structure continues the presence of a light/dark interface that may disorient migrating fish and increase the risk of predation, the increased elevation will reduce this effect over the existing structure. Other impacts, such as loss in primary production and forage material due to shading effects, are minimized due to the increased elevation. Overall, salmonid exposure to the slight reduction in habitat associated with shade will result largely in behavior responses only, with slight migration delay being expected among some individuals, and a subset of these being killed by predators. Juvenile salmonids are expected to continue seeking out areas where prey are adequately abundant.

Water Quality Reductions

Construction Activities - In-water construction activities will temporarily disturb soil and streambed sediments, resulting in the potential for temporary increases in turbidity and suspended sediments in the action area. Turbidity plumes are expected to affect a portion of the channel and extend 2,400 feet downstream of the site. Construction-related increases in sedimentation and turbidity above background levels could potentially affect fish species and their habitat by reducing egg and juvenile survival, interfering with feeding activities, causing breakdown of social organization, and reducing primary and secondary productivity. The magnitude of the potential effects on fish depends on the timing and extent of sediment loading and flow in the river before, during, and immediately following construction.

High concentrations of suspended sediment can have both direct and indirect effects on salmonids. The severity of effects depends on the sediment concentration, duration of exposure, and sensitivity of the affected life stage. Based on the types and duration of proposed in-water construction methods, short-term increases in turbidity and suspended sediment may disrupt feeding activities or result in avoidance or displacement of fish from preferred habitat. Juvenile salmonids have been observed to avoid streams that are chronically turbid (Lloyd 1987) or move laterally or downstream to avoid turbidity plumes (Sigler *et al.* 1984). Prolonged exposures to turbidities between 25 and 50 NTUs may result in reduced growth and increased emigration rates of juvenile coho salmon and steelhead compared to controls (Sigler *et al.* 1984). These findings are generally attributed to reductions in the ability of salmon to capture prey in turbid water (Waters 1995). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Berg and Northcote (1985) observed changes in social and foraging behavior, and increased gill flaring (an indicator of stress) in juvenile coho salmon at moderate turbidity (30 to 60 NTUs). In that study, behavior returned to normal quickly after turbidity was reduced to lower levels (0 to 20 NTUs).

The Elwha River basin has not yet reached a natural equilibrium following the dam removal, and the turbidity varies between approximately 0.5 to 138 NTUs (Hall *et al.* 2017), with highs of up to 4,000 NTUs (Pess *et al.* 2014). Any increase in turbidity associated with in-water work is likely to be brief and to occur only in the vicinity of the action, attenuating downstream as suspended sediment settles out of the water column. Temporary spikes in suspended sediment may result in avoidance of the site by fish; several studies have documented active avoidance of turbid areas by juvenile and adult salmonids (Sigler *et al.* 1984; Lloyd 1987; Servizi and Martens 1992). Individual fish that encounter increased turbidity or suspended sediment concentrations will likely move away from affected areas into more suitable surrounding habitat. In-water work will only occur from approximately June 15 to August 31 in each of 2 years, which will limit the duration of turbidity effects and potential exposure of salmonids to them. The exact beginning and ending dates may vary depending on constructability issues, sufficient justification, and written approval from NMFS. Juvenile Chinook salmon and steelhead may be present during instream construction activities. Individual fish present during instream construction will likely be exposed to the above effects. However, due to the short duration of turbidity-generating activities, the effects of turbidity are minimized but still likely to result in increased predation, decreased feeding, injury, or death among exposed juvenile salmonids. Some spawning streams have high turbidity from glacial flour, and it is surmised that this may provide cover from predators (Spangler, 2020).

Sedimentation can kill or injure incubating salmonid eggs by decreasing space between spawning gravel in which dissolved oxygen can be transported. Sediment also blocks micropores on the surface of incubating eggs, inhibiting oxygen transport, and creates an additional oxygen demand through the chemical and biological oxidation of organic material (Suttle *et al.* 2004; Greig *et al.* 2007; Kemp *et al.* 2011). Due to the location and timing of construction, Chinook salmon and steelhead eggs are not expected to be present; however, preconstruction redd surveys will help identify and avoid impacting nests.

