UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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Refer to NMFS No: WCRO-2021-02078

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February 2, 2022

Michael S. Erickson
Chief, Environmental Compliance Section
U.S. Army Corps of Engineers, Walla Walla District
201 North 3rd Avenue
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Re: Endangered Species Act Section 7(a)(2) Biological Opinion for the Nursery Bridge Drop Structure Rehabilitation, Walla Walla River (170701020704), Milton–Freewater, Oregon.

Dear Mr. Erickson:

Thank you for your November 4, 2021, letter 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 Nursery Bridge Drop Structure Rehabilitation. The U.S. Army Corps of Engineers (Corps) proposes to implement the drop structure repairs for the Milton–Freewater Water Control District, the Milton–Freewater Flood Protection System sponsor, as part of its Levee Rehabilitation and Inspection Program (PL 84-99).

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 project is not likely to jeopardize the continued existence of ESA-listed Middle Columbia River (MCR) steelhead (*Oncorhynchus mykiss*). NMFS also determined the action will not destroy or adversely modify designated critical habitat for MCR steelhead. We provide rationale for our conclusions in the attached biological opinion (opinion). The enclosed opinion is based on information provided in your biological assessment, requested additional information provided by Ben Tice (Corps), and other sources of information cited in the opinion.

As required by section 7 of the ESA, NMFS provided an incidental take statement (ITS) with the opinion. The ITS includes reasonable and prudent measures (RPMs) that NMFS considers necessary or appropriate to minimize incidental take associated with the proposed action. The take statement sets forth terms and conditions, including reporting requirements that the Corps and any person who performs the action must comply with to carry out the RPMs. Incidental take from the proposed action that meets these terms and conditions will be exempt from the ESA take prohibition.

Please contact Colleen Fagan, Interior Columbia Basin Office, La Grande, Oregon, (541) 962-8512 or colleen.fagan@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*]
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Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion

Nursery Bridge Drop Structure Rehabilitation

NMFS Consultation Number: WCRO-2021-02078

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

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
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: February 2, 2022

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ACRONYM GLOSSARY

A&P	Abundance and Productivity
BA	Biological Assessment
BMP	Best Management Practice
cfs	Cubic Feet per Second
CHART	Critical Habitat Analytical Review Team
Corps	U.S. Army Corps of Engineers
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
DPS	Distinct Population Segment
DQA	Data Quality Act
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FR	Federal Register
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
MFWCD	Milton–Freewater Water Control District
MPG	Major Population Group
NMFS	National Marine Fisheries Service
NWFSC	Northwest Fisheries Science Center
OHWM	Ordinary High Water Mark
opinion	Biological Opinion
PAH	Polycyclic Aromatic Hydrocarbon
PBF	Physical or Biological Feature
PCE	Primary Constituent Element
PL	Public Law
RM	River Mile
RPM	Reasonable and Prudent Measure
SS/D	Spatial Structure and Diversity
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WWRID	Walla Walla River Irrigation District

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.), and implementing regulations at 50 CFR 402, as amended.

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, PL 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 NMFS' La Grande, Oregon office.

1.2. Consultation History

NMFS received the U.S. Army Corps of Engineers' (Corps') request for formal consultation on its proposed Public Law (PL) 84-99 Nursery Bridge Drop Structure rehabilitation, and a biological assessment (BA), on April 19, 2021. The Corps will be providing the Milton–Freewater Water Control District (MFWCD), the Milton–Freewater Flood Protection System sponsor, emergency levee rehabilitation assistance for drop structure repairs. Under PL 84-99, the Corps can restore eligible flood protection systems, in this case the Nursery Bridge Drop Structure, to its pre-disaster status.

The Corps concluded that the proposed action is "likely to adversely affect" Middle Columbia River (MCR) steelhead (*Oncorhynchus mykiss*) and its designated critical habitat. NMFS requested additional information on site dewatering, fish salvage, and in-channel work by email on April 27 and May 18, 2021. We received the requested information on April 27 and May 19, 2021. NMFS emailed Mike Lambert, Ethan Green, and Mike Richards of the Confederated Tribes of the Umatilla Indian Reservation (CTUIR) and spoke to Mike Lambert on May 5, 2021, regarding the proposed project and the timing of in-water work. No comments were received from Ethan Green or Mike Richards. NMFS initiated consultation on May 19, 2021.

On June 22, 2021, we received an email from Ben Tice, Corps fish biologist, with an attached memorandum stating that the Corps had declared the proposed repair of the Nursery Bridge Drop Structure, Milton–Freewater Levee System, an emergency under PL84-99. NMFS thus terminated the ongoing ESA consultation via letter on July 13, 2021.

NMFS received an email from Ben Tice (Corps) on August 20, 2021, indicating they were unable to obtain repair materials in time and would delay the project until 2022. Because of the delay, the Corps resubmitted their biological assessment and request for formal consultation on November 4, 2021. NMFS initiated consultation on November 05, 2021, on the new action.

The Corps has consulted with NMFS several times on drop structure repairs following damage by high flows. NMFS issued opinions for flood damage repairs conducted under PL 84-99 on April 10, 2014 (NWR-2014-594) and May 1, 2017 (NWR- 2016-4464). Repairs included armoring the base of the spillway with a steel plate, placing riprap immediately below the end sill, and installing a gabion structure to stabilize the stream channel immediately downstream from the end sill. NMFS initiated another consultation in 2019, but terminated the consultation when the Corps declared the repairs an emergency action under PL84-99.

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). The Corps proposes to repair erosion damage and prevent future damage to the drop structure at Nursery Bridge on the Walla Walla River, pursuant to PL 84-99 (Rehabilitation Program). The Nursery Bridge drop structure is part of the Milton–Freewater Flood Control Project. The Corps constructed the flood control project between 1949 and 1952 to provide flood-risk reduction benefits to the City of Milton–Freewater and surrounding residences and businesses. The drop structure is a reinforced concrete structure built by the Corps in 1967 to control head cutting and to protect a railroad bridge, Eastside Road, and irrigation diversions (Figure 1). The drop structure includes a fish ladder constructed by the Corps in 2001, which provides migration access to the upper Walla Walla River for salmonid species. The MFWCD is the levee sponsor, and in charge of the operation and maintenance of the levee system. MFWCD requested, and the Corps approved, levee rehabilitation assistance under PL 84-99. This program gives the Corps authority to undertake activities in support of State and Local governments prior to, during, and after a flood event. The Corps inspected the damaged drop structure, developed engineered designs, and will hire a contractor to implement the proposed repairs.

High flows in February 2020 damaged the drop structure, with concrete erosion occurring upstream and downstream of the existing steel plates. Damage to the drop structure consisted of: (1) erosion of concrete to a depth of approximately 2 inches, mostly on the east end, up to 3.5 feet above the existing steel armor; and (2) erosion of the stilling basin floor concrete 1 to 10 inches deep, that extends up to 15 feet beyond the existing steel armor. Most of the damage is 1 to 2 inches deep with the exception of a 10-inch scour hole, which is about 5 feet long. The scour hole is about 40 feet from the west end and 9 feet downstream of the existing steel armor plate, with some exposed rebar pulled up from the stilling basin.

The proposed drop structure repair will extend the steel plates 4 feet on the upstream side and 6 feet on the downstream side of the existing steel armor (Figure 2). In one location where a hole exists, the armor will extend an additional 10 feet on the downstream side of the existing armor. Steel plates will be 0.5 inch thick with 0.75-inch-diameter adhesive anchors. The anchors will be welded to the armor with the welds ground smooth. The Corps expects repairs to extend the life of the Nursery Drop Structure indefinitely.

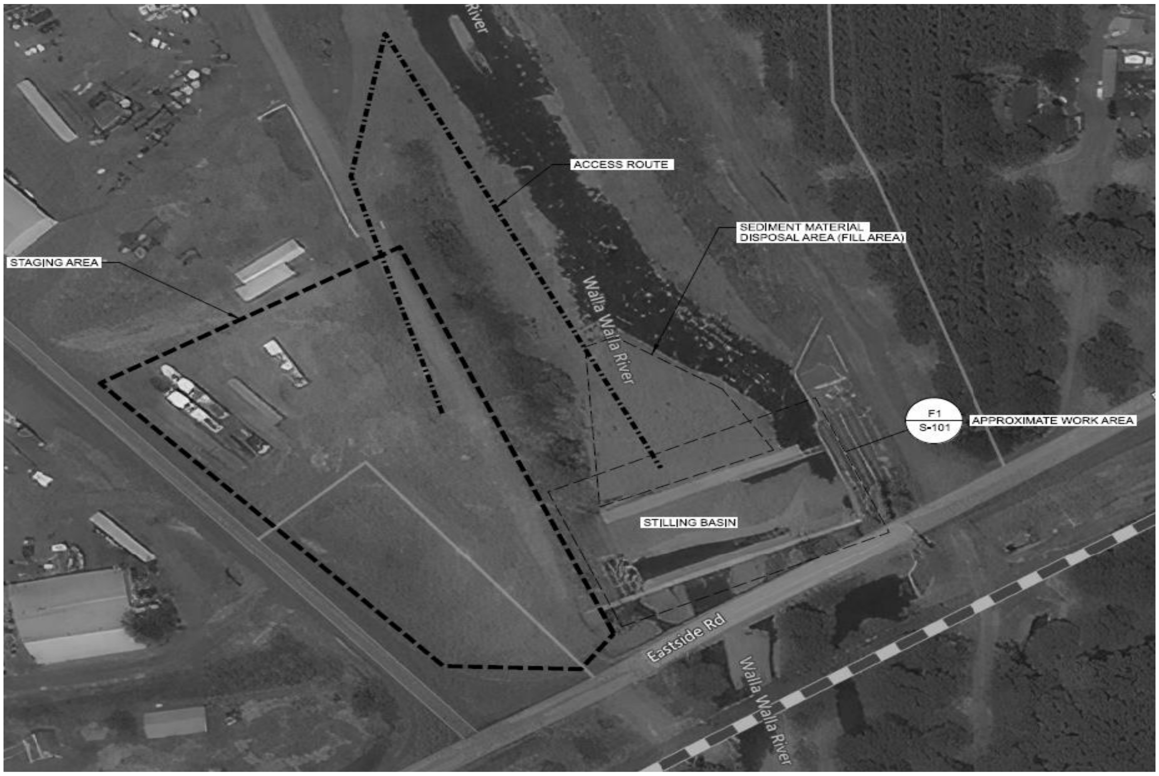

Figure 1. The 2022 Nursery Bridge Drop Structure repair project in the Walla Walla River, Oregon.

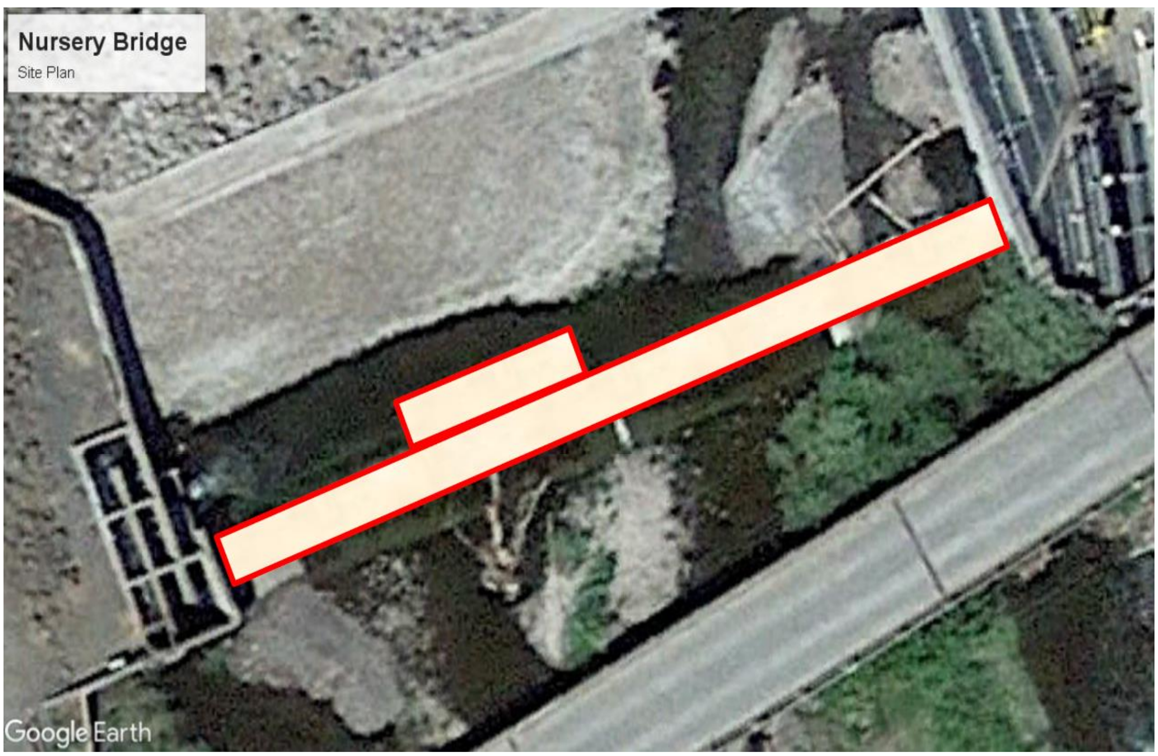

Figure 2. Approximate location of steel plate installation at the Nursery Bridge Drop Structure in 2022. The location of the steel plates is outlined in red.

1.3.1. Dewatering and Fish Salvage

River flow at the Eastside Fishway should be about 25 to 50 cubic feet per second (cfs) during project construction. Prior to initiation of project construction, the Walla Walla River will already be routed around the construction site by installation of the irrigation district's gravel berm. The berm routes most, if not all, of the Walla Walla River, into the Eastside Fishway and adjacent irrigation intake (Figure 3, label B). The Corps proposes to place another gravel berm to divert any remaining water into the fishway (Figure 3, label C). Prior to installation of the berm, the Corps will salvage the area to be dewatered (approximately 1,000 square feet) by seining and dip netting, then relocating fish to upstream of the fishway. This berm will be removed upon completion of the project.

