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

https://doi.org/10.25923/q0km-8940

Refer to NMFS No: WCRO-2021-00399

January 4, 2022

Scott Smithline
Environmental Manager
Federal Highway Administration
Western Federal Lands Highway Division
610 E. Fifth Street
Vancouver, WA 98661

Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the Dickey Creek Bridge Replacement Project, Kittitas County, Washington

Dear Mr. Smithline:

Thank you for your letter of February 24, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Dickey Creek Bridge Replacement Project.

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 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 Federal Highway Administration 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.

Please contact Jody Walters, Columbia Basin Branch, Ellensburg, Washington, at 509-859-6828, jody.walters@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*]
Steve Morrow, FHWA Western Federal Lands Highway Division, stephen.morrow@dot.gov
Abby Sage, USFWS, abigail_sage@fws.gov

Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Dickey Creek Bridge Replacement Project

NMFS Consultation Number: WCRO-2021-00399

Action Agency: Federal Highway Administration–Western Federal Lands Highway Division

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

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

Issued By:

Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office

Date: January 4, 2022

Table of Contents

Table of Tables ii
Acronym Glossary iii
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 4
2.1. Analytical Approach 5
2.2. Rangewide Status of the Species and Critical Habitat 6
2.2.1. Status of the Species 6
2.2.2. Abundance, Productivity, Spatial Structure, and Diversity 8
2.2.3. Limiting Factors 10
2.2.4. Status of Critical Habitat 10
2.2.5. Interior Columbia Recovery Domain 12
2.2.6. Climate Change 13
2.3. Action Area 14
2.4. Environmental Baseline 15
2.5. Effects of the Action 16
2.5.1. Effects to Species 16
2.5.2. Effects to Critical Habitat 18
2.6. Cumulative Effects 19
2.7. Integration and Synthesis 20
2.8. Conclusion 21
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. Data Quality Act Documentation and Pre-Dissemination Review 24
3.1. Utility 24
3.2. Integrity 24
3.3. Objectivity 24
4. References 26

TABLE OF TABLES

Table 1. MCR steelhead DPS major population groups and component populations, and hatchery programs (NMFS 2009) (71 FR 834). Populations with an asterisk (*) are winter-run steelhead populations. All other populations are summer-run steelhead populations..... 7

Table 2. Summary of Middle Columbia Steelhead DPS viability relative to Interior Columbia Technical Recovery Team (ICTRT) viability criteria, grouped by major population group (MPG). Range in annual abundance, standard deviation (sd.) and number of qualifying estimates for productivities in parentheses (NWFSC 2021). 9

Table 3. Physical and biological features of critical habitats designated for ESA-listed salmon and steelhead species considered in this opinion..... 11

ACRONYM GLOSSARY

BA	Biological Assessment
CFR	Code of Federal Regulations
County	Kittitas County Public Works
dbh	Diameter at Breast Height
DPS	Distinct Population Segment
DQA	Data Quality Act
ESA	Endangered Species Act
FHWA	Federal Highway Administration
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
MCR	Middle Columbia River
MPG	Major Population Group
NF	North Fork
NMFS	National Marine Fisheries Service
OHWM	ordinary high-water mark
opinion	Biological Opinion
PBF	Physical and Biological Feature
PCE	Primary Constituent Element
Project	Dickey Creek Bridge Replacement Project
Reclamation	U.S. Bureau of Reclamation
RPM	Reasonable and Prudent Measure
Services	NMFS and the U. S. Fish and Wildlife Service
sq. ft.	Square Feet
TCF	Teanaway Community Forest
U.S.C.	United States Code
USFWS	U. S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WFLHD	Western Federal Lands Highway Division
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 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 at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Columbia Basin Branch Office in Ellensburg, Washington.