Stormwater - Rainwater falling on paved surfaces can accumulate heat and warmed runoff can increase water temperature in receiving water. However, water quality treatment associated with the proposed project is expected to provide infiltration for low precipitation events reducing or eliminating this effect. Water quality monitoring at the US 101 Elwha River Bridge through 2015 suggests that water temperatures in the Elwha River vary between approximately 4°C and 8ºC (Ecology 2017). Because total stormwater runoff discharges to the river are expected to be similar to existing discharges, stormwater is not expected to adversely affect river temperatures.

Highways collect a variety of pollutants from traffic and are disproportionate contributors to overall pollutant loads in waterbodies (Wheeler *et al.* 2005). Pollutants are mobilized by runoff water and are transported to nearby waterbodies. Traffic residue contains several metals including iron, zinc, lead, cadmium, nickel, copper, and chromium (Wheeler *et al.* 2005). The metals come off disintegrating tires, brake pads, and other vehicle parts and accumulate in roadside dust and soil (Wheeler *et al.* 2005). Increased copper and zinc loading presents two pathways for possible adverse effects: 1) direct exposure to water column pollutant concentrations in excess of biological effects thresholds, and 2) indirect adverse effects resulting from the accumulation of pollutants in the environment over time, altered food web productivity, and possible dietary exposure. Dissolved copper and dissolved zinc are the constituents of greatest concern because they are prevalent in stormwater, they are biologically active at low concentrations, and they have adverse effects on salmonids (Sprague 1968; Sandahl *et al.* 2007).

Sub-lethal concentrations of dissolved copper have been shown to impair olfactory function in salmon in freshwater (Tierney *et al.* 2010). Baldwin *et al.* (2003) found that 30- to 60-minute exposures to a dissolved copper concentration of 2.3 micrograms per liter (μg/L) over background level caused olfactory inhibition in coho salmon juveniles. Sandahl *et al.* (2007) found that a 3-hour exposure to a dissolved copper concentration of 2.0 μg/L caused olfactory inhibition in coho salmon juveniles. That copper-induced loss of smell leads to a reduction in predator avoidance (McIntyre *et al.* 2008). Further, fish have shown avoidance of sub-lethal levels of dissolved copper in freshwater (Giattina *et al.* 1982).

The toxicity of zinc is widely variable, dependent upon concurrent levels of calcium, magnesium, and sodium in the water column (De Schamphelaere and Janssen 2004). A review of zinc toxicity studies reveals effects including reduced growth, avoidance, reproduction impairment, increased respiration, decreased swimming ability, increased jaw and bronchial abnormalities, hyperactivity, hyperglycemia, and reduced survival in freshwater fish (Eisler 1993). Juveniles are more sensitive to elevated zinc concentrations than adults (EPA 1987).

Sprague (1968) documented avoidance in juvenile rainbow trout exposed to dissolved zinc concentrations of 5.6 µg/L over background levels.

There are five threshold discharge areas in the action area that discharge to three waterbodies: the Elwha River, Indian Creek, and an unnamed tributary to Indian Creek. The existing stormwater system collects runoff in ditches and culverts and discharges it untreated to receiving water bodies. The project will increase PGIS by 0.38 acre and will provide enhanced water quality treatment for approximately 1.5 acres of new and replaced PGIS, substantially increasing the amount of water quality treatment in the action area. Loads and concentrations of total suspended solids (TSS), copper, dissolved copper, zinc, and dissolved zinc in stormwater runoff will all be reduced by 18 to 34 percent (Table 5), benefitting fishery resources in the action area, however residual amounts of contaminants will remain, which creates a chronic adverse condition.

Table 5. Summary of stormwater pollutant loads and concentrations.

