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

Refer to NMFS No: WCRO-2022-00320

https://doi.org/10.25923/s9q5-1t53

May 13, 2022

Jacalen Printz
Chief, Regulatory Branch
U.S. Army Corps of Engineers, Seattle District
4735 East Marginal Way South, Bldg 1202
Seattle, WA 98134-2388

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Cowiche Canyon Trail Bridge, Yakima County, WA (6th field HUC: 170300020311 South Fork Cowiche Creek-Cowiche Creek)

Dear Ms. Printz:

Thank you for your letter of February 15, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA)(16 U.S.C. 1531 et seq.) for the Cowiche Canyon Trail Bridge.

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

After reviewing the current status of the species, the environmental baseline, the effects of the proposed action and the cumulative effects, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Middle Columbia River (MCR) steelhead (*O. mykiss*). NMFS also determined that the action will not destroy or adversely modify designated critical habitat. Rationale for our conclusions is provided in the attached biological opinion (opinion). The enclosed opinion is based on information provided in your biological assessment, email discussions, and other sources of information cited in the opinion.

As required by section 7 of the ESA, NMFS is providing an incidental take statement (ITS) with the opinion. The ITS includes reasonable and prudent measures (RPMs) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The ITS also sets forth terms and conditions, including reporting requirements, that the U.S. Army Corps of Engineers (Corps) must comply with to carry out the RPMs. Incidental take from actions that meet these terms and conditions will be exempt from the ESA's prohibition against the take of the listed species considered in this opinion.

This document also includes the results of our analysis of the action's effects on the EFH pursuant to section 305(b) of the MSA, and includes one Conservation Recommendation to avoid, minimize, or otherwise offset potential adverse effects on the EFH. Section 305(b)(4)(B) of the MSA requires federal agencies provide a detailed written response to NMFS within 30 days after receiving this recommendation.

Please contact Justin Yeager, Columbia Basin Branch, Ellensburg, Washington, at justin.yeager@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Enclosure

cc: [*File*]
Kirk Holmes - Perteet
David Moore – USACE
Madisen Norton – USFWS

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

Cowiche Canyon Trail Bridge

NMFS Consultation Number: WCRO-2022-00320

Action Agency: U.S. 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?
Middle Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

Consultation Conducted By: National Marine Fisheries Service, West Coast Region

Issued By: Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Date: May 13, 2022

TABLE OF CONTENTS

Table of Tables iii

Acronym List iv

1. Introduction 1

1.1. Background 1
1.2. Consultation History 1
1.3. Proposed Federal Action 2

2. Endangered Species Act: Biological Opinion And Incidental Take Statement 3

2.1. Analytical Approach 4
2.2. Rangewide Status of the Species and Critical Habitat 5
2.2.1. Status of the Species 5
2.2.2. Abundance, Productivity, Spatial Structure, and Diversity 7
2.2.3. Limiting Factors 9
2.2.4. Status of Critical Habitat 9
2.2.5. Interior Columbia Recovery Domain 11
2.2.6. Climate Change 12
2.3. Action Area 14
2.4. Environmental Baseline 14
2.5. Effects of the Action 15
2.5.1. Effects to Species 15
2.5.2. Effects to Critical Habitat 18
2.6. Cumulative Effects 19
2.7. Integration and Synthesis 20
2.8. Conclusion 22
2.9. Incidental Take Statement 22
2.9.1. Amount or Extent of Take 22
2.9.2. Effect of the Take 23
2.9.3. Reasonable and Prudent Measures 23
2.9.4. Terms and Conditions 23
2.10. Reinitiation of Consultation 24

3. Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response 25

3.1. Essential Fish Habitat Affected by the Project 25
3.2. Adverse Effects on Essential Fish Habitat 25
3.3. Essential Fish Habitat Conservation Recommendations 26
3.4. Statutory Response Requirement 26
3.5. Supplemental Consultation 27
4. Data Quality Act Documentation and Pre-Dissemination Review 27
4.1. Utility 27
4.2. Integrity 27
4.3. Objectivity 27
5. References 29

TABLE OF TABLES

Table 1. MCR steelhead DPS major population groups and component populations, and hatchery programs. MCR steelhead DPS major population groups and component populations, and hatchery programs. 6

Table 2. Summary of Middle Columbia steelhead Distinct Population Segment viability relative to Interior Columbia Technical Recovery Team viability criteria, grouped by major population group.. 8

Table 3. Physical and biological features of critical habitats designated for Endangered Species Act listed salmon and steelhead species considered in this opinion. 10

ACRONYM LIST

BE	Biological Evaluation
CFR	Code of Federal Regulations
City	City of Yakima
Corps	Unites States Army Corps of Engineers
DPS	Distinct Population Segment
DQA	Data Quality Act
EFH	Essential Fish Habitat
ESA	Endangered Species Act
FR	Federal Register
HUC	Hydrologic Unit Code
HUC5	fifth-field Hydrologic Unit Code
ICRD	Interior Columbia Recovery Domain
ICTRT	Interior Columbia Basin Technical Recovery Team
ITS	Incidental Take Statement
MaSA	Major Spawning Area
MCR	Middle Columbia River
MPG	Major Population Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NTU	Nephelometric Turbidity Units
OHWM	ordinary high-water mark
Opinion	Biological Opinion
PBF	Physical and Biological Feature
PCE	Primary Constituent Element
Project	Cowiche Canyon Bridge Project
Reclamation	U.S. Bureau of Reclamation
RPM	Reasonable and Prudent Measure
Sq. Ft.	Square Feet
U.S.C.	United States Code
USFWS	U. S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation

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

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 within 2 weeks in the NOAA Library Institutional Repository at https://repository.library.noaa.gov/welcome. A complete record of this consultation is on file at the Columbia Basin Branch Office, Ellensburg, Washington.

1.2. Consultation History

The Corps requested consultation on July 28, 2021. On August 11, 2021, we responded with a request for additional information that was necessary to analyze the potential effects of the project. On October 5, 2021, we participated in a phone conference hosted by the City of Yakima (City) and their agent (Perteet), who wanted to follow up with our request for more information. On November 5, 2021, we had not received the requested information from the Corps, and withdrew the consultation request.

The Corps sent a new request for formal consultation on February 14, 2022, along with a revised Biological Evaluation (BE). The request also included a memo addressing our questions from August 2021, and several attachments, including a completed Joint Aquatic Resources Permit Application form, an In-Water Work Water Quality Monitoring Plan, a Critical Areas Impacts and Conceptual Mitigation Plan, and a Hydraulic Project Approval permit. On March 4, 2022, we sent an email back to the Corps requesting additional information and suggesting a couple ways to minimize project effects. On March 7, 2022, the Corps provided the requested information and clarified that all actions and conservation measures identified in all of the attachments included with the revised BE are to be considered as part of the proposed action. We initiated formal ESA consultation for Middle Columbia River (MCR) steelhead, and consultation for MSA essential fish habitat for Pacific Coast salmon on March 7, 2022. The Corps sent additional clarification on the proposed action on March 10, 2022. On April 6, 2022, the Corps,

City, Perteet, NMFS and the U.S. Fish and Wildlife Service (USFWS) met via conference call to clarify additional details about the proposed action. We received a revised BE on April 15, 2022.

Per email notification from the Corps on March 7, 2022, the proposed action included conservation measures and activities in the documents submitted with the revised BE. During consultation, NMFS also coordinated with the USFWS, Washington Department of Fish and Wildlife (WDFW), and the Confederated Tribes and Bands of the Yakama Nation regarding minimization measures and knowledge of anadromous salmon occurrence and life-histories in Cowiche Creek. All of these information sources and communications were considered in NMFS determination of project effects.

