UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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September 10, 2021

Refer to NMFS No: WCRO-2021-01520

Susan Poulson
Section Manager, NPDES Permitting Section
Environmental Protection Agency
1200 Sixth Avenue, Suite 155
Seattle, Washington 98101

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Issuance of NPDES Permits for Eight Federal Dams on the Lower Columbia and Lower Snake Rivers

Dear Ms. Poulson:

Thank you for your letter of May 19, 2021, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the lower Columbia and Snake Rivers Federal Hydroelectric Facilities National Pollutant Discharge Elimination System (NPDES) Permits. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action. We concur with your determination that the proposed action may affect designated EFH. We have included the results of our EFH review in Section 3 of this document.

In the attached biological opinion, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of:

• *Oncorhynchus tshawytscha*: SR (SR) spring/summer Chinook salmon, SR fall Chinook salmon, Upper Columbia River (UCR) spring-run Chinook salmon, Lower Columbia River (LCR) Chinook salmon;
• *O. mykiss*: Snake River Basin (SRB) steelhead, UCR steelhead, Middle Columbia River (MCR) steelhead, LCR steelhead;
• *O. nerka*: SR sockeye salmon;

• *O. kisutch*: LCR coho salmon;
• *O. keta*: Columbia River (CR) chum salmon;

or result in the destruction or adverse modification of their designated critical habitats. We also concur with the EPA that the proposed action is not likely to adversely affect the southern Distinct Population Segment of Pacific eulachon or their designated or proposed critical habitat.

As required by section 7 of the ESA, NMFS is providing an incidental take statement with the biological opinion. The incidental take statement describes a reasonable and prudent measure that NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth a reasonable and prudent measure, including a term and condition, that requires the EPA to forward to NMFS any monitoring plans or reports generated as part of the proposed Best Management Practices Plan. Incidental take from actions that meet this term and condition will be exempt from the ESA's prohibition against the take of listed species.

Please contact Claire McGrath; Portland, Oregon; (503) 230-5433; claire.mcgrath@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*]
Jenny Wu, Environmental Protection Agency
John Palmer, Environmental Protection Agency

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

Issuance of NPDES Permits for Eight Federal Dams on the Lower Columbia and Lower Snake Rivers

NMFS Consultation Number: WCRO 2021-01520

Action Agency: U.S. Environmental Protection Agency

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?**
Lower Columbia River Chinook salmon	Threatened	Yes	No	Yes	No
Upper Columbia River spring-run Chinook salmon	Endangered	Yes	No	Yes	No
Snake River spring/summer Chinook salmon	Threatened	Yes	No	Yes	No
Snake River fall Chinook salmon	Threatened	Yes	No	Yes	No
Columbia River chum salmon	Threatened	Yes	No	Yes	No
Lower Columbia River coho salmon	Threatened	Yes	No	Yes	No
Snake River sockeye salmon	Endangered	Yes	No	Yes	No

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?
Upper Columbia River steelhead	Threatened	Yes	No	Yes	No
Lower Columbia River steelhead	Threatened	Yes	No	Yes	No
Middle Columbia River steelhead	Threatened	Yes	No	Yes	No
Snake River Basin steelhead	Threatened	Yes	No	Yes	No
Southern DPS of Pacific eulachon	Threatened	No	No	No	No

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

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

Issued By: [signature]
Michael P. Tehan
Assistant Regional Administrator
Interior Columbia Basin Office
NMFS West Coast Region

Date: September 10, 2021

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Terms and Definitions

Abundance	In the context of salmon recovery, abundance refers to the number of adult fish returning to spawn.
Adaptive management	The process of adjusting management actions and/or directions based on new information.
Anadromous	Species that are hatched in freshwater, migrate to and mature in salt water, and return to freshwater to spawn.
Compliance monitoring	Monitoring to determine whether a specific performance standard, environmental standard, regulation, or law is met.
Delisting criteria	Criteria incorporated into ESA recovery plans that define both biological viability (biological criteria) and alleviation of the causes for decline (threats criteria based on the five listing factors in ESA section 4[a][1]), and that, when met, would result in a determination that a species is no longer threatened or endangered and can be proposed for removal from the Federal list of threatened and endangered species.
Distinct population segment (DPS)	A listable entity under the ESA that meets tests of discreteness and significance according to USFWS and NOAA Fisheries policy. A population is considered distinct (and hence a "species" for purposes of conservation under the ESA) if it is discrete from and significant to the remainder of its species based on factors such as physical, behavioral, or genetic characteristics, it occupies an unusual or unique ecological setting, or its loss would represent a significant gap in the species' range.
Diversion	Refers to taking water out of the river channel for municipal, industrial, or agricultural use. Water is diverted by pumping directly from the river or by filling canals.

Diversity All the genetic and phenotypic (life history, behavioral, and morphological) variation within a population. Variations could include anadromy vs. lifelong residence in freshwater, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, physiology, molecular genetic characteristics, etc.

Dredging The act of removing sediment from the river bottom to keep the channel at the proper depth for navigation. The continual moving and shifting of sediment makes dredging an ongoing activity.

ESA recovery plan A plan to recover a species listed as threatened or endangered under the U.S. Endangered Species Act (ESA). The ESA requires that recovery plans, to the extent practicable, incorporate (1) objective, measurable criteria that, when met, would result in a determination that the species is no longer threatened or endangered; (2) site-specific management actions that may be necessary to achieve the plan's goals; and (3) estimates of the time required and costs to implement recovery actions.

Evolutionarily significant unit (ESU) A group of Pacific salmon or steelhead trout that is (1) substantially reproductively isolated from other conspecific units and (2) represents an important component of the evolutionary legacy of the species. Equivalent to a distinct population segment and treated as a species under the Endangered Species Act.

Fish ladder A series of stair-step pools that enables salmon to get past the dams. Swimming from pool to pool, salmon work their way up the ladder to the top where they continue upriver.

Hydrologic unit code (HUC)	A Hydrologic Unit Code (HUC), developed by the U.S. Geological Survey as a standardized way of identifying drainage basins, subbasins, and watersheds throughout the country.
Levee	A levee is a raised embankment built to keep out flood waters.
Limiting factor	Physical, biological, or chemical features (e.g., inadequate spawning habitat, high water temperature, insufficient prey resources) experienced by the fish at the population, major population group, or ESU levels that result in reductions in viable salmonid population (VSP) parameters (abundance, productivity, spatial structure, and diversity).
Morphology	The form and structure of an organism, with special emphasis on external features.
Peak flow	The maximum rate of flow occurring during a specified time period at a particular location on a stream or river.
Piscivorous	Describes any animal that preys on fish for food.
Productivity	A measure of a population's ability to sustain itself or its ability to rebound from low numbers. The terms "population growth rate" and "population productivity" are interchangeable when referring to measures of population production over an entire life cycle. Can be expressed as the number of recruits (adults) per spawner or the number of smolts per spawner.
Reach	A length of stream between two points.
Redd	The nest constructed by female salmonids in streambed gravels where eggs are deposited and fertilization occurs.

Salmonid	Fish of the family *Salmonidae*, including salmon, trout, chars, grayling, and whitefish. In general usage, the term usually refers to salmon, trout, and chars.
Smolt	A juvenile salmon or steelhead migrating to the ocean and undergoing physiological changes to adapt from life in freshwater to the saltwater environment.
Snowpack	The accumulation of snow in the mountains that occurs during the late fall through early spring.
Spatial structure	The geographic distribution of a spawning population or the populations in an ESU.
Spill	Water released from a dam over the spillway instead of being directed through the turbines.
Streamflow	Streamflow refers to the rate and volume of water flowing in various sections of the river. Streamflow records are compiled from measurements taken at particular points on the river, such as The Dalles, Oregon.
Threats	Human activities or natural events (e.g., road building, floodplain development, fish harvest, hatchery influences, volcanoes) that cause or contribute to limiting factors. Threats may exist in the present or be likely to occur in the future.
Turbine	A hydro turbine is a device used in hydroelectric power generation that transfers energy from moving water to a rotating shaft to generate electricity. The turbines rotate or spin as a response to water being introduced to their blades and drive an electric generator to produce power.