1.2. Consultation History

The Western Federal Lands Highway Division (WFLHD) of the Federal Highway Administration (FHWA), in partnership with Kittitas County, proposes to replace the Dickey Creek Bridge. The WFLHD initiated pre-consultation discussions with stakeholders on November 12, 2020, but NMFS was unable to attend this meeting. The WFLHD hosted a second meeting on January 13, 2021. At this meeting, NMFS (and others) stressed the importance of minimizing riparian disturbance and replanting, with assurance of plant survival. NMFS received a biological assessment (BA) and request for consultation on February 25, 2021. NMFS initiated formal consultation on November 10, 2021.

On April 27, 2021, the WFLHD held a meeting to help clarify details of the proposed action. Due in part to NMFS and others' concerns over the amount of planned vegetation removal and uncertainty over riparian vegetation reestablishment, there was interest by attendees to visit the site and further discuss issues. In June 14 and 23, 2021, emails, WFLHD notified NMFS that the project design had evolved, and that the amount of riparian revegetation would increase by 3,762 square feet (sq. ft.) relative to what was proposed in the BA. The WFLHD also provided a riparian restoration plan, developed in coordination with the Yakama Nation and stated that temporary fencing would be installed upstream of the old bridge to exclude cattle browse of new plantings. The site visit occurred on June 24, 2021, though NMFS was unable to attend.

On August 6, 2021, the WFLHD emailed a summary report of the site visit, further clarifying and extending some activities under the proposed action, including revegetation performance standards. On August 27, 2021, the WFLHD provided a revised BA, fencing plans and permit plans, which again updated the amount of vegetation that would be both removed and replanted, and stated that an existing fence will be rebuilt to exclude livestock from accessing revegetated areas. The WFLHD will also coordinate with the Washington Department of Natural Resources

(WDNR) to make the removed trees available for aquatic habitat restoration actions in the Teanaway watershed.

The WFLHD hosted a conference call on September 9, 2021, to provide a project update, discuss the updated permit plans and address any questions or information needs to assist the regulatory and resource agencies with environmental reviews and permits. The WFLHD sent a memo on September 17, 2021, that summarized the September 9 meeting. On September 30, 2021, the WFLHD held a conference call with NMFS and the U. S. Fish and Wildlife Service ("Services") to discuss potential minimization measures to reduce effects of lost riparian function. At this meeting, the WFLHD agreed to check the feasibility of planting additional riparian reaches, due to the lag-time (decades) in replacing riparian function within the project footprint. On November 12, 2021, the WFLHD notified the Services that WFLHD and Kittitas County had no authority to plant additional riparian areas or conduct other habitat enhancement work outside of the proposed project footprint. However, the WFLHD revised the project plan, which will result in a smaller footprint in the riparian zone.

Throughout the consultation, NMFS also communicated with the U. S. Fish and Wildlife Service (USFWS), Washington Department of Fish and Wildlife, and the Yakama Nation. Our analysis took all of these communications into consideration, along with communications with, and documents received from, the WFLHD.

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02).

The WFLHD, in partnership with Kittitas County Public Works (County), plans to replace the Dickey Creek Bridge over the North Fork (NF) Teanaway River (47.289523° N latitude, 120.859588° W longitude). The existing bridge is functionally obsolete and currently load restricted. These load restrictions affect the safety of a heavily used recreation area by limiting access for special haul vehicles, as well as impacting road maintenance, commercial, and restoration activities. The Dickey Creek Bridge Replacement Project (Project) will likely begin in spring 2022 and will take up to 24 weeks to complete. Work below the ordinary high water mark (OHWM) of the NF Teanaway River will require approximately 2 weeks to complete and will occur within the approved Washington Department of Fish and Wildlife (WDFW) in-water work window of July 16 to September 15.

The OHWM width at the existing bridge location is approximately 65–67 feet, 15 feet wider than the existing bridge. The bridge is too low and narrow for high stream flows. The new, 125-foot-long bridge, including abutments, will completely span the OHWM. To account for future conditions such as global warming related effects, the bridge is designed with 3 feet of freeboard to provide an additional factor of safety and increased conveyance.