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 (50 CFR 402.02). Under the 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 Corps is proposing to issue a Clean Water Act section 404 permit to the City to construct a recreation trail pedestrian bridge over Cowiche Creek. The bridge crossing site is located at 46° 37' 25.903" N, 120° 35' 7.130" W. The project is planned for 2022, but depending on the permitting process, may occur in 2023. The Corps proposed an in-water work window of July 15 through August 31.

The bridge will be constructed of concrete and steel with no treated wood. Each bridge abutment will be located landward of the ordinary high water mark (OHWM). There will also be two mid-span supports constructed using concrete supports set on top of micro-piled footings protected by riprap rock. One of these supports will need to be built within the wetted channel. The wetted channel support will have a footprint of 100 square feet. The City will also excavate 135 feet of legacy railroad grade (approximately 90 feet wide as estimated from Figure 5 in the BE) to below the 100-year flood elevation, which will restore 12,150 square feet of floodplain. There will be no impact pile driving. Construction will require both excavation and fill within the flood plain. The completed project will result in no-rise of the 100-year base flood elevation.

The contractor will be required to provide primary and secondary containment for concrete placement to prevent material from entering into the surrounding environment. Uncured concrete will not contact flowing water or groundwater. Any wastewater produced will not be infiltrated onsite.

The City of Yakima Public Works will install and maintain Temporary Erosion Sediment Controls and sediment control best management practices pursuant to Yakima County's currently approved Construction Stormwater Manual. Proposed water quality monitoring is documented in the "Cowiche Canyon Trail Bridge In-Water Work Water Quality Monitoring Plan", which accompanied the revised BE and is incorporated here by reference. The contractor will be required to prevent stream turbidity from extending beyond 200 feet from the project area. Sump holes will be installed to capture and pump turbid groundwater away from the work area. Pump intakes will be screened following (NMFS 2011c) specifications. Turbidity will not

exceed 5 nephelometric turbidity units (NTU) over background turbidity of 50 NTU or less, or have more than a 10 percent increase in turbidity if background is more than 50 NTU.

The construction area will be isolated from flow by a cofferdam. Fish will be relocated out of and excluded from the area to be dewatered, pursuant to Washington State Department of Transportation (WSDOT) protocols (WSDOT 2021). Cowiche Creek will then be diverted through a culvert past the construction footprint, so construction activities will be isolated from flowing water. A total of 2,100 square feet of streambed will be dewatered during the July 15 through August 31 in-water work window.

Riprap necessary for bridge scour protection will be buried and the disturbed streambed will be covered with appropriate substrate to restore the pre-construction channel grade. Also, excavation of 135 feet of legacy railroad grade will create additional floodplain connectivity.

Construction activities will disturb 10,800 square feet of riparian vegetation (predominantly herbaceous with some scrub/shrub impact) and 4,050 square feet of wetland vegetation (predominantly emergent vegetation). Any riparian vegetation that will be cut during construction will be placed in the stream to mimic allochthonous input, and to add habitat complexity. The applicant will replant disturbed wetland and riparian areas with native species at a 2:1 ratio. The City of Yakima and its agents will be responsible for monitoring the new riparian plantings and ensuring they meet performance standards as identified in the "Cowiche Canyon Trail Bridge Critical Areas Impacts and Conceptual Mitigation Plan."

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that construction of new sections of trail (approximately 4,065 feet along Cowiche Creek) would be a related activity. This activity will result in approximately 64,400 square feet of scrub-shrub riparian vegetation removal for trail construction. The City will replant the disturbed riparian area with native species at a 2:1 ratio. This planting will occur at disturbed areas adjacent to Cowiche Creek and on the south and east side of the stream for increased shade function. We considered the effects of this activity in our analysis.

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.

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 MCR 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.

2.2. Rangewide Status of the Species and Critical Habitat

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

2.2.1. Status of the Species

For Pacific salmon, steelhead, and other relevant species, NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany et al. 2000). These "viable salmonid population" (VSP) criteria therefore 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. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

"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 fundamentally 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 at 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, NMFS assesses 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 area affected by the proposed action in Cowiche Creek is occupied by Middle Columbia River (MCR) steelhead. The MCR steelhead Distinct Population Segment (DPS) was listed as threatened under the ESA on January 5, 2006 (71 FR 834). Critical habitat for the DPS was designated on September 2, 2005 (70 FR 52630). The summary that follows describes the status of MCR steelhead and its designated critical habitat considered in this opinion. More detailed information can be found in the listing regulations and critical habitat designations published in the Federal Register (FR), the most recent draft 5-year status review (NMFS 2022), applicable recovery plans (NMFS 2009; YBFWRB 2009), and biological viability assessment reports (Ford 2022). These additional documents are incorporated by reference.

The MCR steelhead DPS is comprised of 17 independent populations within four Major Population Groups (MPGs) in Washington and Oregon. This DPS includes all naturally-spawned populations of steelhead (and their progeny) in streams from above the Wind River, Washington, and the Hood River, Oregon (exclusive), upstream to, and including, the Yakima River, Washington, excluding steelhead from the Snake River Basin. Seven artificial propagation programs are considered part of the DPS: Touchet River Endemic, Yakima River Kelt Reconditioning Program (in Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River), Umatilla River, and the Deschutes River steelhead hatchery programs (Table 1).

Table 1. MCR steelhead DPS major population groups and component populations, and hatchery programs.

Major Population Group (MPG)	**Populations**
Cascades Eastern Slope Tributaries	Deschutes River Eastside Deschutes River Westside Fifteenmile Creek* Klickitat River* Rock Creek* White Salmon* (extirpated) Deschutes Crooked River (extirpated)
John Day River	John Day River Lower Mainstem Tributaries John Day River Upper Mainstem Tributaries North Fork John Day River Middle Fork John Day River South Fork John Day River
Yakima River	Naches River Satus Creek Toppenish Creek Yakima River Upper Mainstem

Major Population Group (MPG)	Populations
Umatilla/Walla Walla Rivers	Touchet River Umatilla River Walla Walla River Willow Creek (extirpated)
Hatchery Programs	
Hatchery programs included in DPS	Touchet River Endemic Yakima River Kelt Reconditioning (four programs: Satus Creek, Toppenish Creek, Naches River, and Upper Yakima River) Umatilla River Program Deschutes River Program

Populations with an asterisk (*) are winter-run steelhead populations. All other populations are summer-run steelhead populations.

The life history characteristics for MCR steelhead are similar to those of other inland steelhead DPSs. Most fish smolt at 2 years and spend 1 to 2 years in salt water before re-entering freshwater, where they may remain up to a year before spawning (Howell et al. 1985). All steelhead upstream of the Dalles Dam are summer-run (Reisenbichler et al. 1992) fish that enter the Columbia River from June to August. Adult steelhead ascend mainstem rivers and their tributaries throughout the winter, spawning in the late winter and early spring. Fry emergence typically occurs between May and the end of June.

2.2.2. Abundance, Productivity, Spatial Structure, and Diversity

The following information is from Ford (2022): There has been functionally no change in the viability ratings for the component populations, and the MCR steelhead DPS does not currently meet the viability criteria described in the Mid-Columbia Steelhead Recovery Plan. In addition, several of the factors cited by the 2005 Biological Review Team remain as concerns or key uncertainties. While recent (5-year) returns are declining across all populations, the declines are from relatively high returns in the previous 5-10 year interval, so the longer-term risk metrics that are meant to buffer against short period changes in abundance and productivity remain unchanged Ford (2022).