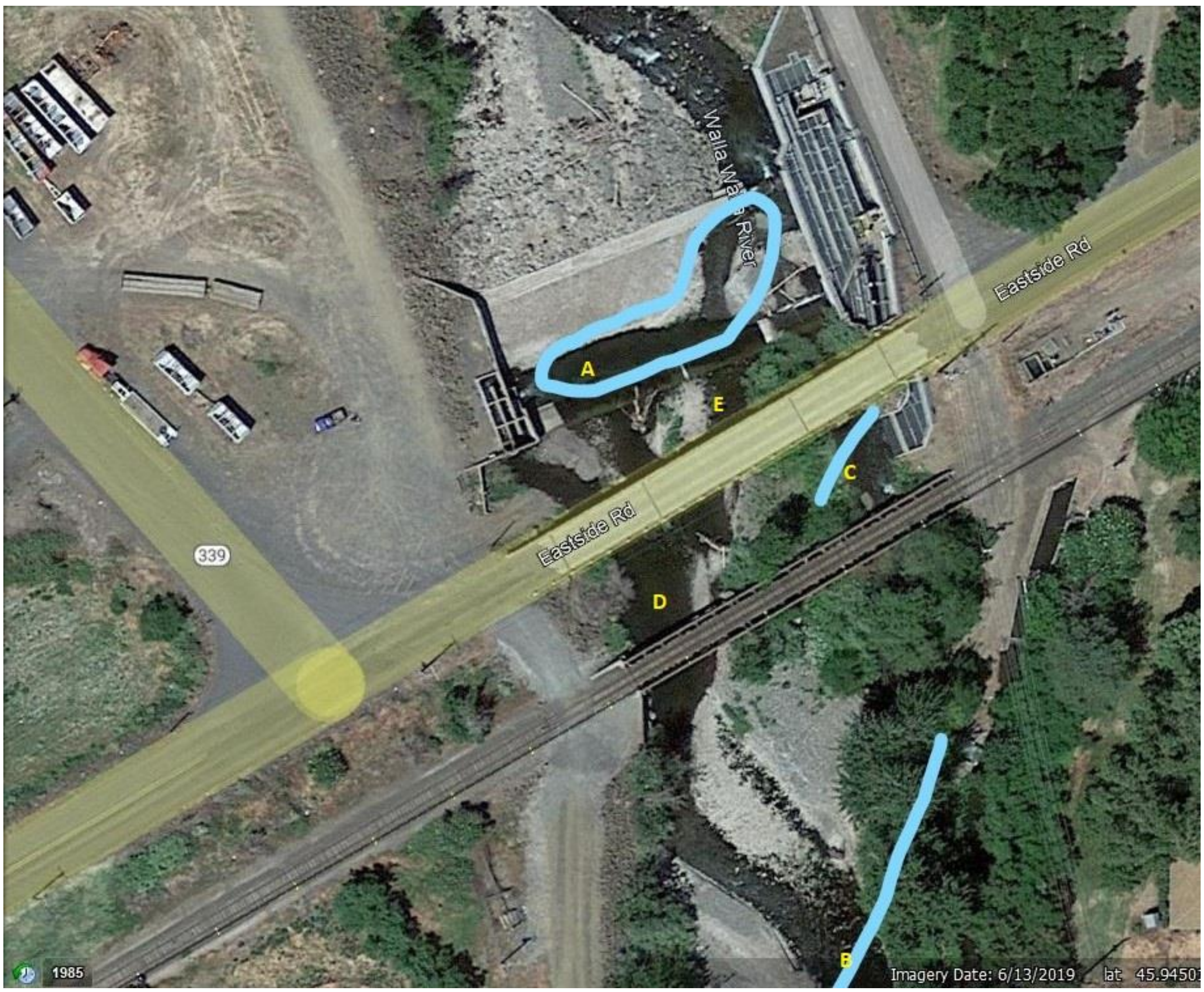

Figure 3. Location of dewatering and fish salvage activities associated with the U.S. Army Corps of Engineers' Nursery Bridge Drop Structure rehabilitation project in 2022.

There could be a very small amount of flow seeping under the berm labeled B. If seepage and fish are observed in the channel between the berm and drop structure, fish salvage will occur in the area labeled D using seines and dip nets. Any fish salvaged will be released upstream of the Eastside Fishway or the berm labeled B. The maximum area salvaged will be about 10,000 square feet, but very likely will be 2,500 square feet or less based on anticipated low flows and water diversion into the Eastside Fishway.

Seepage under both gravel berms could result in water going over the drop structure and into the work area. If this occurs, the Corps will install a sump and pump system above the Nursery Bridge Drop Structure. An excavator will dig a shallow 2-foot-deep sump at label E, and water pumped from above the drop structure to below the stilling basin and released. If the pumped water is visibly turbid, it will be pumped into a filter bladder. The disturbed area will be about 10 feet by 10 feet.

Fish salvage will also occur if water going over the drop structure creates a pool in the stilling basin (label A). The Corps will seine the pool, approximately 2,500 square feet, and herd fish downstream to the Eastside Fishway entrance. If necessary, the Corps will net and transport fish by buckets to the fishway entrance. Sandbags and plastic will be installed in the stilling basin to reroute water that flows into the work area. Once project construction is completed, all the temporary dewatering pumps and temporary water diversion and piping systems will be removed.

If heavy rains occur during project construction, all flow will still be diverted into the Eastside Fishway. In the extremely rare event that the fish ladder capacity is exceeded, remaining flow will be routed into the irrigation canal system.

1.3.2 Project Construction

Equipment will access the construction sites from existing roads (Figure 1). Approximately 270 cubic yards of river sediment in the stilling basin will be removed using an excavator, and spread in the dry portion of the channel downstream of the end sill to provide access to the damaged area. The sediment will consist of sand, gravel, cobble, and possibly some riprap.

Prior to placing the steel armor, approximately 4 cubic yards of concrete will be removed by saw cutting. Once the concrete is excavated, approximately 600 anchor holes, 7/8 of an inch in diameter and 8 inches deep, will be drilled. The surface of the concrete excavation will then be cleaned by pressure washing. Areas with concrete scour deeper than 2 inches will be filled with concrete mortar to maintain the grout fill to less than 2 inches. The anchors will be installed using epoxy adhesive.

Leveling nuts will be placed on the anchors to align the armor plates. The anchors will be welded to the armor plates, and the upper armor plates will be welded to the existing armor plates (Figure 2). The welds will be ground smooth on the surface of the armor. Rubber expansion joint filler will be placed between the armor plates. Cement based grout will be pumped into the space between the armor plates and the existing concrete surface. Approximately 8 cubic yards of grout will be used.

Construction activity will occur during the in-water work window, July 1–September 30, 2022. Repair work will likely take 2 months to complete.

1.3.3. Proposed Impact Minimization and Best Management Practices

The Corps will implement the following impact minimization measures and best management practices (BMPs):

1. All steel welds will be ground smooth.
2. Special measures taken to prevent chemicals, fuels, oils, greases, concrete dust, or concrete from entering surface water, land, and substrate soils.
3. Water from the pressure washing will be contained.
4. Fueling and lubrication of equipment and motor vehicles conducted in the staging areas.
5. Construction equipment kept in good repair without fuel, hydraulic or lubricating fluid leaks.
6. Equipment repairs performed in the staging areas or off the project site.
7. An Emergency Spill Response Kit available onsite. Kits will include products to absorb or encapsulate up to 25 gallons of hydrocarbons (oils, coolants, solvents). Spill absorbent mats will be in the immediate vicinity of all equipment performing work.
8. Riverbed sediment and large woody debris in the channel left in the channel to provide ecological functions downstream.

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 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 opinion also relies on the 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) 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), 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 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

In this opinion, we examine 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" as described in 50 CFR 402.02. We also examine the condition of critical habitat throughout the designated area, evaluate the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discuss the function of the PBFs that are essential for the conservation of the species.

2.2.1. Status of the Species

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

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

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

"Abundance" generally refers to the number of naturally-produced adults (i.e., the progeny of naturally-spawning parents) in the natural environment (e.g., on spawning grounds).

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

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

The summary that follows describes the status of MCR steelhead and its designated critical habitat. MCR steelhead is the one ESA-listed species that occurs within the geographic area of this proposed action and considered in this opinion. More detailed information on the status and trends of this listed resource, and its biology and ecology, are in the listing regulations and critical habitat designations published in the Federal Register (Table 1), as well as applicable recovery plans and 5-year status reports. These additional documents are incorporated by reference (NMFS 2009; NMFS 2016). The most recent 5-year status review was completed in 2016 (NMFS 2016), and a technical memo prepared by the Northwest Fisheries Science Center (NWFSC) for the status review contains detailed information on the biological status of MCR steelhead (NWFSC 2015). The next 5-year status reviews will be completed in 2022. These documents are available on the NMFS West Coast Region website (https://www.westcoast.fisheries.noaa.gov/).

Table 1. Listing status, status of critical habitat designation and protective regulations, and relevant Federal Register (FR) decision notices for Endangered Species Act-listed Middle Columbia River steelhead considered in this opinion.

Species	Listing Status	Critical Habitat	Protective Regulations
Middle Columbia River Steelhead (*Oncorhynchus mykiss*)	Threatened 3/25/1999; 64 FR 14517 Reaffirmed 5/26/2016; 81 FR 33458	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Life history. The MCR steelhead distinct population segment (DPS) includes 16 summer-run populations and 4 winter-run populations. MCR summer steelhead enter freshwater (the Columbia River) between May and October and require several months to mature before spawning in late winter through spring. Winter steelhead enter freshwater between November and April and spawn shortly thereafter. Summer steelhead usually spawn further upstream than winter steelhead. Steelhead in the Walla Walla Basin are summer-run. Fry emergence typically occurs between May and August dependent on water temperature. Some juveniles move downstream to rear in larger tributaries and mainstem rivers. Most steelhead smolt at 2 years and adults return to the Columbia River after spending 1 to 2 years at sea (NMFS 2009).

Steelhead are iteroparous, meaning they can spawn more than once. Repeat spawning for Columbia River Basin steelhead ranges from reported rates of 2 to 4 percent above McNary Dam (Busby et al. 1996) to 17 percent in the unimpounded tributaries below Bonneville Dam (Leider et al. 1986).

Spatial structure and diversity. This species includes all naturally-spawned steelhead populations originating below natural and manmade impassable barriers from the Columbia River and its tributaries upstream and exclusive of the Wind River in Washington and the Hood River in Oregon, to and including the Yakima River in Washington, excluding steelhead originating from the Snake River Basin. The Interior Columbia Basin Technical Recovery Team (ICTRT) identified 17 extant populations in this DPS (ICTRT 2003; McClure et al. 2005). The populations fall into four Major Population Groups (MPGs): Cascade eastern slope tributaries (five extant and two extirpated populations), the John Day River (five extant populations), the Walla Walla and Umatilla rivers (three extant and one extirpated populations), and the Yakima River (four extant populations) (ICTRT 2003; McClure et al. 2005). Steelhead in the Walla Walla River Basin are part of the Umatilla/Walla Walla MPG.

This DPS includes steelhead from seven artificial propagation programs (USDOC 2014). The DPS does not currently include steelhead that are designated as part of an experimental population above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon (USDOC 2013). NMFS has defined the steelhead DPSs to include only the anadromous members of this species (70 FR 67130). As of the latest status review (NWFSC 2015; NMFS

2016), viability ratings for the populations in the MCR steelhead DPS range from extirpated to highly viable (Table 2).

Table 2. Major population groups, populations, and scores for the key elements of abundance and productivity (A&P), diversity, and spatial structure and diversity (SS/D), used to determine current overall viability risk for Middle Columbia River steelhead during the most recent status review (NWFSC 2015). Risk ratings include very low (VL), low (L), moderate (M), high (H), and extirpated (E). Maintained (MT) population status indicates that the population does not meet the criteria for a viable population but does support ecological functions and preserves options for recovery of the Distinct Population Segment.

Major Population Group	Population (Watershed)	A&P	Natural Processes Risk	Diversity	Integrated SS/D	Overall Viability Risk
Cascade Eastern Slope Tributaries	Fifteenmile Creek	M	VL	L	L	MT
	Klickitat River	M	L	M	M	MT
	Deschutes Eastside	L	L	M	M	Viable
	Deschutes Westside	H	L	M	M	H
	Rock Creek	*	M	M	M	H
	White Salmon	N/A	N/A	N/A	N/A	E
	Crooked River	N/A	N/A	N/A	N/A	E
John Day River	Upper John Day	M	VL	M	M	MT
	North Fork John Day	VL	VL	L	L	Highly Viable
	Middle Fork John Day	L	L	M	M	Viable
	South Fork John Day	L	VL	M	M	Viable
	Lower John Day Tributaries	M	VL	M	M	MT
Walla Walla and Umatilla rivers	Umatilla River	M	M	M	M	MT
	Touchet River	H	L	M	M	H
	Walla Walla River	M	M	M	M	MT
Yakima River	Satus Creek	L	L	M	M	Viable
	Toppenish Creek	L	L	M	M	Viable
	Naches River	M	L	M	M	M
	Upper Yakima	M	M	H	H	H

* Reintroduction efforts underway (NMFS 2009).

Abundance and productivity. During the most recent status review (NWFSC 2015; NMFS 2016), NMFS determined that for almost all populations in this DPS, the most recent 5-year geomean for natural-origin abundance had increased relative to the previous 5-year review.[1] Similarly, 15-year trends were positive for most populations in the DPS.[2] Based on the most recent status review, NMFS concluded that the MCR steelhead DPS was at moderate risk and remained threatened. While there had been improvements in the extinction risk for some populations, and while several populations were considered viable, the MCR steelhead DPS as a

[1] For all five populations in the John Day MPG, all four populations in the Yakima River MPG, all three populations in the Umatilla/Walla Walla MPG, and for two of the three populations for which data were available in the East Cascade MPG.
[2] For four of five populations in the John Day MPG, all four populations in the Yakima River MPG, one population in the Umatilla/Walla Walla River MPG (a second population had a slightly negative trend and data were insufficient for the third), and for one of three populations with available data in the East Cascade MPG.

whole was not meeting delisting criteria and most risk ratings remained unchanged from the previous review. The increases in abundance and productivity needed to achieve recovery goals for MCR steelhead were generally smaller than those needed for the other Interior Columbia River basin-listed DPSs (NWFSC 2015).

However, there has been a downward trend in the abundance of natural-origin spawners at the DPS level from 2014 to 2019 (NMFS 2019). Estimates of natural-origin and total (natural- plus hatchery-origin) spawners through 2018 or 2019 at the population level have also decreased recently, with substantial downward trends in abundance for most of the MPGs and populations, including the Walla Walla River population, when compared to the number of spawners from 2009 to 2013. In many cases, including the Walla Walla River population, the most recent 5-year geometric mean in natural-origin abundance is considerably below the minimum abundance thresholds established by the ICTRT. However, the Klickitat, Middle Fork John Day, and Umatilla River populations are well above these thresholds.