Abbreviations and Acronyms

°C	degrees Celsius
°F	degrees Fahrenheit
Action Agency	Environmental Protection Agency
BE	biological evaluation
BHC	alpha-Hexachlorocyclohexane
BMP	best management practice
BOD	biological oxygen demand
BPA/Bonneville	Bonneville Power Administration
BTA	best technology available
CFR	Code of Federal Regulations
CHARTs	Critical Habitat Analytical Review Teams (NMFS')
COD	chemical oxygen demand
Corps	U.S. Army Corps of Engineers
CR	Columbia River
CRS	Columbia River System
CWA	Clean Water Act
CWIS	cooling water intake structures

DART	Data Access in Real Time
DDD	dichloro-diphenyl-trichloroethane
DDE	1,1-Dichloro-2,2-bis(p-chlorophenyl) ethylene (DDE), a breakdown product of DDT
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DPS	Distinct Population Segment
DQA	Data Quality Act
EAL	environmentally acceptable lubricant
ECO	Environmental Consultation Organizer
Ecology	Washington Department of Ecology
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FOP	Fish Operations Plan
FPP	Fish Passage Plan
FR	Federal Register

FWS	Fish and Wildlife Service (also U.S. Fish and Wildlife Service)
HAPC	Habitat Areas of Particular Concern
HUC5	5th-field hydrologic unit code
ITS	incidental take statement
ITS	Incidental Take Statement
kcfs	thousand cubic feet per second
LCR	Lower Columbia River
MCR	Middle Columbia River
mg/L	milligrams per liter
MPG	major population group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOEC	no observed effect concentration
NPDES	National Pollutant Discharge Elimination System
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality

PAHs	polycyclic aromatic hydrocarbons
PBF	physical or biological feature
PCB	polychlorinated biphenyl
PCE	primary constituent element
PFMC	Pacific Fishery Management Council
PIT	passive integrated transponder
Reclamation	U.S. Bureau of Reclamation
RPM	Reasonable and Prudent Measure
SR	Snake River
SRB	Snake River Basin
T&C	Term and Condition
TCDD	2,3,7,8 -Tetrachlorodibenzo-p-dioxin (TCDD, "dioxin")
TMDL	total maximum daily load
TSS	total suspended solids
UCR	Upper Columbia River
USACE	U.S. Army Corps of Engineers
U.S.C.	U.S. Code
USFWS	U.S. Fish and Wildlife Service

WAC	Washington Administration Code

1 Introduction

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

1.1 Background

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

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

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

1.2 Consultation History

The U.S. Environmental Protection Agency (EPA) is proposing to issue National Pollutant Discharge Elimination System (NPDES) permits to the U.S. Army Corps of Engineers (Corps or USACE) for discharges to the state of Washington at eight federal dams on the lower Columbia River (Bonneville Lock and Dam, The Dalles Lock and Dam, John Day Lock and Dam, and McNary Lock and Dam) and lower Snake River (Ice Harbor Lock and Dam, Lower Monumental Lock and Dam, Little Goose Lock and Dam, and Lower Granite Lock and Dam). These are eight of the 14 projects that comprise the federal Columbia River System (CRS). In July, 2020, NMFS completed consultation on the operation of the CRS with the Corps, U.S. Bureau of Reclamation (Reclamation), and U.S. Department of Energy - Bonneville Power Administration (BPA), collectively referred to as the CRS Action Agencies, and issued a biological opinion (opinion) for the Continued Operation and Maintenance of the Columbia River System (CRS opinion) (NMFS 2020). EPA was not an action agency for the 2020 consultation for activities they authorize or permit associated with these eight federal facilities. Thus, EPA has requested to consult with NMFS on its proposed issuance of NPDES permits for discharges at these eight CRS projects.

The Clean Water Act (CWA) prohibits any entity from discharging “pollutants” through a “point source” into a “water of the United States” unless they have an NPDES permit. The NPDES permit contains limits on what can be discharged, includes monitoring and reporting requirements, and has other provisions to ensure that the discharge does not hurt water quality or human health.

Pre-consultation discussions with EPA occurred from May 22 through June 22, 2020, when EPA provided information on the draft NPDES permits and draft analysis of effects. NMFS and EPA had additional pre-consultation correspondences related to EPA's proposed NPDES permits during January to May, 2021. In these exchanges, NMFS provided technical information to EPA on the spatial and temporal distribution and biological requirements of ESA-listed species, and on EFH requirements for Chinook and coho salmon. EPA sent NMFS a draft BE on April 26, 2021, and NMFS provided verbal feedback to EPA in a meeting on May 3, 2021. EPA sent NMFS a revised draft BE on May 9, 2021. On May 17, 2021, NMFS provided written comments and suggestions for additional information to include in EPA's final BE.

On May 19, 2021, EPA requested to consult with NMFS under Section 7(a)(2) of the ESA and Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act, and provided a final BE for the proposed action (EPA 2021a). NMFS confirmed receipt of the complete initiation package and initiated consultation on May 20, 2021. The BE provides a description of the proposed permits and an analysis of effects on anadromous fish species, critical habitat, and essential fish habitat in the Snake River and Columbia River. The present opinion and MSA consultation are based on information provided in the BE, EPA's draft NPDES permits and technical fact sheets,[1] and existing analyses in the CRS opinion (NMFS 2020). This consultation is not a reinitiation of the CRS opinion, and this new opinion does not replace the CRS opinion. This opinion incorporates by reference the relevant portions of the CRS opinion, provides information and additional analysis that is specific to the EPA's proposed issuance of NPDES permits, and specifies Reasonable and Prudent Measures and Terms and Conditions (RPM/T&Cs) applicable to EPA.

EPA determined that the discharges authorized under the proposed NPDES permits would be likely to adversely affect Snake River (SR) spring/summer Chinook salmon, SR fall Chinook salmon, SR sockeye salmon, Snake River Basin (SRB) steelhead, Upper Columbia River (UCR) spring Chinook salmon, UCR steelhead, Middle Columbia River (MCR) steelhead, Columbia River (CR) chum, Lower Columbia River (LCR) Chinook salmon, LCR coho salmon, and LCR steelhead. EPA determined that the proposed action is not likely to adversely affect Pacific eulachon. EPA also determined that the discharges authorized under the proposed NPDES permits may adversely affect EFH for Chinook salmon and coho salmon at and within 500 meters (m) downstream of each of the eight dams in the lower Columbia and Snake rivers.[2]

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[1] EPA provided draft NPDES permits for public review and comment from March 18 through May 4, 2020, and January 15 through February 16, 2021. We accessed the draft permits and fact sheets on June 7, 2021 at https://www.epa.gov/npdes-permits/draft-discharge-permits-federal-hydroelectric-projects-lower-columbia-river and https://www.epa.gov/npdes-permits/draft-discharge-permits-federal-hydroelectric-projects-lower-snake-river.

[2] In their letter requesting consultation, EPA stated that "EPA has made the determination that the discharges authorized under the eight proposed NPDES Permits may adversely affect EFH." In the Biological Evaluation document, EPA stated that " EPA has determined the proposed actions is not likely to adversely affect designated EFH within the action areas." On September 9, 2021, EPA clarified that their determination for EFH was that the proposed action may adversely affect EFH for Chinook and coho salmon (Wu 2021a).

EPA noted in the BE its determination that the proposed action would have no effect on Upper Willamette River (UWR) Chinook salmon, UWR steelhead, Southern Distinct Populations Segment (DPS) green sturgeon, and Southern Resident killer whale.