Natural-origin spawning estimates are highly variable, relative to minimum abundance thresholds across the populations in the DPS (Table 2). Two of the four MPGs in this DPS include at least one population rated at low/very low risk for abundance and productivity, while the other two MPGs remain in the moderate/high risk range. Updated information indicates that stray levels into the John Day River populations have decreased in recent years. Out of basin hatchery stray proportions, although reduced, remain high in spawning reaches within the Deschutes River basin and the Walla Walla/Umatilla and Touchet populations. Overall, the MCR steelhead DPS remains at moderate risk of extinction, with viability unchanged from the prior review.

Table 2. Summary of Middle Columbia steelhead Distinct Population Segment viability relative to Interior Columbia Technical Recovery Team viability criteria, grouped by major population group.

Population	Abundance and Productivity Metrics				Spatial Structure and Diversity Metrics			Overall Viability Rating
	ICTRT Minimum Threshold	*Natural Spawning Abundance*	*ICTRT Productivity*	*Integrated A/P Risk*	*Natural Processes Risk*	*Diversity Risk*	*Integrated SS/D Risk*	
Eastern Cascades MPG								
Fifteen Mile Creek	500	378 (sd. 170)	2.12 (0.19 8/20)	Moderate	Very Low	Low	Low	Maintained
Deschutes (Westside)	1,500 (1,000)	538 (sd. 306)	1.10 (0.15 18/20)	High	Low	Moderate	Moderate	High Risk
Deschutes (Eastside)	1,000	604 (sd. 453)	1.75 (0.29 7/20)	Moderate	Low	Moderate	Moderate	Maintained
Klickitat River	1,000	1,462 (sd. 919)	1.07 (0.12 8/20)	Moderate	Low	Moderate	Moderate	Maintained
Rock Creek	500	298 (sd. 232)		High	Moderate	Moderate	Moderate	High Risk
Crooked River (ext.)	*2,000*							*Extirpated*
White Salmon R. (ext.)	*500*							*Extirpated (recolonizing)*
Yakima River MPG								
Satus Creek	1,000 (500)	1,064 (sd. 777)	1.92 (0.30 3/20)	Low	Low	Moderate	Moderate	Viable
Toppenish Creek	500	407 (sd. 231)	3.35 (0.23 9/20)	Moderate	Low	Moderate	Moderate	Maintained
Naches River	1,500	1,340 (sd. 601)	2.00 (0.23 6/20)	Moderate	Low	Moderate	Moderate	Maintained
Upper Yakima River	1,500	346 (sd. 129)	1.73 (0.15 20/20)	Moderate	Moderate	High	High	High Risk
John Day River MPG								
Lower John Day	2,250	1,424 (sd. 1,026)	2.72 (0.19 12/20)	Moderate	Very Low	Moderate	Moderate	Maintained
Middle Fork John Day	1,000	3,371 (sd. 1811)	4.49 (0.27 8/20)	Very Low	Low	Moderate	Moderate	Viable
North Fork John Day	1,000	1,852 (sd. 1343)	3.31 (0.16 2/20)	Very Low	Very Low	Low	Low	Highly Viable
South Fork John Day	500	943 (sd. 552)	2.45 (0.29 10/20)	Very-Low	Very Low	Moderate	Moderate	Viable
Upper John Day	1,000	738 (sd. 418)	1.56 (0.16 14/20)	Moderate	Very Low	Moderate	Moderate	Maintained
Umatilla/Walla Walla MPG								
Umatilla River	1,500	2,747 (sd. 1,108)	0.98 (0.27 6/20)	Moderate	Moderate	Moderate	Moderate	Maintained
Walla Walla River	1,000	713 (sd. 511)	1.79 (0.18 8/20)	Moderate	Moderate	Moderate	Moderate	Maintained

Population	Abundance and Productivity Metrics				Spatial Structure and Diversity Metrics			Overall Viability Rating
	ICTRT Minimum Threshold	***Natural Spawning Abundance***	***ICTRT Productivity***	***Integrated A/P Risk***	***Natural Processes Risk***	***Diversity Risk***	***Integrated SS/D Risk***	
Touchet River	1,000	253 (sd. 222)	0.91 (0.09 19/20)	High	Low	Moderate	Moderate	High Risk

Range in annual abundance, standard deviation (sd.) and number of qualifying estimates for productivities in parentheses.
ICTRT: Interior Columbia Basin Technical Recovery Team

The ESA recovery plan for MCR steelhead includes delisting criteria for the DPS, based on the status of natural-origin MCR steelhead assessed at the population level (NMFS 2009). Cowiche Creek steelhead are part of the Naches River population in the Yakima River MPG. To achieve viable status for the Yakima MPG, two populations should be rated as viable, including at least one of the two classified as large-the Naches River or the Upper Yakima River. Neither large population currently meets viable status. The other two populations in the Yakima MPG should be rated as maintained.

2.2.3. Limiting Factors

The most significant factors limiting productivity of the MCR steelhead DPS include: (1) mainstem Columbia River hydropower adverse effects (e.g., modified hydrograph, increase in lentic conditions, passage barriers, increased stream temperatures, and increased predators); (2) riparian degradation and large wood recruitment; (3) altered floodplain connectivity and function; (4) reduced streamflow; (5) water quality; and (6) predation and competition (NMFS 2011b). Within the Yakima Basin, the U.S. Bureau of Reclamation's (Reclamation) operation of the Yakima Project and subsequent diversion of irrigation water is the single largest limiting factor. Climate change is also identified as a significant threat to MCR steelhead. Crozier et al. (2019b) concluded that the MCR steelhead DPS has a high risk of overall climate vulnerability based on its high risk for biological sensitivity, high risk for climate exposure, and moderate capacity to adapt.

2.2.4. Status of Critical Habitat

This section examines the status of designated critical habitat affected by the proposed action by examining the condition and trends of PBFs 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).

For salmon and steelhead, NMFS ranked watersheds within designated critical habitat at the scale of the fifth-field hydrologic unit code (HUC5) in terms of the conservation value they provide to the listed species they support. The conservation rankings are high, medium, or low. To determine the conservation value of each watershed to species viability, NMFS' critical habitat analytical review teams evaluated:

- The quantity and quality of habitat features (e.g., spawning gravels, wood and water condition, side channels).

- The relationship of the area compared to other areas within the species' range.
- The significance of the population occupying that area to the species' viability criteria.

Thus, even a location that has poor quality habitat could be ranked as 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 the fact that it serves another important role (e.g., obligate area for migration to upstream spawning areas).

Table 3 describes the PBFs of the habitat types within the full range of habitat designated as critical for the listed salmonid species. Range-wide, all habitat types are impaired to some degree, even though many of the watersheds comprising the fully designated area are ranked as providing high conservation value. The proposed action, however, affects only freshwater habitats.

Table 3. Physical and biological features of critical habitats designated for Endangered Species Act listed salmon and steelhead species considered in this opinion.

Physical and Biological Features		**Species Life History Event**
Site Type	**Site Attribute**	
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
Offshore marine areas	Forage Water quality	Adult growth and sexual maturation Adult spawning migration Subadult rearing

The PBFs 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. These features are essential to conservation, because without them the species cannot successfully spawn and produce offspring.

The PBFs 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.

2.2.5. Interior Columbia Recovery Domain

Habitat quality in tributary streams in the Interior Columbia Recovery Domain (ICRD) range from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (NMFS 2009; Wissmar et al. 1994). Critical habitat throughout much of the ICRD has been degraded by agriculture, alteration of stream morphology (e.g., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas.

Migratory habitat quality in this area has been affected by the development and operation of the Columbia River System dams and reservoirs in the mainstem Columbia River, Reclamation tributary projects, and privately owned dams in the Snake and Upper Columbia River basins. For example, construction of Hells Canyon Dam eliminated access to several likely production areas in Oregon and Idaho, including the Burnt, Powder, Weiser, Payette, Malheur, Owyhee, and Boise river basins (Good et al. 2005), and Grand Coulee and Chief Joseph dams completely block anadromous fish passage on the upper mainstem Columbia River.