A relatively limited number of hatchery fish are present on the spawning grounds within this DPS. Therefore, the 5-year geometric means are the same or very close for both natural-origin and total estimates of adults. Stray levels into the John Day River populations have decreased in recent years. However, out of basin hatchery stray proportions, although reduced, remain high in spawning reaches within the Deschutes River Basin populations. The 2019 natural-origin abundance level for the South Fork John Day River population was higher than the geometric mean for 2013 to 2018, but the abundance levels for the Lower John Day River Tributaries, Middle Fork John Day River, Walla Walla River, and Touchet River were lower than their respective recent geometric means.

This recent downturn in adult abundance is thought to be driven primarily by marine environmental conditions and a decline in ocean productivity, because hydropower operations, the overall availability and quality of tributary and estuary habitat, and hatchery practices have been relatively constant or improving over the past 10 years.[3] Increased abundance of sea lions in the lower Columbia River could also be a contributing factor.

NMFS will evaluate the implications for viability risk of these more recent returns in the upcoming 5-year status review, expected in 2022. The status review will also include new information on productivity, diversity, and spatial structure.

Limiting factors. Limiting factors for this species include (NMFS 2009; NWFSC 2015):

- Degradation of floodplain connectivity and function, channel structure and complexity, riparian areas, fish passage, stream substrate, stream flow, and water quality.
- Mainstem Columbia River hydropower-related impacts.
- Degraded estuarine and nearshore marine habitat.
- Hatchery-related effects.

[3] Many factors (e.g., higher summer temperatures, lower late summer flows, low spring flows, etc.) affect the ability of tributary habitat to produce juvenile migrants (capacity) each year. Recent drought and temperature patterns may have had a negative effect on tributary habitat productivity, and as a result, lower than average juvenile production may have contributed in some years to downturns in adult abundance.

- Harvest-related effects.
- Effects of predation, competition, and disease.

2.2.2. Status of Critical Habitat

In this section, we examine the status of designated critical habitat by examining the condition and trends of the essential PBFs of that habitat throughout the designated areas (Table 3). These features are essential to the conservation of the ESA-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). Rangewide, 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 rearing and freshwater migration habitats.

Table 3. Physical and biological features of critical habitat designated for Middle Columbia River steelhead, and corresponding species life history events.

Physical or 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/parr/smolt growth and development
Freshwater Migration	Free of artificial obstruction Natural cover Water quality Water quantity	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

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

Interior Columbia Recovery Domain

Critical habitat has been designated in the Interior Columbia recovery domain (ICRD), which includes the Umatilla and Walla Walla rivers. Habitat quality in tributary streams in the ICRD varies from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994; NMFS 2009). Intense agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization (EPA 2020; Lee et al. 1997; McIver and Starr 2001; NMFS 2009) have degraded critical habitat throughout much of the ICRD. Reduced summer stream flows, impaired water quality, and reduced habitat complexity are common problems for critical habitat in developed areas, including the Walla Walla River at the Nursery Bridge Drop Structure.

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, Bureau of 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 of emigrating juveniles is inversely related to the number of hydropower projects encountered. Similarly, development and operation of extensive irrigation systems and dams for water withdrawal and storage in tributaries have altered hydrological cycles.

A series of large regulating dams on the middle and upper Deschutes River affect flow and block access to upstream habitat, and have extirpated one or more populations from the Cascades Eastern Slope major population. Also, operation and maintenance of large water reclamation systems such as the Umatilla Basin and Yakima projects have significantly modified flow regimes and degraded water quality and physical habitat in this domain.

Many stream reaches designated as critical habitat in the ICRD are over-allocated, with more allocated water rights than existing streamflow. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). NMFS has identified reduced tributary streamflow as a major limiting factor for MCR steelhead in this area (NMFS 2007; NMFS 2011).

Many stream reaches designated as critical habitat are listed on Oregon's and Washington's Section 303(d) lists for water temperature. Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Contaminants such as insecticides and herbicides from agricultural runoff and heavy metals from mine waste are common in some areas of critical habitat.

The ICRD is a very large and diverse area. The CHART determined that few watersheds with PBFs for Chinook salmon or steelhead are in good-to-excellent condition with no potential for improvement. Overall, most ICRD watersheds are in fair-to-poor or fair-to-good condition. However, most of these watersheds have some or high potential for improvement.

Despite these degraded habitat conditions, the hydrologic unit codes that have been identified as critical habitats 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 Evolutionarily Significant Unit (ESU) or DPS.

A summary of the status of critical habitats considered in this opinion is provided in Table 4.

Table 4. Critical habitat, designation date, Federal Register (FR) citation, and status summary for critical habitat considered in this opinion.

Species	Designation Date and Federal Register Citation	Critical Habitat Status Summary
Middle Columbia River steelhead	9/02/05 70 FR 52630	Critical habitat encompasses 15 subbasins in Oregon and Washington containing 111 occupied watersheds, as well as the Columbia River rearing/migration corridor. Most fifth-field hydrologic code watersheds with physical or biological features for salmon are in fair-to-poor or fair-to-good condition (NMFS 2005). However, most of these watersheds have some or a high potential for improvement. The conservation value of occupied fifth-field hydrologic code watersheds is rated as high for 80 watersheds, medium for 24 watersheds, and low for 9 watersheds.

2.2.3. Climate Change

One factor affecting the status of ESA-listed species considered in this opinion, and aquatic habitat at large, is climate change. Climate change is likely to play an increasingly important role in determining the abundance and distribution of ESA-listed species, and the conservation value of its designated critical habitats, in the Pacific Northwest. These changes will not be spatially homogeneous across the Pacific Northwest. The largest hydrologic responses are expected to occur in basins with significant snow accumulation, where warming decreases snow pack, increases winter flows, and advances the timing of spring melt (Mote et al. 2014, 2016). Rain-dominated watersheds and those with significant contributions from groundwater may be less sensitive to predicted changes in climate (Tague et al. 2013; Mote et al. 2014).

During the last century, average regional air temperatures in the Pacific Northwest increased by 1 to 1.4°F as an annual average, and up to 2°F in some seasons, based on average linear increase per decade (Abatzoglou et al. 2014; Kunkel et al. 2013). Warming is likely to continue during the next century as average temperatures are projected to increase another 3 to 10°F, with the largest increases predicted to occur in the summer (Mote et al. 2014; USGCRP 2018). 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).

Decreases in summer precipitation of as much as 30 percent by the end of the century are consistently predicted across climate models (Mote et al. 2014). Precipitation is more likely to occur from October through March, less during summer months, and more winter precipitation will be rain than snow (ISAB 2007; Mote et al. 2014). Earlier snowmelt will cause lower stream flows in late spring, summer, and fall, and water temperatures will be warmer (ISAB 2007; Mote et al. 2014). Models consistently predict increases in the frequency of severe winter precipitation events (i.e., 20-year and 50-year events), in the western United States (Dominguez et al. 2012). The largest increases in winter flood frequency and magnitude are predicted in mixed rain-snow watersheds (Mote et al. 2014).

The combined effects of increasing air temperatures and decreasing spring-through-fall flows are expected to cause increasing stream temperatures. Overall, about one-third of the current cold-water salmonid habitat in the Pacific Northwest is likely to exceed key water temperature thresholds by the end of this century (Mantua et al. 2009). Higher temperatures will reduce the quality of available salmonid habitat for most freshwater life stages (ISAB 2007). Reduced flows will make it more difficult for migrating fish to pass physical and thermal obstructions, limiting their access to available habitat (Isaak et al. 2012; Mantua et al. 2010). Temperature increases shift timing of key life cycle events for salmonids and species forming the base of their aquatic foodwebs (Crozier et al. 2011; Tillmann and Siemann 2011; Winder and Schindler 2004). Higher stream temperatures will also cause decreases in dissolved oxygen and may also cause earlier onset of stratification and reduced mixing between layers in lakes and reservoirs, which can result in reduced oxygen (Meyer et al. 1999; Raymondi et al. 2013; Winder and Schindler 2004). Higher temperatures are likely to cause several species to become more susceptible to parasites, disease, and higher predation rates (Crozier et al. 2008; Raymondi et al. 2013; Wainwright and Weitkamp 2013).

As more basins become rain-dominated and prone to more severe winter storms, higher winter stream flows may increase the risk that winter or spring floods in sensitive watersheds will damage spawning redds and wash away incubating eggs (Goode et al. 2013). Earlier peak stream flows will also alter migration timing for salmon smolts and may flush some young salmon and steelhead from rivers to estuaries before they are physically mature, increasing stress and reducing smolt survival (McMahon and Hartman 1989; Lawson et al. 2004).

In addition to changes in freshwater conditions, predicted changes for coastal waters in the Pacific Northwest as a result of climate change include increasing surface water temperature, increasing but highly variable acidity, and increasing storm frequency and magnitude (Mote et al. 2014). Elevated ocean temperatures already documented for the Pacific Northwest are highly likely to continue during the next century, with sea surface temperature projected to increase by

1.0 to 3.7°C by the end of the century (IPCC 2014). Habitat loss, shifts in species' ranges and abundances, and altered marine food webs could have substantial consequences to anadromous, coastal, and marine species in the Pacific Northwest (Tillmann and Siemann 2011).

Moreover, as atmospheric carbon emissions increase, increasing levels of carbon are absorbed by the oceans, changing the pH of the water. A 38 to 109 percent increase in acidity is projected by the end of this century in all but the most stringent CO_2 mitigation scenarios, and is essentially irreversible over a time scale of centuries (IPCC 2014). Regional factors appear to be amplifying acidification in Northwest ocean waters, which is occurring earlier and more acutely than in other regions and is already impacting important local marine species (Barton et al. 2012; Feely et al. 2012). Acidification also affects sensitive estuary habitats, where organic matter and nutrient inputs further reduce pH and produce conditions more corrosive than those in offshore waters (Feely et al. 2012; Sunda and Cai 2012).

Global sea levels are expected to continue rising throughout this century, reaching likely predicted increases of 10 to 32 inches by 2081–2100 (IPCC 2014). These changes will likely result in increased erosion and more frequent and severe coastal flooding and shifts in the composition of nearshore habitats (Tillmann and Siemann 2011). Estuarine-dependent salmonids such as chum and Chinook salmon are predicted to be impacted by significant reductions in rearing habitat in some Pacific Northwest coastal areas (Glick et al. 2007). Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances, and therefore these species are predicted to fare poorly in warming ocean conditions (Scheuerell and Williams 2005; Zabel et al. 2006). This is supported by the recent observation that anomalously warm sea surface temperatures off the coast of Washington from 2013 to 2016 resulted in poor coho and Chinook salmon body condition for juveniles caught in those waters (NWFSC 2015). Changes to estuarine and coastal conditions, as well as the timing of seasonal shifts in these habitats, have the potential to impact a wide range of listed aquatic species (Tillmann and Siemann 2011; Reeder et al. 2013).

The adaptive ability of these threatened and endangered species is depressed due to reductions in population size, habitat quantity and diversity, and loss of behavioral and genetic variation. Without these natural sources of resilience, systematic changes in local and regional climatic conditions due to anthropogenic global climate change will likely reduce long-term viability and sustainability of populations in many of these ESUs and DPSs (NWFSC 2015). New stressors generated by climate change, or existing stressors with effects that have been amplified by climate change, may also have synergistic impacts on species and ecosystems (Doney et al. 2012). These conditions will possibly intensify the climate change stressors inhibiting recovery of ESA-listed species in the future.

Potential climate change effects in the Walla Walla River Basin are likely to include more precipitation in the form of rain than snow, increased frequency of high flows in the late fall and winter, and an earlier onset of spring snowmelt (Stewart et al. 2005). These changes will affect adult upstream migration and juvenile spring outmigrating flows, and will lower late season flows (Elsner et al. 2010). With a reduction in snowpack, the infiltration into groundwater that occurs from snow melting will be reduced and the corresponding late season flows that are fed by the groundwater will decline. A further reduction in late season flows will increase the need for fish to access higher elevations of the basin during the summer to find areas of cooler water. The higher elevation areas contain much greater habitat diversity providing areas of cool water upwelling in the summer and refugia during floods. Overall, climate change represents a significant threat to recovery of MCR steelhead populations, including the Walla Walla population (ISAB 2007; NMFS 2009).

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 Nursery Bridge Drop Structure is located at River Mile (RM) 44.6, where Eastside Road crosses the Walla Walla River in Milton–Freewater, Oregon. For purposes of this consultation, the action area is the Walla Walla River from 300 feet downstream to approximately 300 feet upstream of the Nursery Bridge Drop Structure. It also includes an area extending 150 feet landward of the left bank (west side) from the upstream end of the drop structure and 100 feet landward on the right bank (east side), both 300 feet upstream and 300 feet downstream. This includes the area below the ordinary high water mark (OHWM) where flows will be managed, the dewatered area where construction will occur, the free-flowing river where turbidity is likely when the construction area is re-watered, the fish ladders and Eastside Fishway exit, the area of isolation and fish salvage below the irrigation berm, and the adjacent staging and river access areas.

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).

2.4.1. Middle Columbia River Steelhead in the Action Area

The proposed action will take place within the Umatilla/Walla Walla Basin MPG boundaries and will affect the Walla Walla River population. The Umatilla/Walla Walla MPG does not meet viability criteria because the abundance and productivity of the Umatilla and Walla Walla populations are considered at moderate risk, the Touchet River population abundance and productivity is at high risk, and all three populations have moderate risk for spatial structure and diversity (SS/D). Overall, the Umatilla and Walla Walla River populations are considered maintained while the Touchet River population is considered to be at high risk. Recovery criteria for the Umatilla/Walla Walla MPG requires two populations to meet viability criteria and the third population to be maintained. The ICTRT also calls for at least one population to be highly viable. Under current conditions, the Umatilla River population is the closest to being highly viable. Of the remaining two populations, the Walla Walla is much closer to reaching viable status than the Touchet River population.

The Walla Walla River population occupies the Walla Walla River and its tributaries, except the Touchet River. The Walla Walla River population is considered intermediate sized, with an abundance threshold of 1,000 spawners (10–12 year geometric mean) and a productivity threshold of 1.35 recruits per spawner. Currently, the Walla Walla population does not meet its abundance and productivity or its SS/D viability criteria (Table 5). In 2015, the 10-year geomean (2005–2014) of total abundance decreased for the Walla Walla River population (NWFSC 2015), and the most recent draft escapement data suggests the 10-year geomean (2010–2019) for the Walla Walla population is continuing to decline (Table 5). Based on current abundance and productivity and SS/D, NMFS considers the Walla Walla steelhead population to be at moderate risk of extinction, less than 25 percent risk of extinction over the next 100 years.

Table 5. The most recent 10-year geometric mean of natural-origin steelhead spawners and the most recent 20-year geometric mean of recruits per spawner for the Walla Walla River steelhead population. Source of data is the Oregon Department of Fish and Wildlife's salmon and steelhead recovery tracker.