1.3 Proposed Federal Action

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

Under the MSA, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

The EPA Region 10 is proposing to issue NPDES permits for the discharge of pollutants to Washington waters from federal dams operated by the USACE on the lower Columbia and Snake Rivers. These facilities are Bonneville Project, The Dalles Lock and Dam, John Day Project, McNary Lock and Dam, Ice Harbor Lock and Dam, Lower Monumental Lock and Dam, Little Goose Lock and Dam, and Lower Granite Lock and Dam. These permits would authorize the following types of discharges from the federal dams into waters of the State of Washington:[3] equipment cooling water, equipment and floor drain water, equipment backwash strainer water, and specific maintenance waters. The proposed permits do not regulate waters that flow over the spillway or pass through the turbines. The permits also do not authorize oil spills. The permits contain the following requirements and stipulations:

- Numeric effluent limits on discharges for oil, grease, pH, and heat;
- Narrative effluent limits restricting visible oil sheens, floating and suspended, submerged matter, and toxics;
- The use of environmentally acceptable lubricants (EALs), unless technically infeasible; and
- Technologies and operations that minimize the impingement and entrainment of fish in cooling water intake structures (CWIS).
- Monitoring requirements for flow, oil, grease, pH, temperature, and PCBs, and in some outfalls, total suspended solids, and chemical oxygen demand;
- A detailed best management practices (BMP) plan and BMP annual report to prevent and minimize oil releases, including oil accountability tracking;
- An EAL annual report to inventory equipment where EALs may be used and to report when and where EALs have been implemented;
- A CWIS annual report to report on the implementation of technologies to meet CWIS permit conditions; and

[3] The state line between Washington and Oregon is in the middle of the Columbia River. Bonneville, The Dalles, John Day, and McNary projects have some outfalls that discharge into Oregon waters and some outfalls that discharge into Washington waters. As a result, jurisdiction for NPDES permitting in the Columbia River is divided between Washington and Oregon. The Oregon Department of Environmental Quality (ODEQ) has jurisdiction to issue NPDES permits to federal facilities in Oregon. However, the Washington Department of Ecology (Ecology) does not have authority to issue such permits, thus, the EPA is the permitting authority for federal facilities in Washington (EPA 2021a).

- A PCB Management Plan and PCB Annual Report to inventory past actions to reduce/remove PCBs, identify potential current sources, and describe actions to reduce those sources.

Section 2 and Appendix A of EPA's BE (EPA 2021a) describe the proposed action including the types of discharges and outfalls covered by the proposed permits; the effluent limitations and monitoring; and additional permit requirements such as the Best Management Practices Plan and the use of Environmentally Acceptable Lubricants, requirements related to PCBs, cooling water intake structures, and reporting requirements. The proposed permits require no discharge of toxics in amounts that would impair or harm beneficial uses, including aquatic life, and prohibits the use of PCBs on equipment such as wires in the hydroelectric generating facilities. The proposed permits also require the facilities to submit a PCB management plan annually that characterizes sources of PCBs and describes how those sources will be controlled.

We adopt by reference EPA's description of the proposed action contained in Section 2 of the BE. These would be the first individual NPDES permits issued by EPA for these facilities and would be effective for five years.

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.

The EPA determined the proposed action is not likely to adversely affect Pacific eulachon or its critical habitat. Our concurrence with their determination for Pacific eulachon and its critical habitat is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.13). EPA (2021a) also indicated that it had determined the proposed action would not adversely affect critical habitat for UCR spring-run Chinook salmon or CR chum salmon in Tables 3 and Tables 44 and 45 of the BE, but on inquiry stated that they had intended to determine that the proposed action was "Likely to Adversely Affect" critical habitat for both Evolutionarily Significant Units (ESUs) (Wu 2021b).

2.1 Analytical Approach

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

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

The designations of critical habitat for SR spring/summer Chinook salmon, SR sockeye salmon, and SR fall Chinook salmon use the term primary constituent element (PCE) or essential features. The 2016 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 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition 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

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

2.2.1 Status of the Species

We incorporate by reference here the sections describing the status of the species and designated critical habitat in the CRS opinion (NMFS 2020): Section 2.2.1 (SR spring/summer Chinook salmon), Section 2.3.1 (SRB steelhead), Section 2.4.1 (SR sockeye salmon), section 2.5.1 (SR fall Chinook salmon), Section 2.6.1 (UCR spring-run Chinook salmon), Section 2.7.1 (UCR steelhead), Section 2.8.1 (MCR steelhead), Section 2.10.1 (LCR Chinook salmon), Section 2.11.1 (LCR steelhead), Section 2.12.1 (LCR coho salmon), and Section 2.9.1 (CR chum salmon). This includes information on status of the species since NMFS' 2016 status review.[4] We did not find more recent information (e.g., 2020 adult returns) that would substantially change the status of the species as described in NMFS (2020).

Summary – Status of the Species

Each species of salmon and steelhead considered in this opinion is at risk of becoming endangered in the foreseeable future, with the exception of two species (UCR spring Chinook salmon, and SR sockeye salmon), which are currently endangered. Each species is ESA-listed due to a combination of low abundance and productivity, reduced spatial structure, and decreased genetic (and life history) diversity. Many of the component populations of these ESUs and DPSs are also at low levels of abundance or productivity; in many cases, decreases in the last few years are associated with poor ocean conditions. Several species have lost some of their historical population structure due to human activities, and the populations that remain in the available habitat face multiple limiting factors. Individuals from most of the ESA-listed component populations must move through or use parts of the action area at some point during their life history.

[4] The upcoming status reviews will include population-level adult returns through 2019 where available, and updated rolling 5-year geomeans.

2.2.2 Status of Critical Habitat

This section describes designated critical habitat affected by the proposed action. 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.

Physical and Biological Features of Salmon and Steelhead Critical Habitat

The NMFS designated critical habitat for three different groups of salmonids that occupy the lower Columbia River on three different dates. For each designation, NMFS used slightly different descriptions of the physical and biological features (PBFs) of critical habitat. In addition, NMFS identified the essential elements of the PBFs using slightly different terminology. This section presents each of the approaches to terminology used for each of the subsequent designations and attributes those to the specific salmonids covered by each designation. For convenience, in the remainder of the document we will refer to these attributes as PBFs, even though the original designations used different terminologies. Many of the PBFs and their essential elements actually overlap across designations.

The NMFS designated critical habitat for several Snake River salmonids on October 25, 1999 (64 FR 57399): the SR sockeye and SR spring/summer and fall Chinook salmon ESUs. The PBFs (which were originally termed "essential features") of critical habitat for Snake River salmon are (1) spawning and juvenile rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; and (4) adult migration corridors. The essential elements of the spawning and rearing PBFs are: 1) Spawning gravel; (2) water quality; (3) water quantity; (4) water temperature; (5) food; (6) riparian vegetation; and (7) access. The designation also breaks down the migration corridor for juvenile and adult salmonids as follows: Essential features of the juvenile migration corridors include adequate: (1) Substrate (2) water quality; (3) water quantity; (4) water temperature; (5) water velocity; (6) cover/shelter; (7) food; (8) riparian vegetation; (9) space; and (10) safe passage conditions. The adult migration corridors are the same areas included in juvenile migration corridors. Essential features would include those in the juvenile migration corridors, excluding adequate food.

Subsequently, NMFS designated critical habitat for 10 more ESUs and DPSs of Columbia River basin salmon and steelhead on September 2, 2005 (70 FR 52630), and for lower Columbia River coho salmon on February 24, 2016 (81 FR 9252) (Table 2). The PBFs are referred to as Primary Constituent Elements (PCE) in 70 FR 52630 and in 81 FR 9252, and those terms may be used interchangeably in this document. Specific PBFs, and essential features for salmonids designated in 2005 and in 2016 include:

- Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, water quality and forage that support juvenile development, and natural cover such as shade,

submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;
- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;
- Nearshore marine areas[5] free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and
- Offshore marine areas[6] with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For most salmon and steelhead, NMFS's critical habitat analytical review teams (CHARTs) 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 were high, medium, or low. To determine the conservation value of each watershed to species viability, the CHARTs evaluated the quantity and quality of habitat features, the relationship of the area compared to other areas within the species' range, and the significance to the species of the population occupying that area. 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, a unique contribution of the population it served, or is serving another important role.