Hydroelectric development modified natural flow regimes, resulting in higher water temperatures, changes in fish community structure leading to increased rates of piscivorous and avian predation on juvenile salmon and steelhead, and delayed migration for both adult and juveniles. Physical features of dams such as turbines also kill migrating fish. In-river survival is inversely related to the number of hydropower projects encountered by emigrating juveniles. Similarly, development and operation of extensive irrigation systems and dams for water withdrawal and storage in tributaries have altered hydrological cycles.

Many stream reaches designated as critical habitat in the ICRD are over-allocated, with more allocated water rights than existing streamflow conditions can support. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increase summer stream temperatures, block fish migration, strand fish, and alter sediment transport (Spence et al. 1996). Reduced tributary stream flow has been identified as a major limiting factor for MCR steelhead in the ICRD (NMFS 2011a; NMFS 2022).

Despite these degraded habitat conditions, the HUCs that have been identified as critical habitat for this species are largely ranked as having high conservation value. Conservation value reflects several factors, including: (1) how important the area is for various life history stages, (2) how necessary the area is to access other vital areas of habitat, and (3) the relative importance of the populations the area supports relative to the overall viability of the DPS.

The action area of the proposed project falls within the Tieton River-Naches River HUC5. This HUC was assigned a High conservation value rating because it has a Moderate-High HUC5 score and PBFs that support one of four demographically independent populations in the Yakima River group (NOAA Fisheries 2005). The proposed action has the potential to affect the freshwater spawning, rearing, and migration PBFs.

2.2.6. Climate Change

One factor affecting the rangewide status of salmon and steelhead, including MCR steelhead and aquatic habitat is climate change. Major ecological realignments are already occurring in response to climate change (Crozier et al. 2019a). As observed by Siegel & Crozier (2020), long-term trends in warming have continued at global, national and regional scales. The five warmest years in the 1880 to 2019 record have all occurred since 2015, while 9 of the 10 warmest years have occurred since 2005 (Lindsey & Dahlman 2020).

Climate change is predicted to cause a variety of impacts to Pacific salmon and their ecosystems (Crozier et al. 2008; Dalton & Fleishman 2021; Martins et al. 2012; Mote et al. 2003; Mote et al. 2019; Wainwright & Weitkamp 2013). The complex life cycles of anadromous fishes, including steelhead, rely on productive freshwater, estuarine, and marine habitats for growth and survival, making them particularly vulnerable to environmental variation. Ultimately, the effects of climate change on salmon and steelhead across the Columbia Basin will be determined by the specific nature, level, and rate of change and the synergy among interconnected terrestrial/freshwater, estuarine, nearshore, and ocean environments. Climate change and anthropogenic factors continue to reduce adaptive capacity in Pacific salmon as well as altering life history characteristics and simplifying population structure.

The primary effects of climate change on Pacific Northwest salmon and steelhead are (Crozier et al. 2016; Crozier et al. 2021):

- Direct effects of increased water temperatures on fish physiology and increased susceptibility to disease.
- Temperature-induced changes to stream flow patterns which can block fish migration, trap fish in dewatered sections, dewater redds, introduce non-native fish, and degrade water quality.
- Alterations to freshwater, estuarine, and marine food webs, which alter the availability and timing of food resources.
- Changes in estuarine and ocean productivity, which have changed the abundance and productivity of fish resources.

The Recovery Plan identified the following potential effects of climate change on MCR steelhead (NMFS 2009):

- Egg incubation: The potential for increased mortality exists due to increased flood events in early spring resulting in greater redd scouring and dewatering of redds due to low spring flows. Increased temperatures will result in accelerated embryo development and earlier fry emergence.

- Fry emergence and colonization: Warmer spring temperatures will likely result in earlier fry emergence. Fry emergence timing is critical for successful colonization, thus altered emergence timing may reduce success in colonizing quality habitat and increase mortality.

- Summer rearing: Most MCR steelhead spend a minimum of two summers rearing prior to smolt seasonal migration. Reduced summer flows and increased temperatures will affect both the quality and quantity of summer rearing habitat. Summer temperatures currently limit habitat quality and quantity in most Oregon Mid-Columbia populations. Lower flows and warmer temperatures have the potential to influence steelhead in many ways.

- Overwinter Rearing: Climate change has the potential to influence growth and survival including: Reduced growth rates resulting from higher metabolic demands and low available food resources.

- Smolt Migration: Climate change has the potential to influence migration timing and survival.

- Smolt-to-Adult Ocean Rearing: Climate change has the potential to influence survival, growth, and age-at-maturation.

- Adult Migration and Holding: Climate change has the potential to influence migration timing, survival, and straying.

- Adult Spawning: Climate change has the potential to influence spawn timing and spawner distribution.

Crozier et al. (2019b) concluded that the MCR steelhead DPS has a high risk of overall climate vulnerability based on its high risk for biological sensitivity, high risk for climate exposure, and moderate capacity to adapt. The adult freshwater stage was rated the most highly vulnerable life stage due to high summer stream temperatures. MCR steelhead scored moderate in adaptive capacity due to habitat loss and degradation.

Current information indicates that climate change will continue, and the effects to salmon and steelhead will increase. With expected diminished snowpacks, lower June through September stream flows, and higher summer water temperatures, climate change will have negative implications for MCR steelhead survival and recovery into the future.

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 total stream length and associated riparian zones comprising the action area will be 4,065 feet. This total includes the construction footprint directly related to the bridge and the Corps' permit, beginning at the upstream end of the proposed left bank abutment, and continuing downstream, accounting for the two bridge piers and the right bank abutment. This total also includes the rest of the proposed section of new trail, which is outside of the Corps' jurisdiction, but is associated with the bridge in order to have a functional trail. This action area will account for potential effects from in-channel work, such as benthic disturbance and suspended sediments, and for riparian vegetation removal.

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).

Cowiche Creek is occupied by steelhead from the Naches population of the Yakima MPG. The location of the Cowiche major spawning area (MaSA), along with the Ahtanum Creek MaSA, between the Satus and Toppenish populations and the remainder of the Naches River population make them important components of the spatial diversity of the population and the Yakima MPG as a whole (YBFWRB 2009). This indicates the importance of Cowiche Creek in supporting recovery of the Naches River population, and thus the need to protect and enhance the spawning, rearing, and migration physical and biological features of critical habitat.

We found very little steelhead data specific to Cowiche Creek. Steelhead spawning occurs in Cowiche Creek and in South Fork Cowiche Creek per the WDFW SalmonScape map which was accessed March 9, 2022, at https://apps.wdfw.wa.gov/salmonscape/map.html. Steelhead tend to not spawn much below the canyon (E. Barton, Area Habitat Biologist, WDFW, personal communication, March 3, 2022). Karp et al. (2009) located radio-tagged adult steelhead in Cowiche Creek, but did not report if they spawned there. Fry emergence from redds is estimated to occur from early June through mid-July (YSFWPB 2004). Thus, adult steelhead migrate through, and potentially spawn in, the action area. Juvenile steelhead are likely to occur in the action area, at least seasonally when water temperatures are suitable.