The new bridge will be placed approximately 100 feet downstream of the existing structure. A hydraulic reach assessment confirmed this to be the best location where the flows and channel confinement are straight and not confined. Armoring will still be required to protect the new bridge abutment footings and foundation piles due to the risk of scour and anticipated movement

of cobble and gravel that has accumulated for the past 60 years upstream of the existing bridge. Rock armoring will be buried below the channel bed elevation to scour depth and covered with appropriately sized streambed material with no exposed oversized rock below the OHWM.

Bridge construction and 0.2 miles of new roadway will require clearing approximately 0.249 acres (10,846 sq. ft.) of vegetation that currently provides some riparian function. A total of 57 trees with a diameter at breast height (dbh) of greater than 6 inches will be removed from the riparian zone. These trees include cedar, grand fir, Douglas fir, lodgepole pine, ponderosa pine, and cottonwood. Where possible, the contractor will clear vegetation to ground level but will not grub where work may be necessary outside the permanent disturbance limits.

Some concrete will be poured on site (e.g., for the abutment shafts and pile caps). The contractor will use best management practices to ensure concrete and any potentially contaminated water is fully contained and hauled off-site. Any groundwater intercepted during excavation (e.g., for shoring and for removing the old bridge footings) will be pumped to an upland location for infiltration or hauled off-site to an upland area for infiltration. No turbid water will be allowed to enter the stream. Pump intakes will be screened to meet NMFS criteria.

The existing bridge footings and abutments will be removed from below the OHWM allowing for more natural hydrologic processes within the floodplain. New streambed will be constructed in the area below the OHWM where the bridge footings are removed. Oversized streambed material will be used to prevent bank scour in the locations where the bridge abutments were located. Areas of new streambed will have fines washed in prior to removal of the isolation structure and re-watering to ensure surface flows are clean.

Before the existing bridge abutments and footings are removed, the construction area below the OHWM will be isolated from flowing water (e.g., with sandbags, super sacks, or water bladders) for up to 2 weeks. Prior to isolation, qualified biologists will verify there are no redds in the footprint of the proposed isolation area. Qualified biologists will also be on-site to remove any stranded fish from the dewatered stream channel. The contractor will attempt to herd steelhead with nets out of the area to be dewatered. Construction of the isolation structures and dewatering of the existing channel will proceed slowly, to allow any fish to voluntarily leave as flows recede. If necessary, any pools will be pumped with small-capacity screened pumps and fish will be removed. Electrofishing will not be used. Knotless nylon sanctuary-type nets will be used, and fish handling will be minimized. All fish will be released downstream of the project area. Worksite isolation and fish exclusion will be conducted in accordance with the 2016 Washington State Department of Transportation Fish Exclusion Protocols and Standards. At no time will isolation span the entire NF Teanaway River.

The isolated footprint (including the isolation structures) will be approximately 70 feet by 20 feet for each abutment, totaling approximately 2,800 sq. ft. Typically, the river thalweg is along the south bank at the existing bridge crossing, and in late summer the NF Teanaway River along the north bank adjacent the existing bridge is dry. After the bridge abutments and footings are removed, the isolation structures will be removed slowly, starting at the downstream end to reintroduce water to the work area and minimize downstream turbidity. Removal of the old abutments will create 375 sq. ft. of new streambed. The contractor will also remove 150 cubic

yards of riprap below the OHWM at the existing bridge's south abutment, restoring approximately 257 sq. ft. of streambed.

The contractor will be required to prevent any turbidity from extending beyond 200 feet from the project area. The potential for turbidity will be limited to the time the in-water isolation structures are constructed (approximately 16 hours) and the time the in-water isolation structure is removed (approximately 8 hours) for a total of approximately 24 hours. Once isolated, removal of the first abutment and the associated riprap will take 5 days and the removal of the second abutment will take 4 days. The BA lists additional impact avoidance and minimization measures that will be required of the contractor.