Habitat quality in tributary streams within the Interior Columbia Basin Recovery Domain varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994). Critical habitat has been degraded by intense agriculture, alteration of stream morphology (i.e., through channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas. Restoration activities addressing tributary habitat quality and complexity, tributary and mainstem migration barriers, water quality, and excessive predation have improved the baseline condition for PBFs in some locations.

Human activities since the late 1800s also have altered the form and function of critical habitat in the Lower Columbia River Recovery Domain, reducing the quantity and quality of its PBFs. Historically, the downstream half of the estuary was a dynamic environment with multiple

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[5] NMFS designated nearshore marine areas as critical habitat for Columbia basin salmon and steelhead only from the mouth of the river to an imaginary line connecting the outer extents of the north and south jetties.

[6] NMFS did not designate any offshore marine areas as critical habitat for Columbia basin salmon and steelhead.

channels, extensive wetlands, sandbars, and shallow areas. Winter and spring floods, low flows in late summer, large woody debris floating downstream, and a shallow bar at the mouth of the Columbia River maintained this environment. Today, navigation channels have been dredged, deepened, and maintained; jetties and pile-dike fields have been constructed to stabilize and concentrate flow in the mainstem navigation channel; and causeways have been constructed that restrict the position of tributary confluences. In addition, more than 70 percent of the original marshes and spruce swamps in the estuary have been converted to industrial, transportation, recreational, agricultural, or urban use. Many wetlands along the shore in the upper reaches of the estuary were converted to industrial and agricultural lands after levees and dikes were constructed.

The remainder of the area designated as critical habitat is in the reservoir reach between Bonneville Dam and the Hood River confluence. The reservoir itself is part of the high value rearing and migration corridor connecting important upstream watersheds with downstream reaches and the ocean. Its conservation value has been affected by upstream and downstream passage at Bonneville Dam, and any historical spawning habitat in the lower reaches of the tributaries that had been used by fall-run LCR Chinook and CR chum salmon populations are now under the reservoir. In most designated tributary watersheds, stream habitat, water quality, and watershed processes have been degraded by development and other land use activities, particularly in low to moderate elevation habitats where fall Chinook and chum salmon spawn and rear.

The effect of these changes as a whole is that critical habitat is not able to fully serve its conservation role in many of the designated watersheds for each of the salmon ESUs and steelhead DPSs.

2.2.3 Climate Change Implications for ESA-listed Species and their Critical Habitat

One factor affecting the rangewide status of the listed species, and aquatic habitat at large, is climate change. The U.S. Global Change Research Program (USGCRP) reports average warming in the Pacific Northwest of about 1.3ºF from 1895 to 2011, and projects an increase in average annual temperature of 3.3ºF to 9.7ºF by 2070 to 2099 (compared to the period 1970 to 1999), depending largely on total global emissions of heat-trapping gases (predictions based on a variety of emission scenarios including B1, RCP4.5, A1B, A2, A1FI, and RCP8.5 scenarios). The increases are projected to be largest in summer (Melillo 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).

Several studies have revealed that climate change has the potential to affect ecosystems in nearly all tributaries throughout the Snake River (Battin et al. 2007; ISAB 2007). While the intensity of effects will vary by region (ISAB 2007), climate change is generally expected to alter aquatic habitat (water yield, peak flows, and stream temperature). As climate change alters the structure and distribution of rainfall, snowpack, and glaciations, each factor will in turn alter riverine hydrographs. Given the increasing certainty that climate change is occurring and is accelerating (Battin et al. 2007), NMFS anticipates salmonid habitats will be affected. Climate and hydrology models project significant reductions in both total snow pack and low-elevation snow pack in the

Pacific Northwest over the next 50 years (Mote and Salathé 2009). These changes will shrink the extent of the snowmelt-dominated habitat available to salmon and may restrict our ability to conserve diverse salmon life histories.

In the Pacific Northwest, most models project warmer air temperatures, increases in winter precipitation, and decreases in summer precipitation. Average temperatures in the Pacific Northwest are predicted to increase by 0.1 to 0.6°C (0.2°F to 1.0°F) per decade (Mote and Salathé 2009). Warmer air temperatures will lead to more precipitation falling as rain rather than snow. As the snowpack diminishes, seasonal hydrology will shift to more frequent and severe early large storms, changing streamflow timing, which may limit salmon survival (Mantua et al. 2009). The largest driver of climate-induced decline in salmon populations is projected to be the impact of increased winter peak flows, which scour the streambed and destroy salmon eggs (Battin et al. 2007).

Higher water temperatures and lower spawning flows, together with increased magnitude of winter peak flows are all likely to increase salmon mortality. The ISAB (2007) found that higher ambient air temperatures will likely cause water temperatures to rise. Salmon and steelhead require cold water for spawning and incubation. As climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations. Thermal refugia are important for providing salmon and steelhead with patches of suitable habitat while allowing them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid waters above summer maximum temperatures, juvenile rearing may be increasingly found only in the confluence of colder tributaries or other areas of cold-water refugia (Mantua et al. 2009).

Climate change is expected to make recovery targets for salmon and steelhead populations more difficult to achieve. Climate change is expected to alter critical habitat by generally increasing temperature and peak flows and decreasing base flows. Although changes will not be spatially homogeneous, effects of climate change are expected to decrease the capacity of critical habitat to support successful spawning, rearing, and migration. Habitat actions can address the adverse impacts of climate change on salmon. Examples include restoring connections to historical floodplains and freshwater and estuarine habitats to provide fish refugia and areas to store excess floodwaters, protecting and restoring riparian vegetation to ameliorate stream temperature increases, and purchasing or applying easements to lands that provide important cold water or refuge habitat (Battin et al. 2007; ISAB 2007; Crozier et al. 2019; Crozier et al. 2020; Crozier 2021).

Expected changes to marine ecosystems due to increased temperature, altered productivity, or acidification will have large ecological implications through mismatches of co-evolved species and unpredictable trophic effects (Cheung et al. 2015, Rehage and Blanchard 2016). However, predicting the composition or outcomes of future trophic interactions is not possible with current models. Daly and Brodeur (2015) showed that bioenergetic demand increased during warm-ocean conditions, suggesting that, at a minimum, prey availability and prey quality, “bottom-up” drivers of growth and survival may become more important in the future. Life-cycle modeling for SR spring/summer and UCR spring-run Chinook salmon in NMFS’ (2020), which considered a range of changing climate severity over the next 24 years, indicates that climate change effects, especially those that may manifest in the ocean, can have severe, negative consequences to the overall productivity (and abundance) of spring-run Chinook salmon populations in the interior Columbia basin.

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 action area for the proposed action is discontinuous and includes all waters within 500 meters downstream of each facility.[7] Water quality dilution modeling indicates that effects from the pollutants addressed in the proposed action are negligible beyond this point (EPA 2021a). While the proposed action covers only the outfalls of a facility that discharge directly into waters of Washington state (and not outfalls in Oregon), we define the action area as including waters of both Washington and Oregon because the proposed action has the potential to affect water quality and aquatic resources, including the fish species considered in this opinion, for up to 500 meters below each project across the entire width of the river channel.

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).