Steelhead passage into Cowiche Creek was eliminated or greatly reduced through the 20th century, but recent diversion improvements have reopened the watershed. Irrigation diversions

and other water withdrawals reduce streamflows from April through October. These low flows and associated increased temperatures limit the availability of summer and early fall rearing habitat and create passage barriers for migrating and rearing steelhead (YBFWRB 2009). Maximum summer water temperatures ranged from 23° to 27.7°C in lower Cowiche Creek in 2004 (Washington State Department of Ecology 2008). In the middle and upper portions of Cowiche Creek, livestock have negatively impacted riparian zones by grazing and trampling streambanks. Past forest practices and road networks have also affected Cowiche Creek. Home development is often located adjacent to streambanks in parts of the Cowiche Creek watershed (YBFWRB 2009). These factors reduce riparian, floodplain, and instream habitat function, and constrain natural river processes; all identified as limiting factors in the 2009 Yakima Steelhead Recovery Plan (YBFWRB 2009).

The following description of the environmental baseline in action area is summarized from the BE. Vegetation within the riparian corridor is composed of a densely stocked native deciduous shrub community in close adjacency to the trail with disturbed areas at and near the bridge crossing comprised of herbaceous and shrub vegetation. The stream, in the vicinity of the study area, is an incised riffle (pool and riffle by late summer) watercourse having little to no meander constrained by historic human alterations. Substrates consist of fine gravels and cobbles through the riffles and interspersed with sands in a beaver dam pool that occurs northeast (downstream) of the proposed bridge crossing. Small woody debris and dense overhanging vegetation are present throughout the study area stream length.

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 (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 (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).

2.5.1. Effects to Species

Species Presence in the Action Area

Middle Columbia River steelhead from the Naches River population use the action area as a migration corridor, and potentially for spawning and rearing. Juvenile steelhead rear year-round in their natal streams, so could be present during the July 15 to August 31 in-water work window, if water temperatures are cool enough. For this analysis, we assume juvenile steelhead will be present during the in-water work. Adult steelhead are highly unlikely to be in the action area during in-water work because spawning typically occurs from March into May in the Naches Basin, and adults will have spawned, died, or left the stream before the in-water work window.

Juvenile steelhead will be affected directly by construction activities, including work site isolation and fish salvage, by exposure to increased suspended sediment concentrations, and by blocked upstream movement. Indirectly, juveniles could experience reduced forage availability.

Work Site Isolation and Fish Salvage

Work site isolation and fish salvage protocols will help minimize effects (WSDOT 2021). We reviewed data from five fish surveys and one fish salvage event from 2009 to 2017 (WDFW, unpublished data) on Cowiche Creek. On average, those efforts yielded 0.4 juvenile *O. mykiss* per linear foot of stream length. From drawings provided with the BE, we estimate that about 200 feet of stream will be dewatered during construction. Thus, we estimate that about 80 juvenile *O. mykiss* will be present prior to cofferdam installation and dewatering, which we assume will all be steelhead. We do not expect any fish to be crushed during cofferdam installation due to the very small scale of the cofferdam needed, and the likelihood that fish will flee the immediate area of disturbance. After the cofferdam is in place, we expect that most juveniles will volitionally move to areas that remain wetted as water levels decrease during work site isolation. Per the WSDOT fish exclusion protocol, a seine will also be used to herd fish out of the isolation area during dewatering. Thus, very few juveniles will remain in the 2,100-square foot work site isolation footprint. Most of the remaining trapped fish will be rescued with dip nets. Due to the small isolation footprint and efforts to remove fish before being completely dewatered, we expect that very few juvenile steelhead will be trapped in the dewatered work site and die.

Suspended Sediments

Streambed disturbance during construction will re-suspend small quantities of fine sediment. In some instances, increased suspended sediment concentrations can be so great as to cause lethal, sub-lethal, and behavioral effects in juvenile and adult salmonids (Newcombe & Jensen 1996). Several parameters may be considered when evaluating the effects of increased suspended sediment on salmonids including the level of increase, along with the duration, timing, and frequency of that increase (Bash et al. 2001).

We expect that substrate disturbance and resulting sediment plumes will be episodic during cofferdam placement and removal. Once the barrier is in place, suspended sediments will be contained within the isolated work site. The contractor will prevent any turbidity from extending beyond 200 feet from the isolated area through the use of best management practices. Per their Water Quality Monitoring Plan, if sampling indicates an exceedance of water quality standards, the contractor will stop work immediately and make adjustments to prevent the issue from reoccurring. Therefore, we expect that the duration that juvenile steelhead will be exposed to increased suspended sediment concentrations will be too short to cause harm or harassment, based on criteria outlined in Newcombe & Jensen (1996). Some juvenile steelhead exposed to slight increases in suspended sediment may respond with temporary behavioral changes, including changes in feeding and movement (Berg & Northcote 1985). However, the temporary nature of these behavioral responses will not result in decreased fitness, or fish being injured or killed.

Blocked Movements

Routing Cowiche Creek around the work site in a culvert will allow fish to move down but not upstream past the work site during the July 15 through August 31 in-water work window. Summer up- and downstream juvenile movements are likely localized (i.e., they are not yet emigrating) in order to find food and cover habitat as flows decrease or water temperatures change. We expect that a few individuals will be prevented from moving upstream in Cowiche Creek and as a result, they may be exposed to conditions that cause reduced growth and increased predation.

Reduced Forage Availability

Construction-related activities have the potential to affect juvenile salmonid forage. Approximately 2,100 square feet of benthic habitat will be disturbed due to stream dewatering. This disturbance will kill or displace benthic invertebrates and slightly reducing available forage. The mid-span support that will occur in the wetted channel (the second support will occur in the dry) will replace 100 square feet of substrate, preventing benthic forage production in the footprint. A total of 75,200 square feet of riparian vegetation (including bridge and trail clearing) and 4,050 square feet of wetland vegetation removal will cause some loss of allochthonous input, such as leaf litter and terrestrial insect fallout. This vegetation is mostly short, scrub-shrub plants, and includes few trees.

Aquatic invertebrates could start recolonizing within days to months after construction (Fowler 2004; Korsu 2004; Miller & Golladay 1996; Paltridge et al. 1997). Some aquatic insect life cycles can extend up to 3 years (Hilsenhoff 1981; Pennak 1953), but most aquatic insects in the north temperate zone have an annual life cycle (Merritt & Cummins 1996). We estimate that recolonization of the disturbed area, with the exception of the mid-span support footprint, will begin within a year.

Any riparian vegetation that will be cut during construction will be placed in the stream to mimic allochthonous input. This will help provide some forage production, helping minimize construction effects. The City will replant over twice the area of riparian vegetation as what they will remove. This additional riparian enhancement will help minimize the loss of allochthonous input. Excavation of 135 feet of railroad prism will partially restore more normative river processes. This will increase aquatic habitat diversity and nutrient transfer from the floodplain, which will improve juvenile steelhead forage production in the long-term.

Together, the benthic habitat disturbance and loss of allochthonous input will slightly decrease potential forage production and availability to juvenile steelhead in the short-term. Forage availability will begin to increase again within about a year after construction, except within the mid-span support footprint. Due to the expected low density of juvenile steelhead rearing in the action area, we believe this slight decrease in forage production will be too small to cause competition for forage, or a decrease in growth or survival.

2.5.2. Effects to Critical Habitat

The PBF characteristics (site attributes) that may be affected by the proposed action are migration, substrate, water quality, and forage.

Migration Free of Artificial Obstruction

Routing Cowiche Creek around the work site in a culvert will allow fish to move down but not upstream past the work site during construction. This temporary block to upstream movement will very slightly and reduce the ability of some juveniles to productively rear. The result is a minor and temporary reduction in the conservation value of critical habitat with respect to this PBF.