			Median Predicted Values from WSDOT HI-Run					
	PGIS (acre)	**Acres with Stormwater Treatment**	**TSS Load (lb/yr)**	**Total Copper (lb/yr)**	**Dissolved Copper (lb/yr)**	**Total Zinc (lb/yr)**	**Dissolved Zinc (lb/yr)**
Pre-project	2.89	0	2,879	0.739	0.172	4.5	1.28
Post-project	3.27	1.49	1,907	0.51	0.14	3	0.98
Change	+0.38	+1.49	-972	-0.229	-0.032	-1.5	-0.3

In addition to TSS and vehicle brake pad metals, recent studies have shown that coho salmon particularly show high rates of pre-spawning mortality when exposed to chemicals that leach from tires (McIntire et al. 2015). Researchers have recently identified the tire rubber antioxidant 6-PPD quinone 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. The potential effects on eulachon are unknown but spawning adults, eggs, and larvae will be exposed for the duration of presence in the Elwha River. Vehicle components 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).

The intensity of effects depends largely on the pollutant, its concentration, and/or the duration of exposure. However, the incremental addition of small amounts of these pollutants are a source of potential adverse effects to salmon and steelhead, even when the source load cannot be distinguished from ambient levels. Some contaminants accumulate in both the tissues and prey of salmon and steelhead and cause a variety of lethal and sublethal effects (Hecht et al. 2007). Repeated and chronic exposures, even at very low levels, are still likely to injure or kill individual fish, by themselves and through synergistic interactions with other contaminants already present in the water (Baldwin et al. 2009; Feist et al. 2011; Hicken et al. 2011; Spromberg and Meador 2006; Spromberg and Scholz 2011).

Although the predicted concentration levels of the discharge are below lethal levels for DZn and DCu, and the dilution zones are extremely small, juvenile salmonids and eulachon are likely to be exposed to chronic low levels of a wide array of contaminants in the stormwater runoff, including fuels and oils, PAHs, and road material and tire wear, as described above. Steelhead and spring Chinook salmon have relatively long freshwater residency periods and thus are likely to experience relatively long exposure and latent or sublethal effects from such exposure. Adult eulachon have a relatively short freshwater residency and eggs/larvae move downstream toward marine water almost immediately. Eulachon can take up and store pollutants from their spawning rivers, despite the fact that they do not feed in fresh water and remain there only a few weeks (Rogers et al 1990).

2.5.2 Effects on Critical Habitat

Designated critical habitat within the action area consists of freshwater spawning, rearing, and migration PBFs for steelhead.

Critical habitat for Pacific eulachon has been designated in the Elwha River from the mouth to 4 miles upstream. Eulachon spawning and migration habitat will not be exposed to effects from construction located at approximately rivermile 7.75; however, deleterious stormwater components may extend into critical habitats for steelhead and eulachon. Relevant features here are water flow, quality and temperature conditions and substrate supporting spawning and incubation and larval and adult mobility.

Critical habitat for PS Chinook salmon has not been designated in the Elwha River.

The essential elements of salmonid freshwater spawning and rearing sites and migration corridors are substrate, water quality and quantity for spawning, floodplain connectivity, water quality and quantity including temperature conditions supporting juvenile and adult mobility, abundant prey items supporting juvenile feeding, cover generally associated with complex habitat, and free passage (no obstructions) for adults and juveniles. These features are essential to conservation because they allow adult fish to reach upstream spawning areas and they allow juvenile fish to rear in and near natal streams for at least 1 to 2 years before proceeding downstream and to the ocean.

Several effects to features of critical habitat are described generally in the above subsection, as they create the pathways of exposure and response among listed fish. We evaluate here if those effects alter the conservation value for which the habitat was designated.

Water Quantity - Water quantity is an element of the spawning, rearing, and migration PBFs. During bridge demolition, approximately 140,000 square feet of channel will be dewatered in two phases. Based on the worst-case scenario of a 10 percent flow exceedance during the summer months while the water diversion is in place, the cofferdams could create a backwater condition within the Elwha River extending approximately 1,300 feet upstream and into the lower reaches of Little River. Downstream effects from changes in flow velocities, shear stresses, and scour may extend up to 2,000 feet downstream. The dewatering activities will occur during the anticipated in-water work window of June 15 to August 31 when adult salmonids are not likely to be present and juvenile salmonids are less likely to be present.