10-Year Geometric Mean of Natural Origin Spawners		**20-Year Geometric Mean or Recruits Per Spawner**	
Abundance Threshold	**Spawn Years 2010–2019**	**Productivity Threshold**	**Brood Years 1993–2012**
1,000	713	1.35	0.9873

Within the Recovery Plan (NMFS 2009), NMFS identifies several limiting factors and proposed actions for the Walla Walla population, including: (1) blocked and impaired fish passage, (2)sedimentation, (3) lack of habitat diversity, (4) flow manipulation, (5) high water temperatures, and (6) degraded floodplain and channel structure. The actions to address these limiting factors include: (1)protect and restore floodplain and riparian function, as well as channel migration processes, structure, and complexity; (2) modify channel geometry; (3)install instream habitat, (4) set levees back or remove them completely, and (5) add large wood.

2.4.2. Critical Habitat in the Action Area

The Walla Walla River in the action area is designated critical habitat for MCR steelhead. The action area provides limited spawning and rearing habitat, and it is a critical migration corridor to high quality spawning and rearing habitat upstream in the North and South Forks of the Walla Walla River (NMFS 2005). The action area provides PBFs of critical habitat for spawning, migration, and rearing, though these persist in a largely degraded condition. The Nursery Bridge Drop Structure limits processes, which help form spawning habitat, including gravel and wood recruitment. The amount of suitable juvenile rearing habitat and the amount of time that the available habitat is suitable for rearing is also limited. The lack of deep water holding habitat for adults, along with the passage barrier at the drop structure, impairs migration in the action area.

Transportation infrastructure, levee construction and maintenance, floodplain development, and irrigation diversions have severely altered the environmental baseline of the Walla Walla River in the action area. They alter the hydrology and the movements of sediment, isolate floodplain areas, decrease summer instream flow, decrease the amount and function of riparian vegetation, decrease available cover for rearing and migrating steelhead, and inhibit adult and juvenile migration.

Transportation infrastructure in the action area includes Nursery Bridge, a Umatilla County bridge that conveys Eastside Road over the Walla Walla River, and a railroad bridge that parallels Eastside Road immediately to the south. Bridge piers are located within the channel. Sedimentation is particularly notable downstream of the railroad bridge piers. Consequently, active maintenance to remove accumulated sediment within the channel bed occurs annually.

The construction, maintenance, and operation of the Milton–Freewater Flood Protection System, authorized by the Flood Control Act of 1941 and constructed by the Corps between 1949 and 1952, confines and simplifies the Walla Walla River and isolates floodplain areas from the Walla Walla River. Flooding in 1964–1965 damaged substantial portions of the levee system (Teasdale 2010). In 1967, the Corps constructed the Nursery Bridge Drop Structure and fishway (west side of channel) because of the accelerated vertical degradation that began following the construction of the levees and to address bed scour after the 1964 flood event that resulted in head cutting that threatened the bridge abutments. However, channel degradation continues. The drop structure inhibits movement of coarse sediment. Excessive aggradation has been, and continues to occur upstream of the Nursery Bridge Drop Structure while downstream of the structure the channel is starved for alluvium and continues to incise in places. Head cuts continue to occur downstream of the drop structure.

The original drop structure included a drop of approximately 13 vertical feet over the spillway with a stilling basin, and a lower sill approximately 6.5 feet above the stilling basin bottom. Repairs to the drop structure, similar to what is currently proposed, occurred in the summer of 2011, 2014, and 2017. In 2011, degraded concrete over the face of the spillway was replaced (Figure 4). In 2014, the spillway was re-faced to address stability concerns (USACE 2014 and 2016). The repair project included construction of a gabion mattress and replacement of the drop structure steel armor plate intended to address damage to the stilling basin and undermining of the sill wall (Figure 5). In 2017, additional rock placed downstream of the lower sill to prevent scour (Figure 6). The lower sill was notched on the east side to direct more flow to the east into the Eastside Fishway. Several other smaller modifications made over the years to improve functionality of the system. The Corps added the Eastside Fishway at the drop structure in 2001.

The Nursery Bridge reach has a history of passage related issues due to the confinement of the river between the levees and incision below the drop structure. At the Nursery Bridge Drop Structure, flood control levees parallel the river along its west (left) bank and a high terrace consisting of eroded banks of cemented alluvium constrains the river on the east bank. Passage issues have reoccurred on an annual basis since the completion of the Eastside Fishway in 2001. The Eastside Fishway was installed to improve fish passage and to provide brood collection facilities. The Eastside Fishway is the primary fish passage route at the site, but its performance has been limited particularly by bedload transported into the facility during high flows. The presence of the Walla Walla River Irrigation District (WWRID) diversion weir on the east side of the valley, and the historical tilt of the Nursery Bridge Drop Structure towards the western fish ladder, results in a condition where the primary flow path is directed to the west side of the levee system. This results in aggradation on the east side at the Eastside Fishway exit, resulting in reduced flows and/or isolation of the Eastside Fishway from the main river channel. In some years, active maintenance of the system requires several multiple mobilizations into the channel per year to move the low flow channel to align with the irrigation diversion and the Eastside Fishway and to dredge accumulated sediment.

Sedimentation has also blocked entrance into the Eastside Fishway. In 2014, CTUIR installed a roughened channel downstream of the concrete drop structure to stabilize the bed and maintain fish ingress/egress to the Eastside Fishway. As long as the Nursery Bridge Drop Structure remains, there will always be a discontinuity in the sediment transport system (Abbe and Hrachovec 2019).

Figure 4. Replacement of degraded concrete on the Nursery Bridge Drop Structure Spillway in 2011 (Photograph provided by John Wells).

The WWRID irrigation diversion is located approximately 350 feet upstream of the drop structure. Summer low flows below the WWRID intake and through the action area are 25 cfs by agreement between the U.S. Fish and Wildlife Service (USFWS) and three local irrigation districts (USFWS 2001). Based on July to September flow measurements in 2010 to 2019, reported on the Walla Walla Basin Watershed Council website, flows in the action area will likely be 25–50 cfs during the summer.

Riparian vegetation is currently limited to the area between the levees. As part of a negotiated agreement in the 1990s to manage vegetation, trees and shrubs are permitted to establish within the leveed corridor, but must be removed from the face of the levees when above surrounding grade. Therefore, the waterward faces of the levees are composed of rock riprap and mostly barren of riparian vegetation. Immediately above the drop structure, riparian vegetation has been establishing on gravel bars. Developing riparian vegetation includes cottonwood, alder, willow, and elderberry. The newer riparian vegetation appears to be aggrading gravel bars. There is much less riparian vegetation below the drop structure.

The Walla Walla River in the action area is on the Oregon Department of Environmental Quality 303(d) list for water temperature. Sediment and turbidity are not documented as problems in the action area but are considered general problems throughout the subbasin.

Figure 5. Corps of Engineers repairs to the Nursery Bridge Spillway in 2014, to address stability concerns.

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 (50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

Effects to MCR steelhead and critical habitat include: (1) injury and mortality from work area isolation and fish salvage; (2) increased exposure to predators from temporary increases in turbidity; (3) water quality impacts from increases in turbidity and releases of small amounts of chemicals during project construction, and from in-water mobilization and work to dredge sediment; (4) temporary and long-term loss of forage; and (5) obstructed fish passage.

Figure 6. Roughened riffle installed by the Corps of Engineers below the Nursery Bridge Drop Structure in 2017.

2.5.1. Effects on Species

Presence and Exposure

Middle Columbia River steelhead use the action area of the Walla Walla River for rearing and migration to and from spawning grounds and rearing areas higher in the watershed. Adult steelhead typically pass Nursery Bridge as early as December, though usually not until February, migrating past the project area through April and as late as early June, to spawn within the upper watershed. Some limited steelhead rearing and use of the action area occurs year-round.

Project construction will occur during the in-water work window, July 1–September 30, 2022, and will take approximately 2 months to complete. Only juvenile steelheads are in the project area during the in-water work window. Therefore, project construction activities will not affect adult steelhead. Rehabilitation of the drop structure will extend its life indefinitely, and will have on-going effects to juvenile and adult steelhead.

Work Area Isolation and Fish Salvage

Project construction will occur during irrigation season. Therefore, all Walla Walla River flow, expected to be 25–50 cfs, will likely be going to the irrigation intake, through the Eastside Fishway, and around the construction site. If there is still flow in the mainstem channel, project construction will include: installation of a berm to divert remaining flow into the Eastside Fishway; installation of isolation barriers; installation of a sump and pump system above the drop structure; and fish salvage in three locations, totaling 6,000 square feet (Table 6). If heavy rains occur during project construction, all flow will still be diverted into the Eastside Fishway. In the extremely rare event that the fish ladder capacity is exceeded, remaining flow will be routed into the irrigation canal system and around the project work area.

Isolation and fish salvage will proceed from the stilling basin, to below the berm at Location C, to between the drop structure and the berm at Location B. All three areas will remain isolated throughout project construction, approximately 2 months. Fish salvage will occur prior to water diversion and installation of the pump. The Corps and NMFS expect the WWRID will have installed the irrigation diversion berm at Location B prior to project construction, and all river flow will be going through the Eastside Fishway. Although water could seep under the berm, we expect very little to no flow below the berm to the Nursery Bridge Drop Structure. Therefore, NMFS estimates only 25 percent of Location D, 2,500 square feet, will have water and require fish salvage.

Table 6. Locations and area of fish salvage, and estimated numbers of juvenile Middle Columbia River steelhead salvaged, for repair of the Nursery Bridge Drop Structure, July–September 2022.

		Number of Juvenile MCR Steelhead		
Fish Salvage Location	**Area (square feet) Salvaged**	**In Fish Salvage Location**	**Successfully Salvaged**	**Mortalities**
Stilling Basin – Location A	2,500	92	91	1
Below Berm – Location C	1,000	37	35	2
Above Nursery Bridge Drop Structure – Location D	2,500	92	87	5
Total	6,000	221	213	8

Fish salvage will consist of herding fish out of the construction area and netting any fish that do not leave on their own. If water is creating a pool below the drop structure, the Corps will use a seine to capture fish and transport them in buckets to the nearest flowing water, or use a seine to herd fish downstream to the Eastside Fishway entrance. Above the Nursery Bridge Drop Structure, the Corps will use a seine to capture fish and transport them in buckets to the nearest flowing water, likely upstream of the Eastside Fishway. Many factors influence the success of fish salvage efforts, including water depth, habitat complexity, temperature, salvage methods, crew experience, and care of fish after capture. At best, all fish are captured without injury and successfully released. However, in many cases some fish are difficult to capture, sustain injuries, and experience high stress after capture. Herding will minimize the risk of injury and mortality to listed fish to the extent possible. However, seining, netting, capture, and handling may injure fish and can increase stress, resulting in harm or death to some individuals. Additionally, a small number of fish may not be found by the fish capture crew and could end up stranded during dewatering.

NMFS estimates up to 6,000 square feet (667 square yards) of the Walla Walla River will be isolated and dewatered. NMFS used available data from the CTUIR sampling in the Walla Walla River in 2004–2005 to estimate the density of juvenile steelhead in the action area during dewatering and fish salvage operations. The CTUIR's density study forms a reasonable basis to estimate how many fish will likely occupy the action area based on similar adult steelhead counts at Nursery Bridge in 2002–2004 and 2017–2020.

In the summer of 2004 and 2005, the CTUIR conducted studies to determine juvenile *O. mykiss* densities in several reaches of the Walla Walla River (Mahoney et al. 2006). In a study reach at RM 43.1, (1.5 miles downstream of Nursery Bridge and the proposed work area), the CTUIR found total densities (age 0 and 1+) of 0.28 to 0.33 fish per square yard (0.031 to 0.0367 fish per square foot). The area of riverbed that will be disturbed is approximately 6,000 square feet. Applying the highest juvenile density of 0.0367 fish per square foot, NMFS estimates 221 fish could be occupying the in-water work area prior to commencement of salvage operations.

The area of riverbed that will be disturbed in the stilling basin is approximately 2,500 square feet. NMFS estimates 92 fish could be occupying the in-water work area within the stilling basin. Because the stilling basin contains little cover, NMFS assumes at least 80 percent of the fish (74 fish) will be unable to hide and will move away from the disturbance of people and nets and out of the work area. Of the 18 or fewer *O. mykiss* likely to remain in the work area, NMFS expects that further removal efforts with seines and dipnets will be 100 percent effective because of the lack of natural substrate to hide in. NMFS also estimates that not more than 5 percent (1 fish) of the fish netted or handled during salvage will be killed or experience sufficient harm to result in death.[4] Therefore, we estimate 91 juvenile steelhead will be salvaged and released safely, and one juvenile will be injured or killed, during fish salvage in the stilling basin.

The area of riverbed that could be salvaged above Nursery Bridge Drop Structure is approximately 3,500 square feet (1,000 square feet in Locations C and 2,500 square feet in Location D). In each location, the substrate is mostly gravel with some small cobble, and water depth will only be a few inches. Applying the highest juvenile density of 0.0367 fish per square foot, NMFS estimates that 129 juvenile fish, 37 below the berm at Location C and 92 between Nursery Bridge Drop Structure and the berm at Location B, could be occupying this in-water work area prior to commencement of salvage operations.

NMFS expects all fish salvaged above Nursery Bridge Drop Structure will be captured and released above the irrigation diversion berm (Location B) or above the Eastside Fishway. NMFS estimates that 95 percent of juveniles in each area (35 below the berm and 87 above the drop structure) will be captured and released upstream without ill effects. However, we expect that the remaining 5 percent (2 below the berm at Location C and 5 between the drop structure and the

[4] This is a conservative estimate based on the professional opinion of NMFS biologists and takes into account expected fish size, capture methods, and site conditions. The latter include anticipated depth, cover, substrate, turbidity, and flow.

berm at Location B; 7 total) will be injured or killed because they are unable to be captured during fish salvage and succumb to lack of oxygen or desiccation during dewatering, or they will experience external or internal injury, including injurious levels of stress, during holding and handling. We assume that fish that are injured or experience injurious levels of stress will be less likely to survive the challenges of outmigration and will ultimately die as a result. Therefore, NMFS estimates 122 juvenile steelhead will be salvaged and released safely, and seven juveniles will be injured or killed during fish salvage above the Nursery Bridge Drop Structure.

Using a fry-to-smolt survival rate of 0.135 (Quinn 2005) and a smolt-to-adult survival rate of 0.035 (Mendel et al. 2014), the injury or death of up to eight juvenile steelhead does not accrue to the loss of one adult steelhead. NMFS does not believe the proposed action will influence the abundance or productivity of the Walla Walla River population.