To minimize the effects of removing 10,846 sq. ft. of riparian vegetation, 0.637 acres (27,748 sq. ft.) of riparian area will be planted. The revegetation plan will overplant, installing over 1,300 trees and over 2,000 shrubs in the riparian area. Performance standards will be as follows:

1) One hundred percent survival of all installed native trees and shrubs 1 year post-installation.
2) In year three, cover of native riparian trees and shrubs combined (planted and volunteer) will be at least 30% in the revegetation area, and at least three species of native trees will be present.
3) In year five, cover of native riparian trees and shrubs combined (planted and volunteer) will be at least 60% in the revegetation area, and at least three species of native trees will be present ("Follow-up and Summary of Clarifications to the June 24, 2021 onsite, Dickey Creek Bridge"; email attachment from the WFLHD, August 6, 2021).

An existing fence line that is in disrepair will be rebuilt to exclude livestock from accessing revegetated areas. The WFLHD will also coordinate with WDNR to stack the removed trees off-site, but on WDNR property, for future use by WDNR, WDFW and the Yakama Nation for aquatic habitat restoration actions in the Teanaway watershed.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

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 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 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 use 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 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 the NF Teanaway River 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 2021), applicable recovery plans (NMFS 2009; YBFWRB 2009), and draft biological viability assessment reports (NWFSC 2021). 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 (NMFS 2009) (71 FR 834). Populations with an asterisk (*) are winter-run steelhead populations. All other populations are summer-run steelhead populations.

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

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 the (NWFSC 2021): There has been functionally no change in the viability ratings for the component populations, and the Middle Columbia River 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 (NWFSC 2021).

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 Middle Columbia River Steelhead DPS remains at moderate risk of extinction, with viability unchanged from the prior review.

Table 2. Summary of Middle Columbia Steelhead DPS viability relative to Interior Columbia Technical Recovery Team (ICTRT) viability criteria, grouped by major population group (MPG). Range in annual abundance, standard deviation (sd.) and number of qualifying estimates for productivities in parentheses (NWFSC 2021).

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
Touchet River	1,000	253 (sd. 222)	0.91 (0.09 19/20)	High	Low	Moderate	Moderate	High Risk

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). North Fork Teanaway River steelheads are part of the Upper Yakima 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 (Reclamation)'s 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 ESA-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 this area (NMFS 2011a; NMFS 2021).

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 Teanaway River HUC5. This HUC was assigned a High conservation value rating because it has extensive PBFs that support one of four demographically independent populations in the Yakima River MPG (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 and 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 and Dahlman 2020).

The year 2020 was another hot year in national and global temperatures; it was the second hottest year in the 141-year record of global land and sea measurements, and capped off the warmest decade on record (https://www.ncdc.noaa.gov/sotc/global202013). Events such as the 2013–2016 marine heatwave (Jacox et al. 2019), have been attributed directly to anthropogenic warming in the annual special issue of Bulletin of the American Meteorological Society on extreme events (Herring et al. 2018). Global warming and anthropogenic loss of biodiversity represent profound threats to ecosystem functionality. These two factors are often examined in isolation, but likely have interacting effects on ecosystem function (Siegel and Crozier 2020). Conservation strategies now need to account for geographical patterns in traits sensitive to climate change, as well as climate threats to species-level diversity.

Climate change is predicted to cause a variety of impacts to Pacific salmon and their ecosystems (Crozier et al. 2008; Dalton and Fleishman 2021; Martins et al. 2012; Mote et al. 2019; Mote et al. 2003; Wainwright and 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 reach and associated riparian zones comprising the action area will be approximately 385 feet. This reach begins approximately 125 feet upstream of the existing bridge (the farthest upstream point of riparian vegetation removal), continues downstream past the bridge (which is about 60 feet wide), and extends another 200 feet downstream of the bridge. This reach will account for potential effects from bridge footing and abutment removal, 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).