Safe Passage - The use of a cofferdam restricting downstream flow will create backwaters that could delay (but not prevent) downstream migration of juvenile fish. When the cofferdams are removed, the action area will restore to pre-action flow and space for migration. The cofferdams will be removed before adult salmonid return to spawn, so it is unlikely any redds will be affected. A channel will provide access to downstream reaches, so any potential behavioral delays in migration will be temporary.

To accommodate streamflow while the cofferdam is in place, the channel will be deepened in an area approximately 600 feet long and 80 feet wide. This will reduce stream velocities, reduce scour, and provide a low-flow channel for the river during construction (Hall *et al.* 2017). All dewatering work will be done during the low-flow summer months prior to the Elwha River Chinook salmon or steelhead early returns for spawning. The proposed channel will reduce stream velocities so rearing juvenile salmonids will not be washed downstream and the temporary channel restriction will not create a barrier to upstream or downstream migration.

Water Quality - Water quality is an essential PBF of the freshwater spawning, rearing, and migration site types. Construction activity that may result in increased turbidity includes the construction and removal of the temporary access pads, the construction of the proposed bridge, the removal of the existing bridge, and installation and removal of the cofferdams. Water quality will also be degraded during construction up to 2,700 feet downstream of the existing bridge when the existing bridge piles are pulled out of the channel, ELJ base logs are excavated into the sediment, and cofferdams are removed. NMFS does not expect the high turbidity from the proposed action to appreciably reduce the suitability of the action area for spawning, rearing, or migrating salmonids, because passage will be maintained throughout the project and will continue unchanged when construction is completed. Likewise, due to the short duration of turbidity, NMFS expects episodic pulses that may affect spawning, rearing, and migrating habitat will not reduce the conservation role of the habitat to support any life stage.

The temporary reduction of water quality due to suspended sediment, even when considered in both years, is not of sufficient duration to reduce the conservation role of the habitat.

The NMFS believes that long-term water quality in the action area will be improved by enhanced stormwater treatment, though some adverse contaminants will remain. An overall reduction in load is expected with the addition of treatment, which would reduce the concentration in the critical habitat of both steelhead and eulachon.

Substrate - Similar to the analysis on turbid condition, the proposed action will have short-term negative effects on the quantity and quality of substrate within the project area and vicinity. To construct the temporary construction access pads, approximately 1,500 cubic yards will be excavated from gravel bars in the channel to use as choking material to prevent fish entrainment in the interstitial spaces of riprap.

The cofferdams used to dewater portions of the channel will be dismantled by opening the bulk bags and releasing the gravel to the channel bed. This method of release will allow for natural redistribution of sediment under normal flows and will increase the amount of substrate suitable for spawning, rearing, and migrating habitats within the mainstem of the Elwha River.

Natural Cover - Approximately 2.9 acres of riparian vegetation will be removed to provide access for constructing the new bridge and removing the existing structures and 1.3 acres for access to the ELJs. The area will experience approximately 6 years (1 for construction, 5 for vegetation to mature) of decreased shade and allochthonous input from the cleared area. The riparian area in the action area consists of forested vegetation. All but approximately 0.4 acres will be replanted, and natural regrowth is expected to return the area to baseline within a few growing seasons. The temporary loss of 4.2 acres and permanent loss of 0.4 acres of vegetation is unlikely to have any measurable effects on water temperatures, shade, or woody debris within the river. Detrital prey may decline until the vegetation has matured.

2.6. 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 and 402.17(a)]. 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.

There are no reasonably foreseeable non-Federal activities within the action area that would affect listed species. Federal actions dominate current and future impacts in the action area because the vast majority of activities that may affect listed species in the action area will require an approval under the Clean Water Act. Future Federal actions will be subject to the section 7(a)(2) consultation under the ESA. As described in Section 2.4, Environmental Baseline, most of the watershed is composed of forestland. Timber harvest operations on state trust lands in the action area are covered under the habitat conservation plan that was developed to support issuance of section 10(a)(1)(B) permit for incidental take of Chinook salmon and steelhead, among other species (WDNR 1997). Because section 7 consultation for that permit has been completed, timber harvest activities on state trust lands is considered to be part of the environmental baseline for those species and are not addressed as cumulative effects (USFWS and NMFS 1998).