Substrate

In the short term, the substrate within the isolated work site will be dewatered and not accessible to foraging juvenile steelhead during construction. For the long term, the City will re-cover the disturbed streambed with substrate to restore the pre-construction channel grade. The wetted channel mid-span support will replace 100 square feet of substrate, a small, though permanent, impairment to benthic forage production and to spawning gravel access. However, railroad grade excavation will partially restore more normative river processes. This will increase aquatic habitat diversity and nutrient transfer from the floodplain, which will improve juvenile steelhead forage production in the long-term. This will also increase opportunities for spawning gravel recruitment and sorting. Because little steelhead spawning occurs in the lower (canyon) reach of Cowiche Creek (E. Barton, Area Habitat Biologist, WDFW, personal communication, March 3, 2022), we do not expect a loss of steelhead spawning opportunities in the action area. Thus, the conservation value of critical habitat with respect to the substrate PBF will be very minimally reduced.

Because the city will isolate the construction area from flow by a cofferdam, and will follow WSDOT dewatering protocols, we expect that only very small amounts of fine sediment will be carried downstream during construction. Stream flow will disperse these fine sediments enough that downstream deposition will not measurably affect substrate embeddedness. In the long term, high flows the following spring will further disperse these fines, restoring the action area to its pre-construction condition before the steelhead spawning season.

Floodplain Connectivity

Excavating 135 feet of legacy railroad prism to below the 100-year flood elevation will create additional floodplain connectivity above the pre-project baseline. This is a beneficial effect as it will allow for more nutrient transfer to aid forage production, potential side-channel habitat development, and hyporheic exchange that may help keep stream temperatures cool in summer. Thus, there will be a long-term increase in the conservation value of critical habitat with respect to the floodplain connectivity PBF.

Water Quality

Construction activities will slightly increase suspended sediments for short periods. Most sediments will be confined to the isolated areas where turbid water will be pumped to an upland area for soil infiltration. The contractor will also ensure that turbidity will not exceed 5 NTU over background turbidity of 50 NTU or less, or have more than a 10 percent increase in turbidity if background is more than 50 NTU. Water quality will return quickly to background levels once the cofferdam is removed.

Though not quantified, drawings, photos, and descriptions provided with the BE indicate that shade loss will occur due to riparian vegetation removal. This vegetation is mostly short, scrub-shrub plants, and includes few trees. This shade loss has the theoretical potential to increase summer water temperatures; though we expect that this relatively small disturbance will not influence stream temperature. The new plantings will replace shade that will be lost during construction, though there will be a lag time of up to several years until the new plants are large enough to provide shade comparable to pre-project conditions. However, the city will replant twice the total riparian area disturbed by construction, which will result in a long-term gain of the shaded area of Cowiche Creek relative to pre-project conditions.

Forage

Construction activities will kill or displace benthic invertebrates while riparian vegetation removal will decrease allochthonous input, reducing available forage. On a stream reach scale, these habitat disturbances will be small and will not be permanent, with recovery expected to begin within a year of construction. Any riparian vegetation that will be cut during construction will be placed in the stream to mimic allochthonous input, which will provide for some forage production. In the long term, the new riparian plantings will cover twice the area of vegetation that was removed, helping minimize the allochthonous input effect. Excavation of 135 feet of railroad prism will partially restore more normative river processes. This will increase aquatic habitat diversity and nutrient transfer from the floodplain, which will improve juvenile steelhead forage production in the long-term.

In summary, the migration, substrate, floodplain connectivity, water quality, and forage PBF attributes will be slightly affected due to the temporary blockage of juvenile steelhead upstream movements, replacement of 100 square feet of wetted-channel substrate with the mid-span support, temporary suspended sediment increases, shade loss until new riparian plantings are re-established, and a slight, short-term loss of forage production. In the long term, the new plantings will improve riparian function, including increased shade and allochthonous input. Excavation of the railroad grade will allow for more nutrient transfer to aid forage production, potential side-channel habitat development, and for hyporheic exchange that may improve stream temperatures. Therefore, the proposed action will not decrease the conservation value of critical habitat within the action area.

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.

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).

In the Yakima Steelhead Recovery Plan, the YBFWRB (2009) reports that rapid human population growth and development is occurring in Yakima County. In many areas, forest and agricultural lands are being converted to residential, commercial, and industrial uses. This development is often located adjacent to streambanks, which can result in the reduction or elimination of riparian zones and increased flood hazards. The probability of conflict between new land uses and floodplain and stream channel functions (which sustain fish habitat and conveyance of water and sediment) is high (YBFWRB 2009). Development of the floodplain in the action area is expected to continue, though impacts will be ameliorated to some degree through more modern floodplain and environmental protection regulations.

Various habitat restoration projects (e.g., fish passage restoration, floodplain restoration) have been implemented on Cowiche Creek, and NMFS assumes that they will continue (YBFWRB 2020). Some of these projects may not require Federal authorization or funding, and therefore they will contribute to cumulative effects. Because these are habitat restoration actions, we expect only short-term construction effects to steelhead or their habitat (e.g., periods of increased suspended sediments), with beneficial long-term effects, including improved riparian and floodplain function.

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.

The MCR steelhead DPS does not currently meet the viability criteria described in the Mid-Columbia Steelhead Recovery Plan. Cowiche Creek steelhead contribute to the Naches River population, which is not meeting viability criteria. The location of the Cowiche MaSA, along with the Ahtanum Creek MaSA, between the Satus and Toppenish populations, and the remainder of the Naches River population make them important components of the spatial diversity of the population and the Yakima MPG as a whole (YBFWRB 2009). The main

limiting factor within the Yakima Basin includes Reclamation's operation of the Yakima Project and subsequent diversion of irrigation water.

Low flows and associated increased temperatures due to irrigation diversions and other water withdrawals limit the availability of summer and early fall rearing habitat and create passage barriers for migrating and rearing steelhead (YBFWRB 2009). Livestock grazing, past forest practices, road networks, and home development reduce riparian, floodplain, and instream habitat function, and constrain natural river processes; all identified as limiting factors in the 2009 Yakima Steelhead Recovery Plan (YBFWRB 2009).

Under the proposed action, the contractor will rescue and handle a few juvenile steelhead during dewatering activities, and there is the potential for a few fish to become trapped and die in the dewatered areas. We also expect that a few individuals will be prevented from moving upstream in Cowiche Creek during construction, and as a result, they may be exposed to conditions that cause reduced growth and predation. These effects will be one-time events, occurring during construction.

The migration, substrate, floodplain connectivity, water quality, and forage PBF attributes will be slightly affected in the short-term. Causes include blockage of juvenile steelhead upstream movements and periods of increased suspended sediments during construction, some shade loss, and a slight decrease in forage production. In the long term, the mid-span support occurring in the wetted channel will replace 100 square feet of substrate. The new plantings will eventually improve riparian function, including increased shade and allochthonous input. Excavation of the railroad grade will allow for more nutrient transfer to aid forage production, for increased aquatic habitat diversity and spawning gravel recruitment, and for hyporheic exchange that may help keep stream temperatures cool in summer. Therefore, the proposed action will not decrease the conservation value of critical habitat within the action area.

We expect that new State and private development will continue in Yakima County. Some development has the potential to reduce riparian zone and floodplain function, including in Cowiche Creek. Impacts will be ameliorated to some degree through more modern floodplain and environmental protection regulations. We also expect that habitat restoration projects on Cowiche Creek will continue. Some of these projects may not require Federal authorization or funding, and therefore they will contribute to cumulative effects. Because these are habitat restoration actions, we expect only short-term construction effects to steelhead or their habitat (e.g., periods of increased suspended sediments), with beneficial long-term effects, including improved riparian and floodplain function.

Current information indicates that climate change will continue, and the effects to salmon and steelhead will increase. Climate change has the potential to increase summer water temperatures within the Cowiche Creek drainage. Successful establishment of the proposed riparian plantings should ensure more shade in the long term compared to baseline conditions in the action area, helping to buffer potential effects of increased temperatures due to climate change.