The NF Teanaway River is occupied by steelhead from the Upper Yakima River Mainstem population of the Yakima MPG. The NF Teanaway River is a major spawning area for steelhead and one of the tributary strongholds for steelhead production in the Upper Yakima River Mainstem population (YBFWRB 2009). Karp et al. (2009) identified the Teanaway River subbasin as the most heavily used steelhead spawning tributary in the Upper Yakima River basin, based on radiotelemetry data. This indicates the importance of the subbasin in supporting recovery of the Upper Yakima River Mainstem population, and thus the need to protect and enhance the spawning, rearing, and migration physical and biological features of critical habitat.

About 34 percent of radio-tagged adult steelhead located in the Teanaway Basin were presumed to have spawned in the NF Teanaway River (Karp et al. 2009). Karp et al. (2009) documented adult steelhead in Stafford, Standup, and Jack creeks, all NF Teanaway River tributaries upstream of the action area. Thus, adult steelhead migrate through, and potentially spawn in, the action area, and juvenile steelhead are likely to occur in the action area.

In the action area, the NF Teanaway River flows through the WDNR Teanaway Community Forest (TCF). Upstream, the watershed includes TCF, Okanogan–Wenatchee National Forest, and some scattered WDNR Trust Land parcels. The NF Teanaway River has been negatively affected by grazing and logging activities, and transportation infrastructure (e.g., bridges, culverts, railroad grades). 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). We are unaware of irrigation withdrawals upstream of the action area.

The NF Teanaway River is currently listed on the state's 303(d) list as "water quality impaired" for high summer water temperatures (Mayo et al. 2009). Stream temperature modeling indicates that increases in riparian shade, reduction in active channel width, and increases in streamflow

can lower stream temperatures (Stohr and Leskie 2000). These high temperatures may be limiting steelhead productivity within the NF Teanaway River, including the action area. We do not know with certainty if climate change has had a role in increased summer water temperatures. However, if climate change does increase air temperatures, reduce snowpack, or result in earlier melting of the snowpack within the Teanaway River subbasin, NF Teanaway River summer water temperatures will likely increase in the future.

2.5. Effects of the Action

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

2.5.1. Effects to Species

Species Presence in the Action Area

Middle Columbia River steelhead from the Yakima River Upper Mainstem population use the action area for rearing and as a migration corridor, and potentially for spawning. Juvenile steelhead rear year-round in the river and so could be present during the July 16 to September 15 in-water work window. Radio-tagged steelhead adults first entered the Teanaway Basin in early-mid March, and likely leave by May and June (Karp et al. 2009). Thus, adult steelhead are unlikely to be in the action area during in-water work.

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

Work Area Isolation and Fish Salvage

Work area isolation and fish salvage protocols [i.e., Washington State Department of Transportation (WSDOT) Fish Exclusion Protocols and Standards] will help minimize effects. Some juveniles may be disturbed and leave the area during the isolation process (e.g., barrier placement and dewatering). Fish that do not leave volitionally will be handled during salvage (rescue) efforts, or will become trapped in the isolated (dewatered) section of the action area and die.

We are unaware of juvenile steelhead density data for the NF Teanaway River. We do know that Upper Yakima River Mainstem adult population numbers are very low, so we assume that juvenile densities are also low, including action area densities. Pictures in the BA indicate that the water is relatively deep near or against the right abutment, while at least part of the left abutment is in the dry. Juvenile densities may be relatively higher in the deeper water, but we expect that most juveniles will volitionally move to areas that remain wetted as water levels