Physical Injury

Work involving the presence of equipment or vehicles in the active channel when ESA-listed fish are present can result in injury or death of some individuals as they come in contact with the equipment. Prior to conducting in-water work, the Corps will salvage all areas with rearing MCR steelhead. Based on anticipated low flows, shallow water, and substrate, we expect most, if not all, steelhead to be herded out of the work area. We also expect any juvenile steelhead that were not herded out of the work area to swim away from any in-water disturbance. Therefore, we do not anticipate physical injury to MCR steelhead from operation of equipment in the active channel.

Water Quality

The proposed action will affect water quality during work area isolation and dewatering, placing gravel below the stilling basin for equipment access, equipment entry and exit from the work area, fish salvage, and when flows are reestablished, by temporarily increasing sediment delivery to the waterway and turbidity in the water column, and by small releases of fuels and contaminants. Increased fine sediment can be detrimental to juvenile salmon and steelhead in several ways including avoidance of the area, abandonment of cover, stress, and reduced growth rates (Newcombe and Jensen 1996). Turbidity from increased fine sediment may disrupt steelhead feeding and territorial behavior and may displace fish from preferred feeding and resting areas. Direct mortality can occur at very high concentrations or extended exposure to suspended solids. The severity of effect of suspended sediment increases as a function of the sediment concentration and exposure time (Bash et al. 2001; Newcombe and Jensen 1996).

We expect turbidity to increase downstream for a short period of time (minutes to an hour) during installation and removal of work area isolation materials, and immediately after flow is reestablished. NMFS also expects increased turbidity from pumping water around the work area, which will last 2 months. Although pumped water will be filtered prior to release, smaller particles such as silts and sands will still be released downstream. Based on monitoring reports of previous actions in this location during low flows, and use of a sediment filter bag at other locations, we expect turbidity to extend 300 feet downstream of the work site, and span an average of 20 feet across the 30- to 50-foot-wide channel (6,000 square feet). Additionally, we expect turbidity to be of low concentration. However, NMFS expects that the turbidity levels generated by this action will cause temporary behavioral changes to steelhead below the drop structure-stilling basin, including changes in feeding behavior and movement of fish within turbidity plumes, which will increase the risk of predation (Berg And Northcote 1985).

We used the same fish density estimate applied above to estimate the number of juveniles that will be exposed to increased suspended sediment concentrations below the stilling basin. Therefore, we estimate exposure to 220 juvenile *O. mykiss* (6,000 square feet x 0.0367 juveniles per square foot). When exposed to increased suspended sediment concentrations, some individuals will likely move to avoid the turbid water, and others may sustain some physical or physiological damage, but it is unlikely that any will die. However, as a worst-case scenario, we assume that all of these fish will be steelhead and all will be harmed. Using the same fry-to-smolt and smolt-to-adult survival rates as above, these 220 juveniles would be one adult equivalent.

Additional impairment of water quality may result from accidental releases of fuel, oil, and other contaminants that can injure or kill aquatic organisms. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can kill salmon at high levels of exposure, and can cause sublethal, adverse effects at lower concentrations (Meador et al. 2006). Therefore, spills that make their way into the Walla Walla River could harm fish. The operation of equipment will predominantly be in isolated and dewatered areas, except for the use of heavy equipment to install the berm at Location C and the sump and pump at Location E. Since most fish will be removed from the in-channel work area before construction, very few are likely to be exposed to accidental spills. In addition, NMFS anticipates that only very small quantities (ounces) of PAHs are likely with each accidental release or spill. Conservation measures will be implemented to prevent or contain any spill that may occur (e.g., staging and fueling equipment in a protected location, emergency spill response kit available onsite, and equipment maintenance). These should minimize the opportunity for contaminants to enter the waterway and affect steelhead. NMFS does not expect any fish to be injured or killed by exposure to accidental releases of fuel, oil, and other contaminants caused by this action.

Forage

Food availability has the potential to limit stream salmonid production (McCarthy et al. 2009; Rosenfeld et al. 2005; Wipfli and Baxter 2010). In lotic environments, salmonids primarily forage on aquatic and terrestrial invertebrates drifting in the water column (Allan et al. 2003; Dedual and Collier 1995; Elliott 1973; Cada et al. 1987; Nielsen 1992; Romaniszyn et al. 2007; Weber et al. 2014; Wipfli 1997). Salmonids may also forage epibenthically, especially during periods of low flow or low drift abundance (Angradi and Griffith 1990; Nakano et al. 1999; Tippets and Moyle 1978).

The proposed action will effect benthic invertebrates by crushing, covering, or dislodging them during installation of the berm at Location C and the sump and pump at Location E, desiccation during dewatering in the stilling basin and above the drop structure, and settling of suspended sediment below the stilling basin. Dewatering of the stilling basin and above the drop structure will disturb approximately 6,000 square feet of river bottom for 2 months. Drying events typically result in major changes to instream communities and reductions in local benthic invertebrate production (Chadwick and Huryn 2005; Graeber et al. 2013; Leigh et al. 2016; Storey 2016). The response of macroinvertebrate assemblages to drying is influenced by drying duration and stream characteristics (Vadher et al. 2018). We expect the dewatering event to last 8 weeks and reduce taxa richness and density by up to 85 percent (Fritz and Dodds 2004).

An additional 6,000 square feet of river bottom, up to 300 feet downstream of the stilling basin, may be disturbed by turbidity and settling of suspended sediment. Fine sediment accumulation can cause a loss of abundance and diversity in macroinvertebrate communities (Ehrhart et al., 2002; Freeman and Schorr, 2004; Hutchens et al., 2009; Larsen and Ormerod 2010; Suren and Jowett 2001; Wood and Armitag 1997). Many macroinvertebrate taxa belonging to the Ephemeroptera, Plecoptera and Trichoptera orders, which provide the most productive and available food for stream fishes, are particularly affected by sedimentation (Waters 1995; Wood et al. 2005). We expect a fine film of sediment to settle out of suspension within 300 feet downstream of the drop structure. We also expect the deposited sediment to flush out with the first high flow event.

The alteration of 12,000 square feet (0.28 acres) of riverbed will cause localized reductions in macroinvertebrates that serve as the principle food source for juvenile steelhead. We expect invertebrate drift through the Eastside Fishway will maintain a source of forage for steelhead below the drop structure. Following reconnection of the isolated areas with the flowing channel, drifting invertebrates from upstream will also provide a prey base. We also expect forage species will begin to recolonize disturbed areas via drift and migration within a few days, and will fully recolonize the area within a few months to 1 year after project completion (Fowler 2004; Fritz and Dodds 2004; Griffith and Andrews 1981; Yount and Nemi 1990).

Therefore, in a worst-case scenario, benthic habitat disturbance will slightly decrease forage production and availability to migrating and rearing steelhead for about 1 year. Less forage will temporarily increase competition for food among salmonid juveniles, requiring expenditure of extra energy, and thus slower growth (Cada et al. 1987; Bacon et al. 2005; Weber et al. 2014). Slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival (Evans et al. 2014; Mesa et al. 1994; Hostetter et al. 2012). Numerous studies report a positive correlation between juvenile salmonid length and survival (Evans et al. 2014; Zabel and Achord 2004. Length-related survival advantages may be associated with longer steelhead being less susceptible to predation (Mesa et al. 1994; Hostetter et al. 2012) and/or having other competitive advantages related to increased swimming performance and energy reserves (Zabel and Achord 2004). Competition for space among stream salmonids often results in a reduction in foraging area or need to occupy suboptimal foraging positions (Wood et al. 2012; Toobaie and Grant 2013). For lotic salmonids, competitive ability and territory size have been shown to increase with body size (Keeley 2001). We do not have sufficient data to determine how many juveniles may be harmed by a decrease in forage production. Some fish will likely find alternative foraging areas while still being able to avoid predation.

Extending the Functional Life of the Drop Structure

The Nursery Bridge Drop Structure greatly limits normal river processes, impairing habitat creation and function for MCR steelhead, and establishment of riparian habitat. As long as the drop structure remains part of the Walla Walla River, reestablishment of natural fluvial process will be hampered or impossible upstream and downstream of the structure. These are ongoing effects since the Corps constructed the drop structure 55 years ago. Over time, as floods, erosion, and other events occur, the drop structure has been damaged and its ability to function as originally constructed reduced. As this structure deteriorates, its environmental effects would tend to decrease as normative river processes return. However, if continuously maintained and repaired, the impaired ecological baseline is extended indefinitely. For example, the Corps estimates that repairs should extend the functional life of the Nursery Bridge Drop Structure indefinitely. Therefore, we conclude that the action will meaningfully extend the functional life of the drop structure.

Forage. Processes occurring both within the stream channel and in the surrounding riparian area control macroinvertebrate production and thus the types and abundances of prey available to salmonids (Hawkins and Sedell 1981; Murphy et al. 1981). Long-term removal of riparian vegetation and altered hydraulic and sediment erosion and depositional processes will reduce food availability for juvenile salmonids. Continued maintenance required by the Corps prevents any substantial natural growth of woody or brushy riparian vegetation within the area of the Nursery Bridge Drop Structure and adjoining fishways. Riparian vegetation provides allochthonous input into the aquatic environment. Allochthonous input supports productivity, which results in forage for salmon and steelhead (e.g., aquatic insects). Riparian vegetation also provides terrestrial insects, which are important forage for fish. Terrestrial invertebrates can comprise more than half of energy ingested by stream fishes and are often the preferred prey of juvenile salmonids (Allan et al. 2003; Wipfli 1997). There is approximately 12,400 square feet of unvegetated area associated with the drop structure and resulting from Corps mandated vegetation maintenance, reducing allochthonous and terrestrial invertebrate inputs. Reducing these inputs will reduce available forage for rearing steelhead.

The Nursery Bridge Drop Structure also interrupts sediment transport and constrains the channel, increasing velocity, bed scour, and embeddedness below the drop structure. These reduce the surface area and quality of habitat for aquatic invertebrate production below the structure (Poff and Zimmerman 2010), further reducing available forage for rearing steelhead.

Reducing food availability generally leads to reduced growth, and ultimately survival (Spence et al. 1996). A source of forage will continue to be provided by invertebrate drift. Because the effects of the drop structure on vegetation maintenance, fluvial processes, and erosion and depositional processes will persist into the future, the proposed action will likely have a small, but long-term, impact on growth and survival of Walla Walla River steelhead.

Fish passage. The Nursery Bridge Drop Structure blocks volitional, upstream fish passage. All passage occurs either via the Eastside Fishway or the Westside Fish Ladder. Both have been modified over time to conform to adjustments to the drop structure. The Eastside Fishway is the primary fish passage route at the site, but its performance has been limited. Sedimentation blocking use of the Eastside Fishway entrance often results in instream mobilization to excavate a channel through sediments in the stilling basin to provide upstream passage at the Westside Fish Ladder. Performance issues also include difficulty engaging in low flows, and substantial and difficult maintenance to remove bedload transported into the facility during high flows. Gravel is removed, often by hand, from the facility. Under today's management, active maintenance of the system requires multiple mobilizations into the channel per year to move the low flow channel to align with the irrigation diversion and Eastside Fishway, and to remove accumulated sediment. These mobilizations impact instream habitat for MCR steelhead and benthic habitat for invertebrates. They can impact water quality by the release of chemicals and production of suspended sediment and turbidity. They can also result in injury and death of rearing juvenile steelhead from crushing and behavioral modifications, and death of invertebrates from crushing.

Maintaining the Nursery Bridge Drop Structure will also promote continued channel degradation downstream. Channel incision below the drop structure will continue to hinder upstream fish movement. Channel incision could also block upstream fish movement and access to the North and South forks of the Walla Walla River, which provide the majority of spawning habitat for the Walla Walla MCR steelhead population if head cuts become too deep or the fish ladders at the drop structure become inaccessible or non-functional. Without access to good spawning habitat, reproductive success will be considerably reduced. Likewise, this habitat will be inaccessible for juvenile rearing. Therefore, if some spawning did occur downstream of the Nursery Bridge Drop Structure by fish that would have spawned upstream, those juveniles would be crowded into less suitable rearing habitat. They would have to compete for food, would be more susceptible to predation due to the lower quality habitat in the lower river, and would be susceptible to high water temperatures, a primary limiting factor in the lower Walla Walla River. These factors would all decrease juvenile survival rates in the Walla Walla River population. However, NMFS expects the Corps and other basin partners to maintain fish passage facilities so that fish migration is not blocked.

Summary of Effects on Species

NMFS estimates eight juvenile MCR steelhead will be injured or killed by fish salvage activities. The injury or death of eight juvenile steelhead does not accrue to the loss of one adult steelhead. Turbidity levels generated by this action will cause temporary behavioral changes to 220 steelhead (one adult equivalent), including changes in feeding behavior and movement of fish within turbidity plumes, which will increase risk of predation. NMFS also expects effects to growth of juvenile steelhead from loss of forage in 12,000 square feet for up to 1 year. Slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival.

The proposed action will essentially maintain the Nursery Bridge Drop Structure indefinitely. This will perpetuate decreased forage production and small, but long-term, reduction of growth and survival of Walla Walla River juvenile steelhead. The drop structure will also continue to impede fish passage, requiring extensive instream dredging and maintenance to maintain passage. These mobilizations impact instream habitat for MCR steelhead and benthic habitat for invertebrates. They can impact water quality by the release of chemicals and production of suspended sediment and turbidity. They can also result in injury and death of rearing juvenile steelhead from crushing and behavioral modifications, and death of invertebrates from crushing. If fish are not able to use the fishways, spawning and rearing will occur in less suitable habitat, and reproductive success and juvenile survival rates would be considerably reduced. NMFS expects the Corps and other basin partners to maintain fish passage facilities so that fish migration is not blocked.

2.5.2. Effects on Critical Habitat

Critical habitat for MCR steelhead is designated for the Walla Walla River. The action area includes PBFs for freshwater migration and rearing. The essential features in the action area that are shared by these two types of PBFs and will be affected by the proposed action include degraded water quality, substrate, loss of forage, loss of natural cover, and obstruction. The effects of the proposed action on these features are summarized below.

Water Quality

Water quality will be reduced within the project area for approximately 8 weeks. The action is expected to temporarily increase delivery of sediment to the waterway and suspend fine sediment during work area isolation and dewatering, placing gravel below the stilling basin for equipment access, equipment entry and exit from the work area, fish salvage, installation and removal of the sump and pump, and, when flows are reestablished, increasing turbidity in the water column. Pumped water will be filtered prior to release, but smaller particles such as silts and sands will still be released downstream.