Even in consideration of the maintained viability rating of the Naches River steelhead population, the impaired environmental baseline, and potential climate change effects, the

number of steelhead that will be injured or killed will be too small to affect VSP parameters at the population level, much less at the DPS level. Thus, the proposed action will not reduce appreciably the likelihood of either survival or recovery of the population, and thus the MPG and the DPS.

The migration, substrate, floodplain connectivity, water quality, and forage PBF attributes will be slightly affected due to the temporary blockage of juvenile steelhead upstream movements, replacement of 100 square feet of substrate with the mid-span support occurring in the wetted channel, temporary suspended sediment increases, some shade loss until new riparian plantings are re-established, and a slight, short-term loss of forage production. In the long term, the new plantings will improve riparian function, including increased shade and allochthonous input. Excavation of the railroad grade will allow for more nutrient transfer to aid forage production, potential side-channel habitat development, and for hyporheic exchange that may help keep stream temperatures cool in summer. Thus, we expect some long-term improvements in PBFs at the action area scale. Therefore, the conservation value of critical habitat at the designation scale will not be appreciably diminished for the MCR steelhead DPS.

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 cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of MCR steelhead or destroy or adversely modify its designated critical habitat.

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 opinion, NMFS determined that incidental take is reasonably certain to occur as a result of work area isolation, fish salvage, and blocked upstream passage, causing harm or death to

juvenile steelhead. As discussed in Section 2.5 above, we estimate that only a few individual juvenile steelhead will die.

For the work area isolation and fish salvage components of the project, the City will not know how many fish could die because some fish could be trapped but not visible in the dewatered area. Therefore, we will use a habitat surrogate to account for this take. For blocked upstream passage it is difficult to estimate the number of juvenile fish that may choose to migrate upstream during the work window to find more favorable habitat. Therefore, we will use the duration of the blocked upstream passage as a surrogate to account for this take. The extent of habitat change and duration of blockage to which juvenile steelhead will experience is readily discernible and presents a reliable measure of the extent of take that can be monitored and tracked. Therefore, when the specific number of individuals "harmed" or killed cannot be predicted, NMFS quantifies the extent of take based on the extent of habitat modified and duration of blockage (June 3, 1986, 51 FR 19926 at 19954).

The estimated extent of habitat affected by construction activities and duration of blockage represents the extent of take exempted in this ITS. The amount of take will increase as the area disturbed by construction or duration of stream bypass increases. Therefore, the extent of take is best identified by the total in-water area the City proposes to disturb during construction (2,100 square feet) and the duration of blockage (July 15 to August 31); the effects of which have been analyzed in this opinion. The Corps shall reinitiate consultation if the in-water construction footprint exceeds 2,100 square feet or the stream is being bypassed outside of July 15 to August 31. Monitoring and reporting requirements will provide opportunities to check throughout the course of the proposed action whether the surrogate is exceeded. For this reason, the surrogate functions as an effective reinitiation trigger.

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

The Corps shall minimize incidental take by:

- Conducting monitoring sufficient to document that the proposed minimization and conservation measures are adhered to, that the terms and conditions listed below are implemented, and that the extent of take is not exceeded.

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 Corps or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1:

    a. Within 90 days following the completion of the proposed construction project, the Corps shall report all monitoring items to include, at a minimum, the following:

        i. Project identification

        ii. Project name: Cowiche Canyon Trail Bridge; NMFS Tracking Number: WCRO-2022-00320

        iii. Corps contact person

        iv. Construction details

            1. Starting and ending dates for in-water construction work

            2. Total area (sq. ft.) of the in-water construction footprint

            3. The number of steelhead captured or killed during work area isolation and fish salvage activities

    b. If take is exceeded, contact NMFS promptly to determine a course of action.

    c. All reports will be sent to: crbo.consultationrequest.wcr@noaa.gov.

2.10. Reinitiation of Consultation

This concludes formal consultation for the Cowiche Canyon Trail Bridge.

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."

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 Corps and descriptions of EFH for Pacific Coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce (PFMC 2014) (https://www.pcouncil.org/documents/2019/08/salmon-efh-appendix-a.pdf/).

3.1. Essential Fish Habitat Affected by the Project

The proposed project action area includes EFH for various life-history stages of Chinook salmon (*O. tshawytscha*) and coho salmon (*O. kisutch*) (PFMC 2014).

3.2. Adverse Effects on Essential Fish Habitat

The following effects will occur to Pacific Coast salmon EFH:

- Routing Cowiche Creek around the work site in a culvert will allow fish to move down but not upstream past the work site during construction. This temporary block to upstream movement will very slightly reduce the ability of some juvenile coho to productively rear. We are not aware of a practical measure to minimize this effect.

- Substrate within the isolated work site will be dewatered and not accessible to foraging juvenile coho salmon during construction. We are not aware of a practical measure to minimize this effect.

- The wetted channel mid-span support will replace 100 square feet of substrate, permanently preventing benthic forage production and spawning gravel access. The City's plan to remove a section of railroad grade will partially restore more normative river processes. This will increase aquatic habitat diversity and nutrient transfer from the

floodplain, which will improve juvenile steelhead forage production in the long-term. This will also increase opportunities for spawning gravel recruitment and sorting.

- Construction activities will kill or displace benthic invertebrates, while riparian vegetation removal will decrease allochthonous input, reducing available juvenile salmonid forage in the short-term. Riparian vegetation removal will also decrease stream shade. During consultation discussions between NMFS, the Corps, and the City of Yakima, the City agreed to minimize EFH effects by placing riparian vegetation that will be cut during construction into the stream. This will mimic allochthonous input, helping provide for some juvenile salmonid forage production. It will also add some habitat complexity for juvenile salmonids. The City also agreed to replant twice the area of riparian habitat that will be removed or disturbed during construction. This will help replace lost allochthonous input and shade caused by vegetation removal.

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.

- The Corps should ensure that riparian plantings meet performance standards as identified in the "Cowiche Canyon Trail Bridge Critical Areas Impacts and Conceptual Mitigation Plan." This should especially include Performance Standard 1b-1 to "re-establish a tree and shrub canopy by year 10 composed of at least five (5) native woody species. Woody species aerial coverage shall be at least 15 percent by year 3, 40 percent by year 5, 80 percent or greater by year 10." This will ensure that riparian function will be restored, including providing allochthonous input, and stream shade.

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

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how

many are adopted by the action agency. Therefore, we ask that, in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

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

4. Data Quality Act Documentation and Pre-Dissemination Review

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps. Other interested users could include the City of Yakima, the Yakama Nation, and the Yakima Basin Fish and Wildlife Recovery Board. Individual copies of this opinion were provided to the Corps. The document will be available within 2 weeks 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

Bash, J., C. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. Center for Streamside Studies–University of Washington.

Berg, L., and T. G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon (*Oncorhynchus kisutch*) following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Crozier, L. G., B. J. Burke, B. E. Chasco, D. L. Widener, and R. W. Zabel. 2021. Climate change threatens Chinook salmon throughout their life cycle. Communications Biology 4(1):222.

Crozier, L. G., E. Dorfmeier, T. Marsh, B. Sandford, and D. Widener. 2016. Refining our understanding of early and late migration of adult Upper Columbia spring and Snake River spring/summer Chinook salmon: passage timing, travel time, fallback and survival. Fish Ecology Division, Northwest Fisheries Science Center, Seattle.