Lands in the action area are zoned for timber production and very-low-density residential development. As such, it is extremely unlikely that any development projects with significant impacts on the environmental will be proposed in the action area. Moreover, the potential for future development projects to adversely affect ESA-listed species and critical habitat will be minimized through compliance with the critical areas rules of Clallam County.

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. Therefore, all relevant future climate-related environmental conditions in the action area are described earlier in the discussion of environmental baseline (Section 2.4).

2.7. 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.

2.7.1 ESA Listed Species

The current status of the PS Chinook salmon ESU and PS steelhead DPS is poor, which is the reason for their continued listing as threatened. The PS Chinook salmon ESU is at moderate risk of extinction. All PS Chinook salmon populations are well below recovery escapement levels (NWFSC 2015). Most populations are also consistently below recovery spawner-recruit levels identified. Across the ESU, most populations have declined in abundance since the last status review in 2005, and trends since 1995 are mostly flat (NWFSC 2015). Abundance across the PS Chinook salmon ESU has generally decreased between 2010 and 2014, within only six small populations of 22 total populations showing a positive change in natural-origin spawner abundances.

Similarly, the PS steelhead remain at moderate risk of extinction. From 2010 to 2014, geometric means of natural spawners indicate relatively low abundance (12 of 20 populations with fewer than 500 spawners annually), and declining trends continue in approximately half of the populations throughout Puget Sound, particularly in southern Puget Sound and on the Olympic Peninsula (NWFSC 2015).Abundance of adult steelhead returning to nearly all Puget Sound rivers has fallen substantially since estimates began for many populations in the late 1970s and early 1980s.

The critical status of the affected species is related to degraded habitat, poor baseline conditions, and overharvesting. In general, baseline habitat conditions within Puget Sound rivers have been degraded chiefly by human development. Relevant habitat modifications include the channelization and diking of rivers, increase of impervious surfaces in most watersheds, simplification of river deltas, reduction in sediment supply due to beach armoring, and loss of tidal wetlands (Fresh et al. 2011). The extent of habitat changes significantly impairs several aspects of critical habitat and puts its function for listed salmonids at risk. Within the Elwha River, the removal of the dams has increased access to historical reaches. However, conditions are still degraded by high water temperatures and low flows during summer and fall, high magnitude of winter peak flows, and poor water quality due to high turbidity and suspended sediment.

For both Chinook and steelhead, factors limiting habitat include habitat quantity, riparian conditions, channel structure and form, side channel and wetland conditions, floodplain conditions, sediment conditions, and water quality and water quantity. The environmental baseline of the action area is degraded by and recovering from previous dam removals and is subject to excessive amounts of sediment and elevated water temperatures. The channel substrate has a high background level of sand and fine sediment following the removal of the Glines Canyon Dam, which released millions of cubic yards of stored sediment (Pess et al. 2014). The high levels of sand and fine sediment limit the probability that eggs in redds constructed in the action area by Chinook or steelhead will survive.

The baseline conditions of habitat are changing as a result of dam removals and have not reached a natural equilibrium. The cumulative effects will be related to timber harvest and very low-density residential development above the OHWM, which currently is not regulated by the COE and, thus, does not have a federal nexus. Such habitat alterations may influence critical habitat for listed species.

Climate change will increase pressure on the survival and recovery of salmonids in the Elwha River. Increased water temperatures can cause mortality from heat stress, changes in growth and development rates, and disease resistance. Behavioral responses to higher temperatures include shifts in seasonal timing of important life history events, such as the adult migration, spawn timing, fry emergence timing, and the juvenile migration. Indirect effects on salmon mortality, growth rates and movement behavior are also expected to follow from changes in the freshwater habitat structure and the invertebrate and vertebrate community, which governs food supply and predation risk. Both direct and indirect effects of climate change will vary among Pacific salmon ESUs and among populations in the same ESU. Adaptive change in any salmonid population will depend on the local consequences of climate change as well as ESU-specific characteristics and existing local habitat characteristics (NWFSC 2015).

We add the effects of the project to this status and baseline. Several effects are behavioral, with very little injury or death resulting. Handling and exposure to high turbidity are likely to cause a greater amount of injury or death. Latent health effects from exposure to stormwater are expected but impossible to quantify as an injury or mortality rate.