Because the in-water work area will be isolated from the flowing channel, and erosion control measures will be implemented during construction, very little sediment is expected to be released from the project site. Resuspension of sediment will be localized and is expected to last for a few hours each day during isolation material installation and removal and fish salvage, but is not expected to extend more than 300 feet downstream, settling quickly in the expected low flows. We expect turbidity from pumping to be of low concentration and not extend more than 300 feet downstream of the work site. NMFS also expects minor leaks and spills of petroleum-based fluids (not more than ounces) that will be contained within isolated work areas and diluted once isolated areas are reconnected with flowing water. Therefore, NMFS expects small, temporary negative effects to water quality at the scale of the action area.

Substrate

Substrate conditions within the affected stream reach are expected to experience minor levels of sediment deposition as the small turbidity plumes settle out within 300 feet downstream of the stilling basin. Accumulated sediment is expected to flush out with the first high flows. Therefore, NMFS expects small, temporary negative effects to substrate at the scale of the action area.

Forage

The proposed action will negatively affect the availability of benthic invertebrates by covering, dewatering, or displacing them from up to 12,000 square feet (0.28 acres) of streambed.

Invertebrate drift will be occurring through the Eastside Fishway providing a source of forage below the stilling basin. Following reconnection of the isolated areas with the flowing channel, drifting invertebrates from upstream will also provide a prey base and recolonize the sediment. Over time, forage will improve and return to pre-project levels. We expect recolonization to occur within a few days to 1 year after project completion (Fowler 2004; Yount and Nemi 1990; Griffith and Andrews 1981). Given the small area of benthic habitat disturbance and the short-term nature of the action, NMFS expects this project to have a small, negative effect on forage at the scale of the action area. Less forage will negatively impact growth, and slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival.

Extending the Habitat Degradation Trend Farther into the Future

Obstruction. As described in the environmental baseline (Section 2.4) and effects to species (Section 2.5.1), the Nursery Bridge Drop Structure greatly limits normal river processes, impairing habitat creation and function for MCR steelhead. The Corps' drop structure repairs will extend the impaired environmental baseline far into the future. Based on the ongoing trend, habitat function will continue to decrease. Especially affected will be the migration obstruction PBF attribute. As the channel continues to incise downstream of the Nursery Bridge Drop Structure due to confinement by the levees, sediment deposition within the stilling basin and Eastside Fishway, and sediment deposition above the Nursery Bridge Drop Structure, head cuts and blocked entrances to the fish ladders will impair migration and require annual instream maintenance to prevent blocked migration. Therefore, the proposed action will continue to impair access to 54.3 miles of spawning habitat and 79.5 miles of rearing habitat, thus affecting the obstruction PBF.

Natural cover, forage, substrate, and water quality. The proposed action will continue to impair the natural cover, forage, and sediment PBFs indefinitely via impacts to riparian and benthic productivity. Riparian vegetation provides overhead cover, shade, woody material that provides complex cover instream, and terrestrial invertebrates and allochthonous inputs. There is approximately 12,400 square feet of unvegetated area associated with the drop structure and resulting from Corps mandated vegetation maintenance. We presume vegetation maintenance at the drop structure and in the action area will continue into the future and longer than it likely would have had the drop structure not been repaired. Therefore, vegetation maintenance will continue to prevent any substantial natural growth of woody or brushy riparian vegetation, perpetuating 12,400 square feet of denuded streambanks, and affecting available cover, shade, and forage. The proposed action will also perpetuate degradation below the drop structure. Degradation impacts substrate and benthic habitat, which impacts aquatic invertebrate productivity.

Mobilizations to maintain passage will continue to impact instream habitat for MCR steelhead and benthic habitat for invertebrates. Mobilization will impact water quality by suspending sediment and increasing turbidity, and minor leaks and spills of petroleum-based fluids (not more than ounces). Mobilizations will also result in crushing of benthic invertebrates.

Therefore, NMFS expects vegetation maintenance, degradation below the drop structure, aggradation above the drop structure, and mobilizations to maintain fish passage to continue to limit the natural cover, forage, substrate, and water quality PBFs.

Summary of Effects on Critical Habitat

The proposed action will have small, temporary effects to water quality (turbidity, sediment, chemical contamination) at the scale of the action area during project construction. Increases in total suspended solids and turbidity during project construction are expected to be small, extend up to 300 feet downstream, and persist for up to 8 weeks. Minor leaks and spills of petroleum-based fluids (not more than ounces) will be contained in isolated work areas and diluted when isolation barriers are removed. Small, negative effects to the substrate PBF in the action area will occur during project construction from sediment deposition up to 300 feet below the stilling basin. Deposited sediment will be flushed out during the first high flow. Small, negative effects to the forage PBF will occur from loss of aquatic invertebrates from dewatering 6,000 square feet of habitat, and from sediment deposition in an additional 6,000 square feet of benthic habitat. Forage will return to pre-project levels within 1 year after project completion. Decreased forage will negatively impact juvenile steelhead growth for 1 year, and slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival.

The proposed action will allow processes currently causing degradation of PBFs to continue indefinitely into the future, which will ensure that PBF function will further decrease in the action area. Maintaining the Nursery Bridge Drop Structure will perpetuate annual water quality effects (turbidity, sediment, chemical contamination) into the future during mobilizations to maintain fish passage. Mobilization will suspend sediment and increase turbidity, and may result in minor leaks and spills of petroleum-based fluids (not more than ounces). These mobilizations will crush benthic invertebrates and will crush or alter juvenile steelhead behavior. Vegetation maintenance required by the Corps will continue to prevent any substantial natural growth of woody or brushy riparian vegetation, perpetuating 12,400 square feet of denuded streambanks, reducing allochthonous and terrestrial invertebrate inputs, and thereby negatively affecting available cover, shade, and forage. The proposed action will also perpetuate degradation below the drop structure. Degradation impacts substrate and benthic habitat, which impacts aquatic invertebrate productivity and available forage. Altered fluvial processes will also continue to obstruct steelhead migration. Aggradation above the drop structure caused by altered fluvial processes will perpetuate annual mobilization above the drop structure, sometimes several per year, to maintain fish passage.

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 versus cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

Milton–Freewater is currently growing at a rate of 0.28% annually, and its population has increased by 0.91% since the 2010 census. NMFS expects that the area around the Nursery Bridge Drop structure will maintain its low population growth and primarily rural character, and that there will be limited additional residential, urban, agricultural, and industrial development along the Walla Walla River for the next few decades. Any potential future development would likely maintain the Nursery Bridge Drop Structure and extensive levee structures that cause measurable negative effects to fish passage, floodplain and riparian functions, the hydrological regime, water quality, and instream habitat. We expect that the cumulative effects from human population growth, development, and continued agricultural practices over time in the action area are likely to continue to impair fish passage, water quantity and quality, restrict floodplain connectivity, and reduce reestablishment of well-functioning riparian habitat or side channels.

NMFS is not aware of any specific future non-Federal actions that are reasonably certain to occur in the action area that are likely to contribute to cumulative effects on MCR steelhead or designated critical habitat. There are many on-going habitat restoration projects throughout the Walla Walla River Basin, but many, if not all, of these and future habitat restoration actions are likely to have a Federal nexus and require section 7 consultation. These projects include CTUIR's Nursery Bridge Phase II Restoration Project to improve irrigation efficiency, fish passage, and fish habitat in the Nursery Bridge reach of the Walla Walla River. They also include implementation of the State of Washington's Walla Walla Water 2050 plan, a 30-year integrated water resources and strategic management plan for management and enhancement of water resources critical to improving instream flows for fish, sustaining municipal water supplies, and an agricultural economy. Implementation of the plan, along with on-going habitat restoration projects, will lead to some localized improvements to freshwater habitat.

2.7. Integration and Synthesis

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

2.7.1. Middle Columbia River Steelhead

Middle Columbia River steelhead from the Walla Walla population inhabit the action area and depend on it to support critical life functions of spawning, rearing, and migration. The MCR steelhead DPS is not currently meeting the viability criteria described in the Mid-Columbia Steelhead Recovery Plan (NMFS 2009). The Walla Walla population of MCR steelhead will be affected by the proposed action. Recovery criteria for the Umatilla/Walla Walla MPG requires two populations to meet viability criteria and the third population to be maintained. The ICTRT also calls for at least one population to be highly viable. Overall, the Umatilla and Walla Walla River populations are considered maintained while the Touchet River population is considered to be at high risk. Under current conditions, the Umatilla River population is the closest to being highly viable. Of the remaining two populations, the Walla Walla is much closer to reaching viable status than the Touchet River population.

MCR steelhead juveniles use the action area for rearing and migration. Adults may spawn within the action area, but primarily use the area for migration to high quality spawning and rearing habitat upstream in the North and South Forks of the Walla Walla River. As described in Section 2.5.1, the proposed action will have effects on juvenile and adult MCR steelhead. We estimate that the proposed action will injure or kill eight juvenile MCR steelhead, less than one adult equivalent, during fish salvage and dewatering. Based on the location of fish salvage, the affected steelhead are members of the Walla Walla River population of MCR steelhead. Additional juvenile steelhead will be affected by impacts to water quality. Fish will be salvaged before dewatering and project construction begins. However, temporary increases in turbidity during installation and removal of isolation barriers, fish salvage, equipment use, and pumping; along with turbidity plumes, which extend 300 feet downstream of isolated areas, are likely to alter the feeding behavior and movement of an estimated 220 juvenile steelhead (one adult equivalent), which will increase risk of predation. NMFS also expects effects to growth of juvenile steelhead from loss of forage in 12,000 square feet for up to 1 year. Slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival.

The proposed action will also extend the functional life of the Nursery Bridge Drop Structure indefinitely. Therefore, the drop structures effect on riparian vegetation and fluvial erosion and deposition processes will also continue indefinitely. This will perpetuate decreased forage production and small, but long-term, reductions in growth and survival of Walla Walla River juvenile steelhead. The drop structure will also continue to impede fish passage, requiring extensive instream dredging and maintenance to maintain passage. These mobilizations impact instream habitat for MCR steelhead and benthic habitat for invertebrates. They can impact water quality by the release of chemicals and production of suspended sediment and turbidity. They can also result in injury and death of rearing juvenile steelhead from crushing and behavioral modifications, and death of invertebrates from crushing. If fish are not able to use the fishways, spawning and rearing will occur in less suitable habitat, and reproductive success and juvenile survival rates would be considerably reduced. NMFS expects the Corps and other basin partners to maintain fish passage facilities so that fish migration is not blocked.

These effects and reductions are not expected to appreciably alter the abundance, productivity, spatial structure, or diversity of the Walla Walla River population or the Umatilla/Walla Walla MPG. It is NMFS' opinion that when the effects of the action and cumulative effects are added to the environmental baseline, and in light of the status of the species, the effects of the action will not cause reductions in reproduction, numbers, or distribution that would reasonably be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of MCR steelhead.

2.7.2. Critical Habitat

Critical habitat in the action area is degraded due to the construction, maintenance, and operation of the Nursery Bridge Drop structure and levees, irrigation diversions, and transportation infrastructure. As noted in Section 2.2.3, climate change is likely to further impact designated critical habitat. Increases in water temperature and changes to the hydrological regime will reduce suitable salmon habitat and cause earlier migration of smolts. Warmer temperatures will likely lead to increased predation on juvenile salmonids in mainstem reservoirs (ISAB 2007). This is particularly true of non-native species such as bass and channel catfish where climate change will likely further accelerate their expansion (ISAB 2007). In addition, the warmer water temperatures will increase consumption rates by predators due to increased metabolic rates, which influence food demand.

The potential effects of the proposed action on MCR steelhead critical habitat are described in Section 2.5.2. NMFS expects adverse effects to water quality, sediment, and forage PBFs for ESA-listed MCR steelhead from installation and removal of isolation materials, operation of machinery within and adjacent to the Walla Walla River, fish salvage, and pumping of turbid water around the work area. The proposed action will have small, temporary effects to water quality (turbidity, sediment, chemical contamination) at the scale of the action area. Increases in total suspended solids and turbidity during project construction are expected to be small, extend up to 300 feet downstream, and persist for up to 8 weeks. Minor leaks and spills of petroleum-based fluids (not more than ounces) will be contained in isolated work areas and diluted when isolation barriers are removed. Small, negative effects to the substrate PBF in the action area will occur during project construction from sediment deposition up to 300 feet below the stilling basin. Deposited sediment will be flushed out during the first high flow. Small, negative effects to the forage PBF will occur within a 12,000 square foot area, with forage returning to pre-project levels within 1 year after project completion. Decreased forage will negatively impact growth for 1 year, and slower growing individuals will be more susceptible to predation and have decreased chances for overwinter survival.

The proposed action will allow processes currently causing degradation of PBF's to continue indefinitely into the future, which will ensure that PBF function will further decrease in the action area. Maintaining the Nursery Bridge Drop Structure will perpetuate annual water quality effects (turbidity, sediment, chemical contamination) into the future during mobilizations to maintain fish passage. Mobilization will suspend sediment and increase turbidity, and may result in minor leaks and spills of petroleum-based fluids (not more than ounces). These mobilizations will crush benthic invertebrates and will crush or alter juvenile steelhead behavior. Vegetation maintenance required by the Corps will continue to prevent any substantial natural growth of woody or brushy riparian vegetation, perpetuating 12,400 square feet of denuded streambanks, reducing allochthonous and terrestrial invertebrate inputs, and thereby negatively affecting available cover, shade, and forage. The proposed action will also perpetuate degradation below the drop structure. Degradation impacts substrate and benthic habitat, which impacts aquatic invertebrate productivity and available forage. Altered fluvial processes will also continue to obstruct steelhead migration. Aggradation above the drop structure caused by altered fluvial processes will perpetuate annual mobilization above the drop structure, sometimes several per year, to maintain fish passage.

Based on our analysis, adverse effects from the proposed action will cause a small and localized decline in the quality and function of PBFs in the action area. However, because of the scale and extent of the effects to PBFs, we do not expect a reduction in the conservation value of critical habitat in the action area. Therefore, as we scale up from the action area to the designation scale, the proposed action is not expected to appreciably reduce the conservation value of critical habitat for MCR steelhead at the designation scale.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of 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 this opinion, NMFS determined that incidental take is reasonably certain to occur and will include harm and harassment caused by injury and mortality during fish salvage and dewatering; altered feeding behavior and movement of an estimated 220 juvenile steelhead (one adult equivalent), which will increase risk of predation; and effects to growth of juvenile steelhead from loss of forage in 12,000 square feet for up to 1 year, which will result in increased predation and decreased survival.