We incorporate by reference here the sections describing the environmental baseline in EPA's BE (EPA 2021a). Specifically, we reference Section 4, Description of the Environmental Baseline, which summarizes influent data, ambient flow data, and ambient temperature data, as well as water quality impairments within the action area. In summary:

- Influent data for the water quality constituents addressed by the permits are limited.
- The 2011 to 2016 average hydrographs for the lower Columbia River dams peaked at over 300 kcfs in May and got as low as 100 kcfs in September. The average hydrographs

[7] EPA (2021a) considered the action area to include "the waters of Washington State within 500 meters downstream of each facility." EPA considered this action area because, based on water quality dilution modeling, effects from the pollutants addressed in the proposed action are negligible beyond this point, and because the proposed permits would be issued to the state of Washington and not the state of Oregon. We agree that all areas affected directly or indirectly are included in the waters 500 meters downstream of each facility. However, we define the action area as including waters of both Washington and Oregon because the discharged pollutants mix quickly in receiving waters and thus may occur across the entire width of the river channel.

from the lower Snake River dams peak at just over 100 kcfs in May and get as low as 25 kcfs in September. The lowest ambient river flows throughout the system generally occur between September and November. There is tremendous variation in flow both within and between years.

- Daily maximum temperatures from 2011 to 2016 at Lower Granite Dam generally met Washington's temperature criteria, largely due to controlled cold-water releases from Dworshak Dam on the Clearwater River. After the Snake River mixes with the Columbia River, temperature tends to be above 20°C from mid-July to mid-September, and consistently peaks at 21 to 23°C during these months, as measured at the tailrace (downstream) of each dam.
- The Columbia and Snake Rivers are impaired for temperature, toxics, and dissolved oxygen. In Washington waters, the Columbia River is impaired for 2,3,7,8-TCDD (dioxin), 4,4"-DDD, 4,4"-DDE, 4,4"-DDT, aldrin, alpha-BHC, chlordane, dieldrin, hexachlorobenzene, mercury, total chlordane, and toxaphene. Hydroelectric generating facilities are not believed to generate or use these compounds. However, the lower Columbia and Snake Rivers are also impaired for PCBs. Although there are no known sources of PCBs at the hydroelectric generating facilities, these compounds may be present as insulation on wires or in other sources. Finally, the areas immediately downstream of The Dalles Lock and Dam and upstream of Ice Harbor Lock and Dam and Little Goose Lock and Dam are impaired for dissolved oxygen.

We described oil and grease contamination from the eight mainstem projects in the 2020 CRS opinion (NMFS 2020). Oils, greases, and other lubricants are used in hydropower turbines, hydraulic systems, lubricating systems, gear boxes, machining coolant systems, heat transfer systems, transformers, circuit breakers, and electrical systems. Leakage of oils, greases, or other lubricants into the tailrace at each project has the potential to expose salmon and steelhead to toxic concentrations of these compounds and could result in behavioral avoidance of contaminated water or sediments, or even, in some circumstances, death. The extent to which oil or grease or other discharges from the facilities have affected the behavior, health, or survival of salmonids in the past is unknown, although any acute effects of past discharges on the survival of juvenile or adult salmonids would be reflected in annual reach survival estimates.

The factors described above are having negative effects on the abundance, productivity, and life history diversity[8] of the listed ESUs/DPSs and their component populations. Likewise, the environmental baseline does not fully support the conservation value of designated critical habitat for the listed species. The PBFs essential for the conservation of listed salmon and steelhead include adequate water quality in freshwater spawning and rearing areas and juvenile and adult migration corridors, including the estuary.

Recovery plans for Snake River salmon and steelhead (NMFS 2015; 2017a,b) have identified the following actions to improve temperature conditions and reduce toxic contaminants within the action area.

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[8] For example, mainstem temperatures are warmer and generally more adverse for juvenile and adult salmonids migrating in late summer.

- Continued releases of cool water from Dworshak Dam during late summer to reduce mainstem Snake River temperatures and maintain adequate migration conditions (for adults and juveniles) in the lower Snake River
- Implement actions to improve the quality of water discharged from the Hells Canyon Complex (temperature effect)
- Revise water quality criteria and implement existing programs to reduce toxic contaminant levels and their adverse effects

Idaho Power Company's Hells Canyon Complex on the Snake River upstream of Lower Granite Reservoir alters Snake River temperatures by delaying the seasonal warming and cooling of water downstream. Compared to inflows, this thermal lag reduces exceedances of criteria for supporting coldwater aquatic life during the summer, but increases the exceedances of temperature criteria for salmonid spawning in the fall (FERC 2007). The use of cool water from Dworshak Reservoir to augment flows and moderate temperatures in the lower Snake River during summer is now built into the Corps and BPA's annual Water Management Plan (e.g., BPA et al. 2021).

The Corps' oil accountability reports from 2015 to 2019 for the eight projects on the lower Snake and Columbia Rivers show that most discharges of oil and grease to the environment have been small and have occurred infrequently. Across the five-year reporting period, there were about 68 suspected or confirmed discharges of oil and grease to the environment. Among the 12 largest (10 gallons or greater) incidents, the estimated volume ranged from 10 to 1,000 gallons (mean = 291 gallons). In most cases these larger discharges occurred at a slow rate over weeks or months. Most of the discharges reported were observed as oil sheens and, when a source was identified, had resulted from leaks or spills that were estimated to be from 1 ounce to 1 gallon in size.

To summarize the information incorporated by reference (NMFS 2020) and described here, the environmental baseline is characterized by altered and degraded habitat including altered floodplain and channel structure, sediment transport, hydrology, water quality, and fish passage. Storage and release of water in upstream storage projects has altered the natural hydrograph in the action area; most notably, lower spring flows have resulted in increased travel times for juvenile salmonids during outmigration. The Columbia and Snake Rivers are impaired for temperature, toxics, and dissolved oxygen; and water and sediment in the action area have low to moderate levels of metals, pesticides, and low levels of other persistently toxic compounds, some of which bioaccumulate through food webs. Salmon and steelhead are exposed to high rates of natural predation during all life stages from fish, birds, and marine mammals. Avian and introduced fish predation on salmonids has been exacerbated by environmental changes associated with river development and altered flows. Shoreline development has harmed native riparian vegetation, displaced shallow water habitat with fill materials, and disconnected the main channel from historic floodplain areas.

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. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

We evaluated the action as proposed in EPA (2021a). The proposed NPDES permits would establish effluent limits, monitoring requirements, and other conditions necessary to comply with the CWA and applicable water quality standards. The permits would establish numeric and narrative effluent limits that comply with applicable water quality standards and consider downstream state standards that protect the beneficial uses of the waters where the facilities discharge.

Discharges allowed by the permits would occur through water used to cool equipment, water drained from equipment and floors, water released when strainers are backwashed, and water used in other maintenance activities. The permits would not regulate waters that flow over spillways or pass through turbines. Situations where permittees are not in compliance with the permits (e.g., an oil spill) would not be authorized and thus are not addressed in EPA's BE or in this opinion. As described above, the types of discharges covered by the proposed permits have occurred, to varying degrees, over decades as part of the routine operations and maintenance of the eight CRS projects. In this section, we describe the discharges and permit requirements and explain the effects in more detail than is described in NMFS (2020).

EPA proposes that permit limits for heat, pH, and oxygen-demanding materials would be measured and enforced at the discharge point. Although the proposed NPDES permits would only address discharges to the waters of Washington State, we are unable to determine the portion of the discharges that would enter the waters of Washington versus Oregon at the four lower Columbia River projects (Bonneville, The Dalles, John Day, and McNary), which are located in both states. For the purpose of this analysis, we assume that the waters of Washington state receive all discharges and we assume that discharges would mix into the tailwaters across the full width of the channel.

2.5.1 Effects of Best Management Practices and Minimization and Conservation Measures

The proposed NPDES permits would require the Corps to implement technologies and operations required in the:

- Corps' CRS Fish Passage Plan (FPP) and Fish Operations Plan (FOP) for the Lower Columbia and Lower Snake River Hydropower Projects, which are developed by and revised annually with input from NMFS and regional fish comanagers;
- NMFS' CRS opinion (NMFS 2020);
- U.S. Fish and Wildlife Service's (FWS) Biological Opinion for the Operation and Maintenance of the Columbia River System in Washington, Oregon, Idaho and Montana (FWS CRS opinion) (USFWS 2020); and
- Washington Department of Ecology's CWA 401 Certification.