Even though we cannot quantify the number of individual salmonids that will be injured or killed from construction we expect that the overall numbers to be low based on timing to avoid peak presence, and BMPs designed to limit exposure. When both seasons of expected effects are considered in the context of 1) the species' threatened or endangered status, 2) the baseline, and 3) likely cumulative effects, the reduced abundance will be too few fish to influence the populations’ viability characteristic for productivity, and in turn are insufficient to distinguish any change in trends for spatial structure or diversity among the affected species. We also consider the long-term value of the ELJs, which are expected to increase habitat characteristics associated with increased survival over time, and which may, subsequent to this projects completion, increase abundance and productivity, and help improve spatial structure and diversity of the species.

Because the proposed action will not reduce the productivity, spatial structure, or diversity of the affected populations, the action, when combined with a degraded environmental baseline and additional pressure from climate change and cumulative effects, will not appreciably affect the status of PS Chinook salmon or PS steelhead.

2.7.2 Critical Habitat

Similarly, despite temporary impacts to features of PS steelhead critical habitat, the proposed action will not significantly reduce the conservation value of critical habitat in the action area or at the ESU scale in the near term, and may improve conservation values of the habitat in the long term.

Regarding downstream areas where eulachon critical habitat exists, the project will add stormwater enhanced treatment designs in an area where there are no existing treatment facilities. Due to the unknown persistence of 6-PPD-quinone, NMFS conservatively anticipates this chemical may be present for the entire length of the Elwha River from the US 101 Elwha River Bridge at rivermile 7.75 downstream to the mouth of the Strait of Juan de Fuca. The project will reduce, but not eliminate, the amount of contaminants reaching this critical habitat though the conservation value may incrementally improve.

2.8. 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, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of PS Chinook salmon, PS steelhead, and Pacific eulachon or destroy or adversely modify PS steelhead and Pacific eulachon designated critical habitats.

2.9. 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.

2.9.1 Amount or Extent of Take

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

- Take in the form of capture, Injury, and or Death will occur among juvenile PS Chinook salmon and juvenile PS steelhead and all life stages of eulachon.
- Take from capture of PS salmonids will occur at a higher level, but these fish will be released to adjacent stream areas.
- Injury and Death will occur among a subset of captured PS salmonids during worksite isolation.
- Take in the form of harm from exposure to elevated turbidity on PS salmonids.
- Take in the form of harm from shade/overwater structure among PS salmonids.
- Take in the form of harm from residual (post treatment) stormwater among PS salmonids and eulachon.

Although available information indicates that listed fish species may be present, the density of each species in the action area is unknown and can vary over time. Additionally, there is no way to observe or count the number of fish affected without potentially increasing the number of injured or killed fish. Therefore, NMFS cannot quantify the number of fish that will be exposed to in-water work related to the proposed action. NMFS instead quantifies the take based on the extent project impacts on habitat that can are causally related, and readily observed.

For this opinion, the extent of take is defined in Table 6.

Table 6. Extent of Take by Effect Pathway

Description of Take Mechanism	Maximum Numbers Affected or Area Affected
Fish capture Injury and Death from fish exclusion	Fish will be excluded from a diverted and dewatered area of 340,000 square feet (7.81 acres).
Harm from elevated turbidity (juvenile PS salmonids only)	Episodic elevated turbidity during construction will occur in approximately 5,000 linear feet of the width of the Elwha River channel. Incrementally this includes: 1300 ft upstream of bridge, 440 ft from bridge downstream to furthest upstream ELJ, 1,448 ft from furthest upstream ELJ to furthest downstream ELJ, and 1,800 feet downstream from furthest downstream ELJ to account for turbidity.
Harm from shade/overwater structure (juvenile salmonids only)	The new bridge will cover 15,710 square feet (6,190 square feet greater) and 9 feet to 17 feet higher than the existing bridge.
Harm from residual exposure to stormwater contaminants	From the new US 101 Elwha River Bridge at approximately rivermile 7.75 to the confluence with the Strait of Juan de Fuca.