Work area isolation will be accomplished by: (1) installing a berm to divert any remaining flow into the Eastside Fishway; (2) installing temporary sandbags and plastic barriers; and

(3) pumping seepage flow from above the Nursery Bridge Drop Structure to downstream of the stilling basin, dewatering 6,000 square feet. Fish salvage will include seining (herding) and netting. NMFS estimates that the Corps will successfully salvage and relocate up to 213 juvenile steelhead from the in-water work area, with eight juvenile steelhead experiencing sufficient harm to result in injury or death. The extent of take will be exceeded if salvage activities result in the death of more than eight juvenile steelhead, or if more than 6,000 square feet of the Walla Walla River is dewatered.

Take in the form of harm caused by the temporary increases in turbidity will be manifested in altered behaviors including avoidance of the area, abandonment of cover, and exposure to predators. NMFS estimates 220 juvenile steelhead (one adult equivalent), will be harmed by turbidity plumes which extend 300 feet downstream of isolated areas. The extent of take will be exceeded if increased turbidity alters the behavior of 220 juvenile steelhead, or if the downstream extent of turbidity plumes exceeds 300 feet below the work area.

In contrast to the fish affected by capture, NMFS is unable to estimate the number of fish harmed by loss of forage. In circumstances where NMFS cannot numerically predict the amount of take, we estimate the extent of take by describing the extent of habitat modified by the proposed action (51 FR 19926). This surrogate represents an observable metric of the extent of take, which if exceeded, would trigger consultation. The extent of modified habitat is 12,000 square feet. This is equivalent to the maximum area of riverbed that will be isolated and dewatered, and the downstream extent of the temporary turbidity plumes in the water column (up to 300 feet downstream from the work area). This description of the extent of modified habitat is the extent of take exempted from the prohibition against take in this statement.

The amount of take and the extent of take are the thresholds for reinitiating consultation. If any of these limits are exceeded during project activities, the amount of take would increase beyond that examined in this consultation, and thus the reinitiating provisions of this opinion apply.

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:

1. Avoid or minimize take due to construction activities.
2. Minimize incidental take during work area isolation and fish salvage efforts.
3. Track, monitor, and report on the proposed action to ensure that the project is implemented as proposed, and the amount and 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 will likely lapse.

1. The following terms and conditions implement RPM 1:
    a. Conduct all work below the OHWM within as short a period as possible between July 1 and September 30.
    b. Confine all impacts to the minimum area necessary to achieve project goals.
    c. Select heavy equipment that will have the least possible adverse effect to the environment, considering factors including, but not limited to, equipment that has the ability to conduct work from existing disturbed areas, exert the least soil compaction impact, and minimize the amount of vibration and noise that could disturb aquatic species.
    d. To the extent feasible, work with heavy equipment from the top of the Walla Walla River bank, unless work from another location will result in less habitat disturbance.
    e. Conduct turbidity monitoring as follows:
        i. Monitoring will be conducted daily, every 4 hours during daylight hours, when in-water work is conducted.
        ii. Observations shall occur daily before, during, and after commencement of in-water work and compared to observable sediment load upstream of the action area.
        iii. Monitor pumped releases of water daily for visible turbidity plumes.
        iv. Measure or observe background turbidity levels at an undisturbed site within the flow channel approximately 100 feet upstream of the project area.
        v. Measure or observe compliance measures in the flowing channel approximately 300 feet downstream from the project area, or within any visible turbidity plume.
        vi. If a visible plume is observed at 300 feet downstream, measurements should not exceed above 10 percent of the background measurements. If there is exceedance, BMPs will be modified to minimize downstream increase of turbidity and fine sediments. Monitoring will be continued every 4 hours. If plume is observed after 8 hours, work shall be stopped for the remainder of the 24-hour day.

2. The following terms and conditions implement RPM 2:
    a. A Corps fish biologist or equivalent with experience supervising fish exclusion operations will supervise or conduct all fish exclusion and handling activities.

b. Complete work below the OHWM between July 1 and September 30. In-water work occurring outside of this timeframe will require written approval from NMFS.
c. Minimize area dewatered. Where dewatering will occur, slowly decrease flow into area to be isolated. Herd and net fish out of area as water recedes to ensure no fish are stranded.

3. The following terms and conditions implement RPM 3:

   a. Track and monitor construction activities to ensure that the conservation measures are meeting the objective of minimizing take. Monitoring shall be conducted by the Corps or contractor, and include a daily visual survey for fish in the areas adjacent to construction and inside the in-water work area.
   b. Submit a completion of project report to NMFS 2 months after project completion. The completion report shall include, at a minimum, the following:
      i. Starting and ending dates for work completed, with in-water work period specified.
      ii. Method used to isolate each work area.
      iii. Total area of in-water work. Include area of each work location isolated and or/dewatered.
      iv. Duration isolation materials were in place at each work area.
      v. Total area of vegetation removal.
      vi. Any daily observed sediment plume from the in-channel work area to 300 feet downstream during the 13-week in-water construction period.
      vii. A summary of pollution and erosion control inspection results, including results of implementing required BMPs, and including a description of any erosion control failure, contaminant release, and efforts to correct such incidences.
      viii. Number and species of fish observed injured or killed in the Walla Walla River.
      ix. Description of all capture and release methods employed including:
         1. Supervisory fish biologist name and address.
         2. Methods used.
         3. Number of fish captured by species.
         4. Location and condition of all fish released.
         5. Observation of injury or mortality.
      x. Reference to NMFS consultation number WCRO-2021-02078.

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

   d. If the amount or extent of take is exceeded, stop project activities and notify NMFS immediately.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

Currently, NMFS, USFWS, CTUIR, Oregon Department of Fish and Wildlife, MFWCD, Walla Walla Basin Watershed Council, Bonneville Power Administration, and the Corps are evaluating a variety of temporary and permanent solutions to remedy the conditions along the Walla Walla River near Milton–Freewater. NMFS recommends that the Corps work with the CTUIR and other basin stakeholders to implement the CTUIR's Nursery Bridge Restoration Reach Phase II project. This project includes actions in the Walla Walla River at Nursery Bridge to reduce the need for ongoing instream maintenance activities, improve the functioning of the Eastside Fishway, increase instream habitat for ESA-listed salmonids at multiple flows, and maintain ongoing water diversion for the WWRID. NMFS also recommends that the Corps work with Walla Walla Basin stakeholders on implementation of the Walla Walla 2050 plan, particularly strategies and actions that increase flow, improve fish passage, increase floodplain connectivity, increase extent and function of riparian vegetation, and increase habitat complexity. Implementation of these strategies will improve PBFs, abundance, and distribution of MCR steelhead.

2.11. Reinitiation of Consultation

This concludes formal consultation for the Nursery Bridge Drop Structure Rehabilitation.

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 (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.

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 user of this opinion is the Corps. Other interested users could include the Milton–Freewater Water Control District. 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 adheres 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 Magnuson–Stevens Fishery Conservation and Management Act implementing regulations regarding Essential Fish Habitat, 50 CFR 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

Abatzoglou, J. T., D. E. Rupp, and P. W. Mote. 2014. Seasonal climate variability and change in the Pacific Northwest of the United States. Journal of Climate 27(5): 2125–2142.

Abbe, T., and M. Hrachovec. 2019. Nursery Bridge restoration reach phase II Milton–Freewater, Oregon basis of design report 60% design. Natural Systems Design, Seattle.

Allan, J. D., M. S. Wipfli, J. P. Caouette, A. Prussian, and J. Rodgers. 2003. Influence of streamside vegetation on inputs of terrestrial invertebrates to salmonid food webs. Canadian Journal of Fisheries and Aquatic Sciences 60(3): 309–320.

Angradi, T. R., and J. S. Griffith. 1990. Diel feeding chronology and diet selection of rainbow trout (*Oncorhynchus mykiss*) in the Henry's Fork of the Snake River, Idaho. Canadian Journal of Fisheries and Aquatic Sciences 47(1):199–209.

Bacon P. J., W. S. C. Gurney, W. Jones, I. S. McLaren, and A. F Youngson. 2005. Seasonal growth patterns of wild juvenile fish: partitioning variation among explanatory variables, based on individual growth trajectories of Atlantic salmon (*Salmo salar*) parr. Journal of Animal Ecology 74(1):1–11.

Barton, A., B. Hales, G. G. Waldbuster, C. Langdon, and R. Feely. 2012. The Pacific Oyster, *Crassostrea gigas*, Shows Negative Correlation to Naturally Elevated Carbon Dioxide Levels: Implications for Near-Term Ocean Acidification Effects. *Limnology and Oceanography* 57(3):698–710.

Bash, J., C. Berman, and S. Bolton. 2001. Effects of turbidity and suspended solids on salmonids. 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.

Busby, P. J., T. C. Wainwright, G. J. Bryant, L. J. Lierheimer, R. S. Waples, R. W. Waknitz, and I. V. Lagomarsino. 1996. Status review of West Coast steelhead from Washington, Idaho, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum, NMFS-NWFSC-27, 8/1/1996.

Cada, G. F., J. M. Loar, and M. J. Sale. 1987. Evidence of food limitation of rainbow and brown trout in southern Appalachian softwater streams. Transactions of the American Fisheries Society 116(5): 692–702.

Chadwick, M. A., and A. D. Huryn. 2005. Response of stream macroinvertebrate production to atmospheric nitrogen deposition and channel drying. Limnology and Oceanography 50(1):228–236.

Crozier, L. G., A. P. Hendry, P. W. Lawson, T. P. Quinn, N. J. Mantua, J. Battin, R. G. Shaw, and R. B. Huey. 2008. Potential responses to climate change for organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1(1):252–270.

Crozier, L. G., M. D. Scheuerell, and R. W. Zabel. 2011. Using time series analysis to characterize evolutionary and plastic responses to environmental change: a case study of a shift toward earlier migration date in sockeye salmon. American Naturalist 178:755–773.

Dedual, M., and K. J. Collier. 1995. Aspects of juvenile rainbow trout (*Oncorhynchus mykiss*) diet in relation to food supply during summer in the lower Tongariro River, New Zealand. New Zealand Journal of Marine and Freshwater Research (29).

Dominguez, F., E. Rivera, D. P. Lettenmaier, and C. L. Castro. 2012. Changes in Winter Precipitation Extremes for the Western United States under a Warmer Climate as Simulated by Regional Climate Models. Geophysical Research Letters 39(5).

Doney, S. C., M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, and L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science 4:11–37.

Ehrhart B. J, R. D. Shannon, and A. R. Jarrett. 2002. Effects of construction site sedimentation basins on receiving stream ecosystems. Transactions of the American Society of Agricultural Engineers 45:675–680.

Elliott, J. M. 1973. The food of brown and rainbow trout (*Salmo trutta and S. gairdneri*) in relation to the abundance of drifting invertebrates in a mountain stream. Oecologia, 12(4):329–347.

Elsner, M. M., L. Cuo, N. Voisin, J. S. Deems, A. F. Hamlet, J. A. Vano, K. E. B. Mickelson, J.-K. Lee, and D. P. Lettenmaier. 2010. Implications of 21st century climate change for the hydrology of Washington State. Climatic Change 102:225–260.

EPA (U. S. Environmental Protection Agency). 2020. Water Quality Standards, Permits, and Plans (TMDLs) in the Columbia Basin: https://www.epa.gov/columbiariver/water-quality-standards-permits-and-plans-tmdls-columbia-basin

Evans A. F, N. J. Hostetter, K. Collis, D. D. Roby, and F. J. Loge. 2014. Relationship between Juvenile Fish Condition and Survival to Adulthood in Steelhead. Transactions of the American Fisheries Society 143:899–909.

Feely, R. A., T. Klinger, J. A. Newton, and M. Chadsey (eds.) 2012. Scientific summary of ocean acidification in Washington State marine waters. Washington Shellfish Initiative Blue Ribbon Panel on Ocean Acidification. NOAA Office of Atmospheric Research Special Report. Contribution No. 3934 from NOAA/Pacific Marine Environmental Laboratory, Seattle.

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

Freeman, P. L., and M. S. Schorr. 2004. Influence of Watershed Urbanization on Fine Sediment and Macroinvertebrate Assemblage Characteristics in Tennessee Ridge and Valley Streams. Journal of Freshwater Ecology 19(3):353–362.

Fritz, K. M, and W. K. Dodds. 2004. Resistance and resilience of macroinvertebrate assemblages to drying and flood in a tallgrass prairie stream system. Hydrobiologia 527:99–112.

Glick, P., J. Clough, and B. Nunley. 2007. Sea-level rise and coastal habitat in the Pacific Northwest: an analysis for Puget Sound, southwestern Washington, and northwestern Oregon. National Wildlife Federation.

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: 597.

Goode, J. R., J. M. Buffington, D. Tonina, D. J. Isaak, R. F. Thurow, S. Wenger, D. Nagel, C. Luce, D. Tetzlaff, and C. Soulsby. 2013. Potential effects of climate change on streambed scour and risks to salmonid survival in snow-dominated mountain basins. Hydrological Processes 27(5):750–765.

Graeber, D., M. T. Pusch, S. Lorenz, and M. Brauns. 2013. Cascading effects of flow reduction on the benthic invertebrate community in a lowland river. Hydrobiologia 717:147–159.

Griffith, J. S., and D. A. Andrews. 1981. Effects of a Small Suction Dredge on Fishes and Aquatic Invertebrates in Idaho Streams. North American Journal of Fisheries Management, 1:21–28.

Hawkins, C. P., and J. R. Sedell. 1981. Longitudinal and seasonal changes in functional organization of macroinvertebrate communities in four Oregon streams. Ecology 62:387–397.

Hostetter, N. J., A. F. Evans, D. D. Roby, and K. Collis. 2012. Susceptibility of Juvenile Steelhead to Avian Predation: the Influence of Individual Fish Characteristics and River Conditions. Transactions of the American Fisheries Society 141:1586–1599, 2012.

Hutchens, J. J., Jr., F. A. Schuldt, C. Richards, L. B. Johnson, G. E. Host, and D. H. Breneman. 2009. Multi-scale mechanistic indicators of Midwestern USA stream macroinvertebrates. Ecological Indicators 9:1138–1150.

ICTRT (Interior Columbia Basin Technical Recovery Team). 2003. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the Interior Columbia River Domain, Northwest Fisheries Science Center.

IPCC (Intergovernmental Panel on Climate Change). 2014. Contribution of working groups I, II and III to the fifth assessment report of the intergovernmental panel on climate change [Core Writing Team, R. K. Pachauri and L.A. Meyer (eds.)] IPCC, Geneva, Switzerland.

Isaak, D. J., S. Wollrab, D. Horan, and G. Chandler. 2012. Climate change effects on stream and river temperatures across the northwest U.S. from 1980–2009 and implications for salmonid fishes. Climate Change 113(2):499–524.

ISAB (Independent Scientific Advisory Board). 2007. Climate change impacts on Columbia River Basin fish and wildlife, Portland, Oregon.