In addition, the proposed NPDES permits would require the use of best management practices (BMPs) to avoid accidental releases of oil and grease, and to minimize any adverse effects from equipment in contact with the water. These BMPs include:

- Use EALs for all equipment with oil or grease interfaces, where technically feasible
- Ensure oil, grease, and hydraulic fluids, from all sources, do not enter the river
- Monitor the quantity and type of all oil products used on-site
- Maintain protective seals on all equipment with oil-to-water interfaces in good operating order
- Reduce lubricants that encounter river water such as those in spill gate and turbine gate mechanisms
- Implement a preventive maintenance and cleaning program for turbine and wicket gate parts
- Regularly inspect fuel hoses, oil drums, oil or fuel transfer valves and fittings, etc. to prevent drips or leaks
- Maintain internal facility drainage water management devices (e.g., cleaning oil/water separators, pits, sumps) including inspections and testing to uncover conditions that could cause breakdowns or failures that result in discharges of pollutants to surface waters
- Operate oil/water separators properly through inspections at appropriate intervals, regularly scheduled maintenance, and review of sampling data.

Taken together, these BMPs and the minimization and conservation measures are expected to limit discharges to levels at or below those described in the proposed permits. Any leaks would be likely to be detected quickly.

2.5.2 Effects of Monitoring and Reporting Requirements

The proposed permits would require the following monitoring and reporting:

- Monitoring flow, oil, grease, pH, temperature, and PCBs, and in some outfalls, total suspended solids, and chemical oxygen demand;
- Implementation of oil accountability plans with enhanced inspection protocols and preparation of annual oil accountability reports;
- Annual reporting requirements documenting use of EALs;
- Development of a PCB Plan and annual reporting requirements;
- Cooling Water Intake Structure annual reporting including use of best available technology and adherence to Fish Operations and Passage Plans.

Monitoring requirements will ensure that EPA, NMFS, and other interested parties have routine access to monitoring data and compliance information, and will allow for adaptive management to adjust BMPs if warranted. The monitoring information also will allow verification that the effects of the permit implementation are no greater than considered in this opinion.

2.5.3 Amounts and Effects of the Discharged Effluents on Receiving Waters

For pH, oil and grease, and heat, EPA (2021a) used the proposed effluent limitations and influent and flow data from the permit applications to determine the impact of the discharges in the action areas. For TSS and oxygen-demanding materials, EPA used influent, effluent, and flow data from the permit applications to determine the maximum concentrations from the discharges. EPA used the CORMIX water quality model (Jirka et al. 1996) to describe pollutant concentrations, dilution factors at various distances downstream of each project (i.e., the amount of receiving water per unit of pollutant), and levels of mixing downstream of each project.

Discharges from the eight CRS projects addressed by the proposed action will continue to contribute oil and grease, pH, heat, TSS, and biological oxygen demand to the already degraded baseline for water quality within the action area. Horizontal and vertical currents and dilution factors mean that concentrations may not be measurable or have biological consequences within the full 500-m distance downstream of each dam as discussed in the following sections.

2.5.4 Effects of the Proposed Permits on Listed Species

The assumptions that EPA (2021a) used to calculate the maximum concentrations to which organisms will be exposed at discharges within the permit limits are described in Section 5.3 of the BE, which we incorporate by reference. In summary:

1. For each project, EPA assumed the outfalls would discharge either at the effluent limit (for oil and grease, pH, and heat) or at the maximum concentration that has been observed at that project (for TSS and oxygen-demanding materials).
2. In cases where a pollutant has not been detected at a project, EPA assumed the maximum concentration of a pollutant to be equal to the maximum concentration observed at any of the outfalls at any of the projects.

The above approach is conservative because it overestimates the amount of each pollutant that is discharged at each project by assuming that pollutants would be continuously discharged at either the permit limit or the maximum observed concentration at design flow. To evaluate effects from chronic exposures, EPA calculated the expected concentration of each pollutant after dissemination in the receiving water by multiplying it by the dilution factor at the end of the action area (500 meters)[9]. In addition, EPA evaluated impacts for acute temperature exposures since aquatic life could experience instantaneous lethal temperature and thermal shock if exposed to high temperatures.

The level of exposure to a pollutant that an individual fish experiences will vary depending on the species' spatial and temporal distribution and life history (Table 2.5-1). Within a species, sensitivity to a pollutant typically varies by life stage, in most cases with eggs and larvae more sensitive than juveniles, which in turn are more sensitive than adults given the same exposure (EPA 1976, 1986). We describe effects that we expect to be common to all of the species, and note exceptions or additions to these effects for individual species or life history types in the subsections below.

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[9] This calculation using dilution factors was to evaluate effects of chronic exposure and differs from the permit discharge limit, which is calculated at the point of discharge with no dilution factor.

All of the salmon and steelhead species considered in this opinion use the action area for juvenile and adult migration (Table 2.5-1). Monitoring of dam passage using PIT-tag detections shows that individual juveniles complete their migration through the hydrosystem, including the action area, within a period of weeks (Widener et al. 2021). The migration period for juveniles from an entire ESU or DPS usually is complete within several months (DART 2021), but a fraction of subyearling (age-0) SR fall Chinook salmon will stop and rear over winter in the reservoirs between lower Snake River dams, before resuming their downstream migration the following spring (NMFS 2020). Although it is possible that some individuals spend days or weeks holding near the shoreline within the 500-meter reach below each dam, telemetry studies show that most juveniles are swept out of the tailraces within a few hours (see Appendix A).

Limited spawning of SR fall Chinook salmon occurs in the tailraces of Ice Harbor, Lower Monumental, Little Goose, and Lower Granite Dams in the lower Snake River (Dauble et al. 1999, Normandeau Associates 2014, NMFS 2017a). For example, about 0.1 percent of all redds in the Lower Tucannon River Major Spawning Area occur in the tailraces of Little Goose and Lower Monumental Dams (NMFS 2017a). Shifting or compacted substrates in the relatively turbulent conditions within the first 500 meters are likely to damage eggs, so that successful spawning is unlikely regardless of water quality. Nonetheless, a small number of SR fall Chinook salmon eggs, alevins, and fry could be present in the action area during fall through early spring.

Adult salmon and steelhead also tend to pass upstream through the migratory corridor over a period of weeks. There are two notable exceptions to this pattern:

1. A small proportion of migrating adults may pause within a tailrace area for days to weeks before ascending a fish ladder, particularly when temperatures are high (EPA 2021d) or during periods of high spill when tailrace conditions may make it difficult to navigate ladder entrance (NMFS 2020).[10] Individuals that pause or delay in project tailraces would experience more exposure to pollutants compared to individuals that migrate without delay.
2. Adult summer steelhead are known to spend a significant amount of time making exploratory movements up and down the mainstem between the time of freshwater entry and spawning. Individual LCR, MCR, UCR, or SR steelhead can be detected passing through at least one of the eight dams, indicating presence in the action area, at almost any time of year.

[10] In addition to adult migrants that may delay in project tailraces (particularly during high spring spill), adult steelhead may spend many weeks in cool water refuges during the warmer summer months. Because cool water refuges are located outside the action area (EPA 2021c), the permitted discharges would not affect fish condition or survival or prey quantity or quality in these areas.

Table 2.5-1. Timing for presence in the action area by life stage for salmon and steelhead species, determined using PIT tag detections at dams unless otherwise noted. Timing for juvenile and adult migration lists the average month with presence in the action area, using the following conventions for passage date: 5th percentile - 95th percentile, (1st percentile to 100th percentile). Average month is calculated using the long-term[a] mean for passage at the upper- and lower-most of the dams within a species' migration corridor (e.g., Bonneville and McNary for UCR and MCR species, Bonneville and Lower Granite for SR species, Bonneville only for LCR and CR species). NP means the life stage is not present within the action area (DART 2021).