2.9.2 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.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" (RPMs) are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). The RPMs are identical to those in the original Opinion but are reiterated here for clarity.

FHWA shall minimize take of PS Chinook salmon, PS steelhead, Pacific eulachon, and Southern Resident Killer Whales. The following reasonable and prudent measures are necessary and appropriate to minimize the take of those species. FHWA shall:

1. Minimize incidental take from worksite isolation and fish handling during construction activities;

2. Minimize incidental take from elevated levels of turbidity resulting from construction activities;

3. Minimize incidental take from stormwater contaminants; and

4. Ensure completion of a monitoring and reporting program to confirm that this opinion is meeting its objective of limiting the extent of take and minimizing take from permitted activities per 50 CFR 402.14(i)(1)(iv) and 50 CFR 402.14(i)(3).

2.9.4 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 FHWA 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 reasonable and prudent measure 1: [Worksite Isolation]

a) Intakes for all pumps used for the project have fish screens installed, operated, and maintained according to NMFS' fish screen criteria (NMFS 2011) or equivalent.

b) Any fish trapped in the in-water work area before dewatering will be herded out or removed and released to suitable habitat as near to the capture site as possible in compliance with the WSDOT Fish Exclusion Protocols and Standards (2016a) or equivalent.

c) ESA-listed fish are handled with extreme care; fish will be kept in water to the maximum extent possible during dewatering, capture, and transfer.

d) If electrofishing equipment is used to capture fish, it shall comply with WSDOT Fish Exclusion Protocols and Standards (2016a) or equivalent.

   i) Electrofishing will not be used if water temperatures exceed 64˚F (18˚C) or are expected to rise above 64˚F (18˚C), unless no other method of capture is available.

   ii) Water quality conditions are adequate in buckets or tanks used to transport fish by providing circulation of clean, cold water, using aerators to provide dissolved oxygen, and minimizing holding times.

   iii) NMFS, or its designated representative, is allowed to accompany the capture team during the capture and release activity, and to inspect the team's capture and release records and facilities.

2) The following terms and conditions implement reasonable and prudent measure 2: [Minimizing turbidity]

   a. Erosion control activities, including minimization measures and BMPs, are monitored and corrective actions are taken, if necessary, to ensure protection of riparian areas and eliminate the potential for BMPs failing along the river.

   b. An onsite representative will monitor water quality conditions during in-water work to monitor for construction-related exceedances. Should exceedances occur, in-water work activities shall be stopped until the plume dissipates within the work area.

3) The following term and condition implements reasonable and prudent measure 3 [Stormwater]

   a. Ensure regular maintenance of stormwater treatment structures.

4) The following terms and conditions implement reasonable and prudent measure 4: [Monitoring]

   FHWA shall ensure that <u>annual</u> monitoring items will include, at a minimum, the following:

   a. Project identification

      i. Project name: US 101 Elwha Bridge Replacement Project

      ii. NMFS Tracking Number: WCRO-2022-01905

      iii. WSDOT contact person.

b. Construction details

   i. Starting and ending dates of each completed in-water construction season.

   ii. Post-erosion control BMP photos.

   iii. A description of any elements of the project that were constructed differently than proposed.

   iv. Notification if water quality monitoring shows exceedances.

   v. Submit monitoring report by December 1 of each in-water work season to Projectreports.wcr@noaa.gov

2.10. 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 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).

NMFS has identified the following measures to further minimize or avoid adverse effects on listed species:

1. To retain all trees within the river system, all large trees removed from upland and riparian areas associated with the project shall be stockpiled and shall be placed on gravel bars or within the river following the completion of construction. Repurposing vegetation from the local site minimizes introducing invasive plants and contributes organic material to the Elwha River.

2. Use new/more effective stormwater treatment methods or protocols as options become available.

2.11. Reinitiation of Consultation

This concludes the reinitiation of formal consultation for US 101 Elwha River Bridge Replacement Project.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.12. "Not Likely to Adversely Affect" Determinations

Southern Resident Killer Whales

As described in section 1.2 and below, the NMFS has concluded that the proposed action would be not likely to adversely affect southern resident killer whales. Detailed information about the biology, habitat, and conservation status and trends of SRKW's can be found in the listing regulations and critical habitat designations published in the Federal Register, as well as in the recovery plans and other sources at: https://www.fisheries.noaa.gov/west-coast/endangered-species-conservation/southern-resident-killer-whale-orcinus-orca, and are incorporated here by reference.