Keeley, E. R. 2001. Demographic responses to food and space competition by juvenile steelhead trout. Ecology 82(5):1247–1259.

Kunkel, K. E., L. E. Stevens, S. E. Stevens, L. Sun, E. Janssen, D. Wuebbles, K. T. Redmond, and J. G. Dobson. 2013. Regional Climate Trends and Scenarios for the U.S. National Climate Assessment: Part 6. Climate of the Northwest U.S. NOAA Technical Report NESDIS 142-6. 83 pp. National Oceanic and Atmospheric Administration, National Environmental Satellite, Data, and Information Service, Washington, D.C.

Larsen, S., and S. J. Ormerod. 2010. Low-level effects of inert sediments on temperate stream invertebrates. Freshwater Biology 55(2):476–486.

Lawson, P. W., E. A. Logerwell, N. J. Mantua, R. C. Francis, and V. N. Agostini. 2004. Environmental factors influencing freshwater survival and smolt production *In* Pacific Northwest coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 61:360–373.

Lee, D. C., J. R. Sedell, B. E. Rieman, R. F. Thurow, and J. E. Williams. 1997. Broadscale assessment of aquatic species and habitats. U.S. Department of Agriculture, Pacific Northwest Research Station.

Leider, S. A., M. W. Chilcote, and J. J. Loch. 1986. Comparative Life History Characteristics of Hatcher and Wild Steelhead Trout (*Salmo gairdneri*) of Summer and Winter Races in the Kalama River, Washington. Canadian Journal of Fisheries and Aquatic Sciences 43(7):726–735.

Leigh, C., N. Bonada, A. J. Boulton, B. Hugueny, S. T. Larned, R. Vander Vorste, and T. Datry. 2016. Invertebrate assemblage responses and the dual roles of resistance and resilience to drying in intermittent rivers. Aquatic Sciences 78:291–301.

Lindsey, R., and L. Dahlman. 2020. Climate change: Global temperature. https://www.climate.gov/news-features/understanding-climate/climate-change-global-temperature.

Mahoney, B. D., M. B. Lambert, T. J. Olsen, E. Hoverson, P. Kissner, and J. D. M. Schwartz. 2006. Walla Walla Basin Natural Production Monitoring and Evaluation Project Progress Report, 2004–2005. Confederated Tribes of the Umatilla Indian Reservation. Report submitted to Bonneville Power Administration, Project No. 2000-039-00.

Mantua, N., I. Tohver, and A. Hamlet. 2009. Impacts of climate change on key aspects of freshwater salmon habitat in Washington State. Chapter 6 *In* Washington Climate Change Impacts Assessment: Evaluating Washington's future in a changing climate. Climate Impacts Group, University of Washington pp. 217–254.

Mantua, N., I. Tohver, and A. Hamlet. 2010. Climate change impacts on streamflow extremes and summertime stream temperature and their possible consequences for freshwater salmon habitat in Washington State. Climate Change 102:187–233.

McCarthy, S. G., J. J. Duda, J. A. Emlen, G. R. Hodgson, and D. A. Beauchamp. 2009. Linking habitat quality with trophic performance of steelhead along forest gradients in the South Fork Trinity River watershed, California. Transactions of the American Fisheries Society 138:506–521.

McClure, M., T. Cooney, and Interior Columbia Technical Recovery Team. 2005. Updated population delineation in the interior Columbia Basin. Memorandum to NMFS NW Regional Office, co-managers and other interested parties. May 11.

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, U.S. Department of Congress: 156.

McIver, J., and L. Starr. 2001. Restoration of degraded lands in the interior Columbia River basin: passive vs. active approaches. Forest Ecology and Management 153(1):15–28.

McMahon, T. E., and G. F. Hartman. 1989. Influence of cover complexity and current velocity on winter habitat use by juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Science. 46:1551–1557.

Meador, J. P., F. C. Sommers, G. M. Ylitalo, and C. A. Sloan. 2006. Altered growth and related physiological responses in juvenile Chinook salmon (*Oncorhynchus tshawytscha*) from dietary exposure to polycyclic aromatic hydrocarbons (PAHs). Canadian Journal of Fisheries and Aquatic Sciences 63:2364–2376.

Mendel, G., B. Mahoney, R. Weldert, J. Olsen, J. Trump, and A. Fitzgerald. 2014. Walla Walla River Subbasin Salmonid Monitoring and Evaluation Project. 2013 Annual Report for the period 1/1/2013–12/31/2013, BPA Project # 2000-039-00. 69 pp.

Mesa, M. G., P. P. Thomas, M. G. Dena, and H. P. James. 1994. Are all prey created equal? A review and synthesis of differential predation on prey in substandard condition. Journal of Fish Biology 45:81–96.

Meyer, J. L., M. J. Sale, P. J. Mulholland, and N. L. Poff. 1999. Impacts of climate change on aquatic ecosystem functioning and health. Journal of the American Water Resources Association 35(6):1373–1386.

Mote, P. W., D. E. Rupp, S. Li, D. J. Sharp, F. Otto, P. F. Uhe, M. Xiao, D. P. Lettenmaier, H. Cullen, and M. R. Allen. 2016. Perspectives on the cause of exceptionally low 2015 snowpack in the western United States, Geophysical Research Letters, 43, doi:10.1002/2016GLO69665.

Mote, P., A. K. Snover, S. Capalbo, S. D. Eigenbrode, P. Blick, J. Littell, R. R. Raymondi, and W. S. Reeder. 2014. Ch. 21: Northwest Climate change impacts in the United States: the third national climate assessment. J. M. Melillo, T. C. Terese, T. C. Richmond, and G. W. Yohe, editors. U.S. Global Change Research Program, pp. 487–513. https://nca2014.globalchange.gov/report/regions/northwest

Murphy, M. L., C. P. Hawkins, and N. H. Anderson. 1981. Effects of canopy modification and accumulated sediments on stream communities. Transactions of the American Fisheries Society 110:469–478.

Nakano, S., K. D. Fausch, and S. Kitano. 1999. Flexible niche partitioning via a foraging mode shift: a proposed mechanism for coexistence in stream-dwelling charr. Journal of Animal Ecology 68(6):1079–1092.

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.

Nielsen, J. L. 1992. Microhabitat-specific foraging behavior, diet and growth of juvenile coho salmon. Transactions of the American Fisheries Society 121:617–634.

NMFS (National Marine Fisheries Service). 2005. Final assessment of NOAA Fisheries’ critical habitat analytical review teams for 12 evolutionarily significant units of West Coast Salmon and Steelhead. NOAA, Portland, Oregon.

NMFS. 2007. 2007 Report to Congress, Pacific Coastal Salmon Recovery Fund FY 2000–2006. National Marine Fisheries Service, Seattle.

NMFS. 2009. Middle Columbia River Steelhead Distinct Population Segment ESA Recovery Plan. National Marine Fisheries Service Northwest Region, Portland, Oregon.

NMFS. 2011. Endangered Species Act Section 7 formal consultation and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Operation and Maintenance of the Mill Creek Flood Control Project, Walla Walla County, Washington.

NMFS. 2016. 5-Year Review: Summary & Evaluation of Middle Columbia River Steelhead. National Marine Fisheries Service, West Coast Region, Portland, Oregon.

NMFS. 2019. Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Continued Operation and Maintenance of the Columbia River System. WCRO-2018-00152. Interior Columbia Basin Office, Portland, Oregon.

NWFSC (Northwest Fisheries Science Center). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. Northwest Fisheries Science Center.

Poff, N. L., and J. K. H. Zimmerman. 2010. Ecological responses to altered flow regimes: a literature review to inform the science and management of environmental flows. Freshwater Biology 55:194–205.

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. American Fisheries Society, Bethesda, Maryland.

Raymondi, R. R., J. E. Cuhaciyan, P. Glick, S. M. Capalbo, L. L. Houston, S. L. Shafer, and O. Grah. 2013. Water Resources: Implications of Changes in Temperature and Precipitation *In* Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities. Island Press, Washington, D.C.

Reeder, W. S., P. R. Ruggiero, S. L. Shafer, A. K. Snover, L. L Houston, P. Glick, J. A. Newton, and S. M Capalbo. 2013. Coasts: Complex Changes Affecting the Northwest's Diverse Shorelines. *In* Climate Change in the Northwest: Implications for Our Landscapes, Waters, and Communities, edited by M. M. Dalton, P. W. Mote, and A. K. Snover, 41–58. Island Press, Washington, D.C.

Romaniszyn, E. D., Hutchens, J. J., and Wallace, J. B. 2007. Aquatic and terrestrial invertebrate drift in southern Appalachian mountain streams: implications for trout food resources. Freshwater Biology 52(1):1–11.

Rosenfeld J. S., T. Leiter, G. Lindner, and L. Rothman. 2005. Food abundance and fish density alters habitat selection, growth, and habitat suitability curves for juvenile coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 62(8):1691–1701.

Scheuerell, M. D., and J. G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography 14:448–457.

Spence, B. C., G. A. Lomnicky, R. M. Hughes, and R. P. Novitzki. 1996. An ecosystem approach to salmonid conservation. ManTech Environmental Research Services Corporation, Corvallis, Oregon. TR-4501-96-6057.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate 18(8):1136–1155.

Storey, R. 2016. Macroinvertebrate community responses to duration, intensity and timing of annual dry events in intermittent forested and pasture streams. Aquatic Sciences 78:395–414.

Sunda, W. G., and W. J. Cai. 2012. Eutrophication induced CO2-acidification of subsurface coastal waters: interactive effects of temperature, salinity, and atmospheric CO2. Environmental Science & Technology 46(19):10651–10659.

Suren, A., and Jowett, I. 2001; Effects of deposited sediment on invertebrate drift: An experimental study. New Zealand Journal of Marine and Freshwater Research 35(4):725-737.

Tague, C. L., J. S. Choate, and G. Grant. 2013. Parameterizing sub-surface drainage with geology to improve modeling streamflow responses to climate in data limited environments. Hydrology and Earth System Sciences 17(1):341–354.

Teasdale, G. N., 2010. Stage 1 Sediment Impact Assessment – Milton–Freewater Levee System. Walla Walla River. U.S. Army Corps of Engineers Walla Walla District. September 24, 2010. Teasdale 2010.

Tillmann, P., and D. Siemann. 2011. Climate Change Effects and Adaptation Approaches in Marine and Coastal Ecosystems of the North Pacific Landscape Conservation Cooperative Region. National Wildlife Federation.

Tippets W. E., and P. B. Moyle. 1978. Epibenthic feeding by rainbow trout (*Salmo gairdneri*) in the McCloud River, California. Journal of Animal Ecology 47:549–559.

Toobaie A., and J. W. A. Grant. 2013. Effect of food abundance on aggressiveness and territory size of juvenile rainbow trout, *Oncorhynchus mykiss*. Animal Behavior 85:241–246.

USACE (U.S. Army Corps of Engineers). 2014. Milton–Freewater Nursery Bridge Drop Structure Rehabilitation. Environmental Assessment. PMEC-2013-0090. June 2014.

USACE. 2016. Milton–Freewater Rehabilitation of the Nursery Bridge Drop Structure. Environmental Assessment. PM-EC-2016-0023. February 2016.

USDOC (U.S. Department of Commerce). 2013. Endangered and threatened species: Designation of a nonessential experimental population for Middle Columbia River Steelhead above the Pelton Round Butte Hydroelectric Project in the Deschutes River Basin, Oregon. Department of Commerce, National Oceanic and Atmospheric Administration. Federal Register 78(10):2893–2907.

USDOC. 2014. Endangered and threatened wildlife; Final rule to revise the Code of Federal Regulations for species under the jurisdiction of the National Marine Fisheries Service. U.S. Department of Commerce. Federal Register 79(71):20802–20817.

USFWS (U.S. Fish and Wildlife Service). 2001. Final Amended Civil Penalty Settlement Agreement: U.S. Fish and Wildlife v. Hudson Bay District Improvement Company, Walla Walla River Irrigation District, and Gardena Farms Irrigation District # 13 FWS .PN .2731.

USGCRP (U.S. Global Change Research Program). 2018. Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume II, Washington, D.C.

Vadher A. N., J. Millett, R. Stubbington, and P. J. Wood. 2018. Drying duration and stream characteristics influence macroinvertebrate survivorship within the sediments of a temporary channel and exposed gravel bars of a connected perennial stream. Hydrobiologia 814:121–132.

Wainwright, T. C., and L. A. Weitkamp. 2013. Effects of Climate Change on Oregon Coast Coho Salmon: Habitat and Life-Cycle Interactions. Northwest Science 87:219–242.

Waters, T. F. 1995. Sediment in streams: sources, biological effects and control. American Fisheries Society, Bethesda, Maryland. 251 p.

Weber, N., N. Bouwes, and C. E. Jordan. 2014. Estimation of salmonid habitat growth potential through measurements of invertebrate food abundance and temperature. Canadian Journal of Fisheries and Aquatic Sciences 71(8):1158–1170.

Winder, M., and D. E. Schindler. 2004. Climate change uncouples trophic interactions in an aquatic ecosystem. Ecology 85:2100–2106.

Wipfli, M. S. 1997. Terrestrial invertebrates as salmonid prey and nitrogen sources in streams: contrasting old-growth and young-growth riparian forests in southeastern Alaska, U.S.A. Canadian Journal of Fisheries and Aquatic Sciences 54(6):1259–1269.

Wipfli, M. S., and C. V. Baxter. 2010. Linking Ecosystems, Food Webs, and Fish Production: Subsidies in Salmonid Watersheds. Fisheries 35(8):373–387

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, PNW-GTR-326.

Wood, P. J., and P. D. Armitage. 1997. Biological Effects of Fine Sediment in the Lotic Environment. Environmental Management 21(2):203–17.

Wood J. L. A., J. W. A. Grant, and M. H. Belanger. 2012. Population density and territory size in juvenile rainbow trout, *Oncorhynchus mykiss*: implications for population regulation. Canadian Journal of Fisheries and Aquatic Sciences 69(6):1121–1128.

Wood P. J., J. Toone, M. T. Greenwood, and P. D. Armitage. 2005. The response of four lotic macroinvertebrate taxa to burial by sediments. Archiv fur Hydrobiologie 163:45–162.

Yount, J. D., and G. J. Niemi. 1990. Recovery of lotic communities and ecosystems from disturbance—a narrative review of case studies. Environmental Management 14(5):547–569.

Zabel, R. W., and S. Achord. 2004. Relating size of juveniles to survival within and among populations of Chinook salmon. Ecology 85:795–806.

Zabel, R. W., M. D. Scheuerell, M. M. McClure, and J. G. Williams. 2006. The interplay between climate variability and density dependence in the population viability of Chinook salmon. Conservation Biology 20(1):190–200.