Crozier, L. G., M. M. McClure, T. Beechie, S. J. Bograd, D. A. Boughton, M. Carr, T. D. Cooney, J. B. Dunham, C. M. Greene, M. A. Haltuch, E. L. Hazen, D. M. Holzer, D. D. Huff, R. C. Johnson, C. E. Jordan, I. C. Kaplan, S. T. Lindley, N. J. Mantua, P. B. Moyle, J. M. Myers, M. W. Nelson, B. C. Spence, L. A. Weitkamp, T. H. Williams, and E. Willis–Norton. 2019a. Climate vulnerability assessment for Pacific salmon and steelhead in the California Current large marine ecosystem. PLoS ONE 14(7):49.

Crozier, L. G., M. M. McClure, T. Beechie, S. J. Bograd, D. A. Boughton, M. Carr, T. D. Cooney, J. B. Dunham, C. M. Greene, M. A. Haltuch, E. L. Hazen, D. M. Holzer, D. D. Huff, R. C. Johnson, C. E. Jordan, I. C. Kaplan, S. T. Lindley, N. J. Mantua, P. B. Moyle, J. M. Myers, M. W. Nelson, B. C. Spence, L. A. Weitkamp, T. H. Williams, and E. Willis–Norton. 2019b. S3 Appendix: distinct population segment scores and narratives, supporting information for: climate vulnerability assessment for Pacific salmon and steelhead in the California Current large marine ecosystem. PLoS ONE:49.

Crozier, L. G., R. W. Zabel, and A. F. Hamlet. 2008. Predicting differential effects of climate change at the population level with life-cycle models of spring Chinook salmon. Global Change Biology 14:236–249.

Dalton, M., and E. Fleishman. 2021. Fifth Oregon climate assessment. Oregon Climate Change Research Institute, Oregon State University, Corvallis, Oregon.

Ford, M. J., editor. 2022. Biological viability assessment update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest, Seattle, Washington.

Fowler, R. T. 2004. The recovery of benthic invertebrate communities following dewatering in two braided rivers. Hydrobiologia 523:17–28.

Good, T. P., R. S. Waples, and P. Adams. 2005. Updated status of federally listed ESUs of west coast salmon and steelhead. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-66.

Hilsenhoff, W. L. 1981. Aquatic insects of Wisconsin, keys to Wisconsin genera and notes on biology, distribution and species. University of Wisconsin-Madison.

Howell, P., and coauthors. 1985. Stock assessment of Columbia River anadromous salmonids Volume II: steelhead stock summaries, stock transfer guidelines, information needs. Bonneville Power Administration. Portland, Oregon.

Karp, C., W. Larrick, M. Johnston, and T. Dick. 2009. Steelhead movements in the Upper Yakima River Basin, Fall 2002 – Spring 2006. Bureau of Reclamation.

Korsu, K. 2004. Response of benthic invertebrates to disturbance from stream restoration: the importance of bryophytes. Hydrobiologia 523:37–45.

Lindsey, R., and L. Dahlman. 2020. Climate change: global temperature. News & Features.

Martins, E. G., S. G. Hinch, D. A. Patterson, M. J. Hague, S. J. Cooke, K. M. Miller, D. Robichaud, K. K. English, and A. P. Farrell. 2012. High river temperature reduces survival of sockeye salmon (*Oncorhynchus nerka*) approaching spawning grounds and exacerbates female mortality. Canadian Journal of Fisheries and Aquatic Sciences 69(2):330–342.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. NOAA Technical Memorandum NMFS-NWFSC-42. National Marine Fisheries Service.

Merritt, R. W., and K. W. Cummins, editors. 1996. An introduction to the aquatic insects of North America. Kendall/Hunt Publishing Company, Dubuque, Iowa.

Miller, A. M., and S. W. Golladay. 1996. Effects of spates and drying on macroinvertebrate assemblages of an intermittent and a perennial prairie stream. Journal of the North American Benthological Society 15(4):670–689.

Mote, P. W., E. A. Parson, A. F. Hamlet, W. S. Keeton, D. Lettenmaier, N. Mantua, E. L. Miles, D. W. Peterson, D. L. Peterson, R. Slaughter, and A. K. Snover. 2003. Preparing for climatic change: the water, salmon, and forests of the Pacific Northwest. Climatic Change 61(1-2):45–88.

Mote, P. W., J. Abatzoglou, K. D. Dello, K. Hegewisch, and D. E. Rupp. 2019. Fourth Oregon climate assessment report. Oregon Climate Change Research Institute.

Newcombe, C. P., and J. O. T. Jensen. 1996. Channel suspended sediment and fisheries: a synthesis for quantitative assessment of risk and impact. North American Journal of Fisheries Management 16:693–727.

NMFS (National Marine Fisheries Service). 2009. Middle Columbia River steelhead distinct population segment ESA recovery plan. National Marine Fisheries Service, Northwest Region, Seattle.

NMFS. 2011a. 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead.

NMFS. 2011b. 2011 Report to Congress, Pacific Coastal Salmon Recovery Fund 2000–2010. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Seattle.

NMFS. 2011c. Anadromous salmonid passage facility design. NMFS, Northwest Region, Portland, Oregon.

NMFS. 2022. DRAFT 2021 5-Year review: summary & evaluation of Middle Columbia River steelhead, Portland, Oregon.

NOAA Fisheries. 2005. Final assessment of NOAA Fisheries' critical habitat analytical review teams for 12 evolutionarily significant units of West Coast salmon and steelhead. NOAA Fisheries, Portland, Oregon.

Paltridge, R. M., P. L. Dostine, C. L. Humphrey, and A. J. Boulton. 1997. Macroinvertebrate recolonization after re-wetting of a tropical seasonally-flowing stream (Magela Creek, Northern Territory, Australia). Marine and Freshwater Research 48:633–645.

Pennak, R. W. 1953. Fresh-water invertebrates of the United States. The Ronald Press Company, New York.

PFMC (Pacific Fishery Management Council). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as Modified by Amendment 18 to the Pacific Coast Salmon Plan: Identification and Description of Essential Fish Habitat, Adverse Impacts, and Recommended Conservation Measures for Salmon. Pacific Fishery Management Council. Portland, Oregon.

Reisenbichler, R. R., J. D. McIntyre, M. F. Solazzi, and S. W. Landino. 1992. Genetic variation in steelhead of Oregon and northern California. Transactions of the American Fisheries Society 121:158-169.

Siegel, J., and L. Crozier. 2020. Impacts of climate change on salmon of the Pacific Northwest, a review of the scientific literature published in 2019. Fish Ecology Division, Northwest Fisheries Science Center, Seattle, WA.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. ManTech Environmental Research Services, Inc., Corvallis, Oregon. National Marine Fisheries Service, Corvallis, Oregon.

Wainwright, T. C., and L. A. Weitkamp. 2013. Effects of climate change on Oregon Coast coho salmon: habitat and life-cycle interactions. Northwest Science 87(3):219–242.

Washington State Department of Ecology. 2008. Upper Naches River Temperature Total Maximum Daily Load Volume 1. Water Quality Study Findings. Environmental Assessment Program, Washington State Department of Ecology, Olympia, Washington.

Wissmar, R. C., and coauthors. 1994. Ecological health of river basins in forested regions of eastern Washington and Oregon. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, General Technical Report PNW-GTR-326, Portland, Oregon.

WSDOT (Washington State Department of Transportation). 2021. Fish exclusion - protocol and standards.

YBFWRB (Yakima Basin Fish and Wildlife Recovery Board). 2009. Yakima steelhead recovery plan: extracted from the 2005 Yakima Subbasin salmon recovery plan with updates.

YBFWRB. 2020. Yakima Basin habitat restoration projects.

YSFWPB (Yakima Subbasin Fish and Wildlife Planning Board). 2004. Yakima Subbasin Plan.