The applicable standard to find that a proposed action is not likely to adversely affect listed species or critical habitat is that all of the effects of the action are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. The effects analysis in this section relies heavily on the descriptions of the proposed action and project site conditions discussed in Sections 1.3 and 2.3, and on the effects analyses presented in Section 2.4.

The SRKW DPS, composed of J, K and L pods, was listed as endangered under the ESA on November 18, 2005 (70 FR 69903), and the listing was revised in 2015 (80 FR 7380) to include captive SRKW Lolita (aka Tokitae). A 5-year status review under the ESA completed in 2016 concluded that SRKW should remain listed as endangered and includes recent information on the population, threats, and new research results and publications (NMFS 2016). The limiting factors described in the final recovery plan included reduced prey availability and quality, high levels of contaminants from pollution, and disturbances from vessels and sound (NMFS 2008). During the summer months, SRKWs predominantly feed on Chinook salmon in or near Puget Sound (Hanson et al. 2021).

Because SRKWs are limited to marine water habitats, they would not be directly exposed to any project-related effects. Still, they could possibly be exposed to indirect effects through the trophic web. The PS Chinook population would be affected by the proposed action and, as described in Sections 2.2 and 2.3, is extremely small when compared to historical numbers. Further, as described in Section 2.4, the proposed action would affect too few individuals annually to cause detectable population-level affects to PS Chinook. The total number of individuals, particularly Chinook salmon, affected by this project are expected to be inconsequential to supporting sufficient prey abundance to measurably affect SRKWs. Similarly, although some juvenile Chinook salmon would be exposed to stormwater discharges at the project site, their individual levels of contamination as well as the total numbers of annually exposed individuals would be too low to cause any detectable trophic link between the stormwater contaminants from this project and SRKWs. Therefore, the action is not likely to adversely affect SRKWs.

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 WSDOT and descriptions of EFH for Pacific Coast salmon (PFMC 2016) contained in the fishery management plan developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction to this document. The action area includes areas designated as EFH for Pacific Coast salmon but does not occur within a Habitat Area of Particular Concern.

3.2. Adverse Effects on Essential Fish Habitat

NMFS determined that the proposed action will have adverse effects on EFH designated for Pacific Coast salmon, based on information provided in the 2017 and 2022 biological assessments (Hall *et al.* 2017) and the analysis of effects presented in the ESA portion of this document. NMFS determined that the proposed action will adversely affect EFH by permanently reducing forage, rearing, and migration habitat and temporarily decreasing habitat value through the permanent removal of 0.4 acre and short-term removal of 2.5 acres of riparian vegetation and construction-related turbidity and altered hydrology.

The EFH of forage, rearing, and migrating habitat (314 square feet [0.007 acre]) will be affected by in-water structure (piers for bridge).

The EFH of riparian vegetation in the action area will be affected by removal of riparian vegetation (6.7 acres total: 0.4 acre permanent and 4.0 acre short-term).

The EFH within 1,300 feet upstream and 2,700 feet downstream of the construction area will be affected by increased turbidity and altered hydraulics during construction.

3.3. Essential Fish Habitat Conservation Recommendations

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

- Monitor riparian planting for minimum 80 percent survival over 3 years;
- Submit the following to NMFS: 1) a turbidity monitoring report by April 1 following each construction season, 2) a report, if applicable, that describes the disposition of creosote-treated wood; and
- Report any violations of WDFW's Hydraulic Project Approval or Ecology's requirements to NMFS.

Fully implementing these EFH conservation recommendations would protect, 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, FHWA 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 FHWA 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 FHWA and Corps of Engineers. Individual copies of this opinion were provided to the above-listed agencies. Other interested users could include WSDOT, Tribes, Clallam County, the State of Washington, and the general public. 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 and EFH consultation 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.

5. REFERENCES

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