decrease during work area 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 1,400-square foot isolation footprint around each abutment (dewatering will occur separately for each abutment removal process; a total of 2,800 sq. ft. of streambed will be isolated). Most of the remaining trapped fish will be rescued with dip nets. Due to the small isolation footprints and efforts to remove fish before being completely dewatered, we expect that very few juvenile steelhead will be trapped 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 and 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 will be episodic during isolation barrier placement and removal. During barrier placement, suspended sediment concentrations will increase very little due to the mainly large (gravel and cobble) substrates in the construction footprint (per the BA). Once the isolation barrier is in place, suspended sediments will be contained within the worksite. The new streambed will be constructed within the isolation area below the OHWM where the bridge footings are removed, and this new streambed will have fine substrates washed in prior to removal of the isolation structure to ensure surface flows are clean. There will also be a sediment plume during isolation barrier removal, but the contractor will prevent any turbidity from extending beyond 200 feet from the project area through the use of best management practices described in the proposed action. Therefore, we expect that harm or harassment from increased suspended sediment will be unlikely, based on criteria outlined in Newcombe and 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 and Northcote 1985). However, the temporary nature of these behavioral responses will not result in decreased fitness, or fish being injured or killed.

Reduced Forage Availability

Construction-related activities have the potential to affect juvenile salmonid forage. Approximately 2,800 sq. ft. of benthic habitat will be disturbed during dewatering to remove the old bridge abutments and associated riprap. This disturbance will kill or displace benthic invertebrates, slightly reducing available forage. Another 10,800 sq. ft. of riparian vegetation removal will cause some loss of allochthonous input, such as leaf litter and terrestrial insect fallout.

Aquatic invertebrates could start recolonizing within days to months after construction (Fowler 2004; Korsu 2004; Miller and 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 and Cummins 1996). Thus, we estimate

that recolonization of the disturbed area will occur within a year. The WFLHD will replant over twice the area of riparian vegetation as what they will remove. These additional plants will help minimize the loss of allochthonous input.

Together, the benthic habitat disturbance and loss of allochthonous input will slightly decrease potential forage production and availability to juvenile steelhead for about a year. Due to the expected low density of juvenile steelhead 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 of juvenile steelhead.

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

Although worksite isolation will occur to remove the old bridge abutments, at no time will isolation span the entire wetted channel. Thus, downstream migration of juvenile steelhead will not be impeded.

Substrate

In the short term, the substrate within the isolated area will be disturbed and not accessible to foraging juvenile steelhead for up to 2 weeks while the contractor removes the old bridge footings and riprap. The bridge footings and the riprap provide for limited forage production, and prevent the potential accumulation of spawning-size gravels. For the long term, the WFLHD will restore 632 sq. ft. of streambed in the former bridge footing and riprap footprint. The restored, unconfined streambed will provide better substrate for forage production, and allow for spawning gravel recruitment from the banks with lateral stream movement. Thus, there will be a decrease in substrate function for a short time during construction, but function will improve above baseline once the project is complete.

Due to the mainly large substrates in the construction area, work site isolation, washing fines into the restored streambed before removing isolation barriers, and the slow removal of isolation barriers, we expect that only very small amounts of fine sediment will be carried downstream during construction. The current 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 quality before the steelhead spawning season.

Floodplain Connectivity

Removing the old bridge footings and abutments will restore floodplain connectivity. This is a beneficial effect as it can allow for more nutrient transfer aiding forage production, potential side-channel habitat development, and for hyporheic exchange that may help keep stream temperatures cool in summer.

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 on shore to infiltrate. The contractor will also monitor and manage turbidity to ensure downstream turbidity remains low. Water quality will return quickly to background levels once the barriers are removed.

From drawings provided with the BA, we estimate that riparian vegetation to be removed currently shades about 165 feet of stream. The right (west) bank vegetation currently casts shade along the entire 165 feet of river, while the occurrence of shade-producing vegetation on the left bank is less consistent. This shade loss has the theoretical potential to increase summer water temperatures, though we expect that any change from this relatively small disturbance would be too small to influence stream temperature. In the long term, the new plantings will produce shade along both stream banks (with the exception of the new bridge approach footprints). The coverage from riparian shade will likely be higher than 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. In the long term, the new riparian plantings will cover a larger area than the vegetation that will be removed, helping minimize the allochthonous input effect. New and repaired fencing that will be completed as part of the proposed action will exclude livestock from accessing revegetated areas, helping ensure the long-term protection of the riparian zones.