ESU/DPS	Juvenile migration 5th - 95th% (first - last)	Juvenile rearing/ overwintering	Adult migration 5th - 95th% (first - last)	Adult overwintering
SR spring/summer Chinook salmon	Apr - Jun, (Mar - Sep)	NP	May - Jul, (May - Jul)	NP
SRB steelhead	Apr - Jun, (Mar - Aug)	NP	Apr - Aug, (Apr - Sep)	Sep - Mar
SR sockeye salmon	May - Jun, (May - Jul)	NP	Jun - Jul, (Jun-Jul)	NP
SR fall Chinook salmon	Apr - Aug, (Mar - Nov)	Sep - Apr	Aug - Oct, (Aug - Oct)	NP
UCR spring-run Chinook salmon	May - Jun, (Apr - Sep)	NP	Apr - Jul, (Apr - Aug)	NP
UCR steelhead	Apr - Jun, (Apr - Jul)	NP	Apr - Sep, (Apr - Oct)	NP
MCR steelhead	Apr - Jun, (Mar - Jun)	NP	May - Nov, (May - Nov)	Dec - Jan
LCR Chinook salmon[b]	Apr - Aug, (Mar - Sept)	NP	Mar-Jun (spring-run), Aug-Oct (fall- run)[b]	NP
LCR steelhead	Apr - Jun, (Apr - Aug)	NP	Mar - Jun (Sept)	Oct - Feb
LCR coho salmon	Apr - Jun[c,d]	NP	Aug-Dec[b]	NP
CR chum salmon	Mar - May[e]	NP	Oct - Nov, (Sept - Nov)[f]	NP

[a]Data available to describe historic timing of adult and juvenile passage varies by ESU/DPS. For adult timing, average dates from 8 to 28 years of data were available; and for juveniles average dates for 17-25 years of data were available. Details on specific years used for each ESU/DPS is in DART (2021).

[b]LCR Chinook salmon timing includes spring-run and fall-run types; information is from NMFS (2020) due to insufficient PIT tag data.
[c]Because they cannot be distinguished visually, the timing of smolt passage for coho salmon includes individuals from both the listed LCR coho salmon ESU and unlisted coho salmon emigrating from the Clearwater drainage.
[d] Information from NMFS (2013) due to insufficient PIT tag data.
[e]Juvenile chum passage timing at Bonneville dam estimated using fry emergence timing observed in Hamilton Creek/ Ives Island area, which is located about 2,000 meters below Bonneville Dam (WDFW 2021).
[f]Determined using visual counts of adults in the Bonneville adult ladders.

In summary, juvenile salmon and steelhead from all of the ESUs and DPSs considered in this opinion are likely to spend very short periods of time (up to an hour) in the action area, the 500-meter reach below each of the eight dams. Juvenile fall Chinook salmon that overwinter in the lower Snake River are likely to occupy pelagic waters of the lower Snake River reservoirs (Tiffan and Connor 2012) rather than tailrace areas where they would be exposed to the proposed levels of pollutant discharges. Adult salmonids may spend hours or days in a tailrace during a period of high temperature (summer) or high spill (spring), increasing the risk of exposure to the pollutants covered by the permits. Adult summer steelhead move throughout the hydrosystem year round so that the risk of exposure is greater than for other ESUs and DPSs.

Effects of Oil and Grease, including Environmentally Acceptable Lubricants

EPA's BE (Section 5.5.1, EPA 2021a) describes expected exposure to oil and grease in the environmental baseline and analysis of effects, and is incorporated by reference here. The narrative criteria in the States of Washington and Oregon's water quality standards prohibit discharges that would cause an oil sheen, and EPA interprets this to be equal to a daily maximum effluent limit of 5 mg/L. The draft permits impose numeric effluent limitations (before dilution) for oil and grease of 5 mg/L, which EPA used to calculate the resulting exposure concentrations.

Since 2014, the Corps has implemented a program of best management practices to avoid accidental releases of oil and grease and minimize any adverse effects from equipment in contact with the water. Where feasible, the Corps uses greaseless equipment or environmentally acceptable lubricants. The Corps implements oil accountability plans with enhanced inspection protocols and prepares annual oil accountability reports that records quantities of oil and grease used at a project and subsequently removed from the project, and so any unaccounted "losses" of oil or grease are tracked.

There are no water quality impairments for oil and grease in the action area, although PAHs, which can be a breakdown product of oil and grease, can be found in measurable quantities. Concentrations of oil and grease both coming into and discharged from the mainstem projects were low (less than 2 mg/L, and often below analytical detection limits), with the exception of a single sample of the influent at McNary Lock and Dam. This sample had 14.3 mg/L of oil and grease, suggesting either a spill upstream of the dam or an unknown point source. All oil and grease concentrations in effluent (i.e., within the action area) at McNary Lock and Dam were low, ranging from <1 mg/L to 1 mg/L (EPA 2021a).

Toxicity to aquatic organisms varies among different types of oils and greases, since a wide range of individual compounds can be present (EPA 1986, EPA 2021a, Meador 2003). Fish can be exposed to oil and grease through their gills or through food, and the exposure can be chronic or acute. Toxic effects include delayed growth, decreased survival, and carcinogenic and mutagenic activity (Ober 2010, Perhar and Arhonditsis 2014). Toxic effects are particularly damaging when fish are exposed as eggs, larvae, or juveniles (Irwin 1997). Juveniles and adults may experience sub-lethal effects including avoidance behaviors and olfactory effects.

EPA (1976) listed the lethal toxicities to freshwater finfish of petroleum-based lubricants as ranging from 10 ppm (approximately 10 mg/L) from soluble hydrocarbons to 180,000 mg/L for "lubricants." For other finfish, lethal toxicities ranged from 5 ppm (approximately 5 mg/L) from soluble hydrocarbons to greater than 10,000 mg/L from dispersants and residual oils. EPA (1986) discusses long-term sublethal effects that interfere with cellular and physiological processes such as feeding and reproduction, but do not lead to immediate death of the organism. Sublethal effects in pink salmon fry were observed at 1.6 mg/L, and in Chinook salmon at 5 and 10 mg/L. Schein et al. (2009) found that dissolved floating diesel had virtually no toxic effects on juvenile rainbow trout embryos up to 1,000 mg/L and observed liver problems in juvenile trout at 10,000 mg/L. EPA determined that a benchmark of 1 mg/L of total oil and grease is reasonable to assess acute effects in the action area from the oil and grease discharges. EPA stated that "identification of a protective benchmark for long term chronic exposure is difficult because studies have generally evaluated specific compounds, such as PAHs, contained in oil and grease."

EPA's CORMIX analysis showed that calculated oil and grease concentrations within 15 meters of the maximum discharges are approximately at the 1 mg/L acute lethality protection level based on a 96-hour exposure. EPA (2021a) estimated that concentrations at the downstream end of the action area are 0.0053 mg/L to 0.012 mg/L, which are levels with low risk of causing either acute or sub-lethal chronic effects.