In summary, the substrate, water quality, and forage PBF attributes will be only slightly and temporarily affected along a short reach of stream within the action area. In the long term, the new plantings will increase riparian function, including allochthonous input and increased shade along the left bank. Removing the old bridge footings and restoring the streambed will improve substrate function to support forage production and spawning habitat, and will restore floodplain connectivity. 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).

We are unaware of cumulative effects that will occur directly within the action area, but some upstream actions could affect conditions in the action area. Watershed recovery actions (e.g., riparian restoration, instream habitat complexity) have been ongoing upstream in the NF Teanaway River and will likely continue. The WDFW, WDNR, non-government organizations, or Yakama Nation are likely to carry out future restoration actions. Because these are recovery 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 increased floodplain connectivity, pool frequency, gravel retention, and fish cover (https://srp.rco.wa.gov/project/300/81131; accessed December 10, 2021).

Timber harvest, grazing, and recreation will continue within the Teanaway Community Forest, including in the NF Teanaway drainage upstream of the action area. However, the TCF management goals will be more holistic, including watershed protection. Management will be overseen by a community partnership, including the Yakama Nation, residents, business owners, local governments, and conservation groups. Management objectives include protection of key watershed functions and aquatic habitat, increasing late season base flows, increasing floodplain connection, and decreasing summer water temperatures (WDNR and WDFW 2015). Therefore, we expect these actions to at least maintain, if not improve, conditions for MCR steelhead in the action area.

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 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 Middle Columbia River Steelhead DPS does not currently meet the viability criteria described in the Mid-Columbia Steelhead Recovery Plan. North Fork Teanaway steelhead contribute to the Upper Yakima River Mainstem population, which is not meeting viability criteria. The NF Teanaway River is a major spawning area and one of the tributary strongholds for steelhead production in the Upper Yakima River Mainstem population. The main limiting factor within the Yakima Basin includes Reclamation's operation of the Yakima Project and subsequent diversion of irrigation water.

Inadequate riparian shade, a stream channel that is too wide and low streamflow contribute to high summer water temperatures in the NF Teanaway River. The environmental baseline within the action area has been degraded by grazing and the bridge, reducing riparian, floodplain, and instream habitat function, and constraining natural river processes. High summer water

temperatures may limit steelhead productivity within the NF Teanaway River, including the action area.

Under the proposed action, the contractor will rescue and handle juvenile steelhead during dewatering activities, and there is the potential that fish could become trapped and die in the dewatered areas. This will be a one-time occurrence for each of the two isolation areas during the construction window. NMFS expects that only a few juvenile steelhead will die.

The substrate, water quality, and forage PBF attributes of critical habitat will be slightly and temporarily affected during project construction. In the long term, the new plantings will increase riparian function, including allochthonous input and increased shade along the left bank. Removing the old bridge footings and restoring the streambed will improve substrate function to support forage production and spawning habitat, and will restore floodplain connectivity. Thus, there will be a slight increase in the conservation value of critical habitat at the scale of the action area.

We are unaware of cumulative effects that could potentially cause harm to steelhead or impair habitat in the action area. Upstream watershed recovery actions and forest management will continue, but potential effects to the action area will be beneficial in the long term.

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 Teanaway River basin. Successful riparian plantings and fencing to exclude cattle 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 high risk status of the Upper Yakima River Mainstem 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.

Short-term construction activities will result in negative effects to PBFs at the scale of the action area and we expect the PBFs to be restored within days to weeks. The new plantings will increase riparian function, including increased shade in the long term. Also, removing the old bridge footings and restoring the streambed will improve substrate function to support forage production and spawning habitat, and will restore floodplain connectivity in the long term. Thus, we expect long-term improvements in PBFs at the scale of the action area, and, 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 and fish salvage, causing harm or death to juvenile steelhead. As discussed in Section 2.5 above, we estimate that only a few individuals will die.

The WFLHD 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. The extent of habitat change to which juvenile steelhead will be exposed 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 (June 3, 1986, 51 FR 19926 at 19954).

The estimated extent of habitat affected by construction activities represents the extent of take exempted in this ITS. The amount of take will increase as the area disturbed by construction activities increases. Therefore, the extent of take is best identified by the total in-water area the WFLHD proposes to disturb during construction (1,400 feet around each bridge abutment for a total of 2,800 sq. ft.); the effects of which have been analyzed in this opinion. The WFLHD shall reinitiate consultation if the in-water construction footprint exceeds 2,800 sq. ft. 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 effective reinitiation trigger.

2.9.2. Effect of the Take

In the 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 WFLHD shall minimize incidental take by:

1. 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 WFLHD 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 WFLHD shall report all monitoring items to include, at a minimum, the following:
        i. Project identification
        ii. Project name: Dickey Creek Bridge Replacement; NMFS Tracking Number: WCRO-2021-00399
        iii. WFLHD contact person
        iv. Construction details
        v. Starting and ending dates for in-water construction work
        vi. Total area (sq. ft.) of the in-water construction footprint
        vii. 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. Send reports to National Marine Fisheries Service, Columbia Basin Branch, Attention Jody Walters (jody.walters@noaa.gov), 304 South Water Street, Suite 201, Ellensburg, Washington 98926.

2.10. Reinitiation of Consultation

This concludes formal consultation for the Dickey Creek Bridge Replacement Project.

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

3. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act 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.

3.1. 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 WFLHD and Kittitas County Public Works. Other interested users could include the Yakama Nation. Individual copies of this opinion were provided to the WFLHD. 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.

3.2. 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.

3.3. Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

4. 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., 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, Lisa 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, Lisa 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.

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.

Herring, S. C., N. Christidis, A. Hoell, J. P. Kossin, C. J. Schreck III, and P. A. Stott, editors. 2018. Explaining extreme events of 2016 from a climate perspective. Bulletin of the American Meteorological Society 99(1):157.

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., K. Jones, D. Scarnecchia, L. LaVoy, W. Rendra, and D. Ortmann. 1985. Stock assessment of Columbia River anadromous salmonids Volume II: steelhead stock summaries, stock transfer guidelines, information needs. Bonneville Power Administration, Portland, Oregon.

Jacox, M. G., M. A. Alexander, C. A. Stock, and G. Hervieux. 2019. On the skill of seasonal sea surface temperature forecasts in the California Current System and its connection to ENSO variability. Climate Dynamics 53(12):7519–7533.

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. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature. Accessed 1/16/2020.

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.

Mayo, T., W. Ehinger, and C. Thomas. 2009. Teanaway watershed aquatic species environmental baseline. U.S. Forest Service, Cle Elum Ranger District.

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

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.

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. 2021. 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.

NWFSC (Northwest Fisheries Science Center). 2021. DRAFT biological viability assessment update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest, Seattle.

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.

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.

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.

Stohr, A., and S. Leskie. 2000. Teanaway River Basin temperature pilot technical assessment. Washington State Department of Ecology, Olympia, Washington.

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.

WDNR (Washington State Department of Natural Resources) and WDFW (Washington Department of Fish and Wildlife). 2015. Teanaway Community Forest management plan. Washington State Department of Natural Resources, Olympia, Washington. 110 p.

Wissmar, R. C., J. E. Smith, B. A. McIntosh, H. W. Li, G. H. Reeves, and J. R. Sedell. 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.

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