Fish performance testing at CRS dams indicates that juveniles pass through tailrace areas relatively quickly (Appendix A). Median travel times from each dam to acoustic arrays deployed from 1 to 3 km downstream were generally less than an hour, and would be even less through the 500-meter area downstream of a project. Exceptions would be during periods of high spring spill when eddies form at Lower Granite, Little Goose, Lower Monumental, and John Day Dams, cycling juveniles back upstream toward the face of the dam before they continue downstream. When eddies develop, in-season managers may alter the spill patterns to break up this type of circulation, reducing the likelihood of exposure to undiluted discharges of oil and grease. Based on this information, we expect that very small numbers of juveniles from each cohort of the salmon ESUs and steelhead DPSs are likely to be within 15 m of a discharge point where these could be exposed to oil and grease at the acute benchmark level (1 mg/L) for very brief periods of time (generally much less than an hour).[11] Subyearling fall Chinook salmon generally occupy pelagic waters while overwintering in the lower Snake River reservoirs rather than shallow areas (Tiffan and Conner 2012), and therefore are not likely to occupy tailrace areas where they could experience acute or chronic exposures to oil and grease. Adult steelhead could be similarly exposed throughout the year, as could salmonids that hold in a project tailrace due to high levels of spring spill or elevated summer temperatures. This evaluation is based on current discharge

[11] Velocities within the turbine draft tubes are high enough that juvenile salmonids cannot hold in that environment.

concentrations, rapid dilution of the discharges below acute thresholds even under worst case scenarios, the overall dilution provided by the river, and the limited duration of species exposure near the discharge areas. The use of EALs, where technically feasible, is expected to result in discharges that are significantly less toxic than those containing conventional oil and grease compounds at the same concentrations.

Some invertebrate prey for juvenile salmonids (especially overwintering fall Chinook salmon) are likely to be entrained through turbine units and exposed to oil and grease discharges. These short-term exposures could affect the survival of individual invertebrates and prey quality, but the numbers affected are likely to be very small compared to the numbers available.

Eggs, larvae, and fry are more sensitive to oil and grease than juvenile migrants and adult fish (Irwin 1997). SR fall Chinook and CR chum salmon eggs, alevins, and fry could occur within the action area at the lower Snake Dams or at Bonneville Dam, respectively, but most redds are at least 100 meters from outfalls, at which point concentrations of oil and grease are diluted by factors of 27 to 53 at each project compared to the discharge points (Dauble 1999, Mueller 2009, EPA 2021a). Fry moving past a dam from an upstream spawning area could encounter an active discharge and experience an acute exposure, but we expect this type of encounter to be very rare.

Implementation of oil accountability plans and annual reporting, and the use of BMPs to avoid accidental releases of oil and grease, will reduce the likelihood of discharges. In summary, very small numbers of juveniles and adults from each ESU and DPS are likely to encounter discharges of oil and grease at the acute effects concentration for brief periods of time (up to an hour), but numbers will be too low to affect the abundance or productivity of any of the component populations or MPGs. We are unable to estimate the numbers of fish that will be injured or killed through this pathway, but assume that the magnitude of exposure to and the likelihood of an effect on condition or survival is a function of the expected maximum concentration of oil and grease discharged into the action area (a daily maximum of up to 5 mg/L at the discharge point).

Effects of pH

pH is a measure of hydrogen ion activity and affects many biochemical processes in aquatic organisms and their habitat. The degree of dissociation of weak acids or bases is affected by pH, which in turn influences the toxicity of many compounds. The principal system regulating pH is the carbonate system which is composed of carbon dioxide, carbonic acid, bicarbonate ion, and carbonate ions. Because of the buffering capacity of carbon dioxide in water, very high pH (alkaline) values are seldom found in natural waters (Stumm and Morgan 1970, EPA 2021a) Washington state's water quality criterion for pH for salmonid spawning, rearing and migration, is within the range of 6.5 to 8.5, with a human-caused variation within the above range of less than 0.5 standard units (WAC 173-201A-200 1(g)). Oregon's pH criterion for the mainstem Columbia River is 7 to 8.5 (OAR-340-041-0104(1)). The permits propose pH limits not less than 6.5 and not more than 8.5 standard units to ensure that surface waters do not exceed this range as a result of discharges from the facilities (EPA 2021a).

Data regarding the effects of pH on salmonids are limited and most studies have focused on adults, while the life stages most sensitive to pH are eggs and alevin/fry (EPA 2021a). The normal development and reproductive success of adult salmonids is impacted at a pH of less than 6.5 or more than about 9.0 to 9.2 (EIFAC 1969, EPA 2021a, Mount 1973, Marshall et al. 1992). Adult salmonids seem to be at least as sensitive as most other fish to low pH, and so information on sensitivity from other families of fish can be useful (ODEQ 1995). Baker et al. (1990) found that decreased reproductive success may occur for highly acid-sensitive fish species (e.g., fathead minnow, striped bass) at pH values of 6.5 to 6.0, and lake trout had decreased reproductive success at pH values between 6.0 and 5.5. Rombough (1983) reported that low pH decreases Chinook egg and alevin survival, but did not report specific values. At elevated pH levels, even less is known regarding effects on fish. Salmonids appear to be sensitive to pH values in the range of 9.2 to 9.7 (EIFAC 1969) and a pH greater than 9.0 may adversely affect benthic invertebrates that provide food for salmonids (ODEQ 1995).

Based on the toxicity studies reviewed above, we consider the pH range in the proposed permits (6.5 to 8.5 at the discharge point) to be protective for all life stages of salmonids. We do not expect there to be any measurable impacts to individual salmon or steelhead as a result of the proposed NPDES permitted effluent for pH discharges.

Effects of Heat

The proposed permits would authorize the discharge of heat from each project between June and October each year as shown in Table 15 of EPA (2021a). The heat discharges would come from water used to cool equipment in the hydroelectric generating facilities (e.g., power generating units) and the drainage sumps that receive this cooling water. Washington State's water quality standards for temperature for salmonid spawning, rearing, and migration is 20.0°C (1-day maximum) for the lower Columbia due to human activities for the lower Columbia River. When natural conditions exceed 20.0°C, the standard is that no temperature increase will be allowed which will raise the receiving water temperature by greater than 0.3°C due to a single source or 1.1°C due to all such activities combined (WAC 183-201A-602). Oregon's state water quality standard for temperature for salmonid migration corridors is 20°C with sufficiently distributed cold water refugia and a human use allowance of 0.3°C (OAR 340-041-0028).

EPA (Section 4.3 and Appendix B in 2021a) describes temperatures in influent and effluent (project forebays and tailraces) during 2011 to 2016, and we incorporate that information by reference here. Temperatures vary significantly among discharge outfalls; the highest measured outfall temperatures are 34°C at Lower Granite Dam, 28°C at Little Goose Dam, 26°C at Ice Harbor Dam, and 24°C at John Day Dam. However the outfalls with the highest temperatures have some of the lowest discharge flows and therefore overestimate heat discharged from an entire project. EPA calculated a flow-weighted average temperature for each project to determine a representative temperature. Due to limited data at some projects, the Corps modeled expected summer effluent discharge temperatures and calculated revised flow-weighted average temperatures. The Corps' estimates were higher than EPA's calculations, which were in some cases based on temperature measurements made outside of the hottest warmer timeframe. As a result, EPA and NMFS use the Corps' (warmer) estimated temperatures to analyze the impacts from discharges for The Dalles and Ice Harbor projects, which had the highest influent temperatures (Table 2.5-2).

Table 2.5-2. Influent and effluent temperatures at each mainstem project and flow-weighted average discharge temperatures calculated using two different methods (EPA 2021a).

Facility	Influent (°C)	Effluent Range (°C)	Flow-weighted average discharge, EPA (°C)	Flow-weighted average discharge, Corps (°C)
Bonneville	22	15-24	21	22
The Dalles	9 (winter)	11-17 (winter)	20	27
John Day	23	17-24	19	21
McNary	23	19-20	20	N/A
Ice Harbor	22	15-26	21	24
Lower Monumental	18	17-23	17	22
Little Goose	18	15-28	19	21
Lower Granite	25	17-34	20	22

Water temperature has a significant effect on salmonids and high summer water temperatures can decrease survival for both juvenile and adult salmon in the lower Columbia and lower Snake rivers. EPA (2003, 2021a) summarized research on thermal impacts to salmonids:

> Temperatures below 18°C are preferable and minimize adverse effects for migrating juvenile and adult salmon and steelhead. Exposure to temperatures above 18°C increases disease risk and stress. Lethal impacts occur to juvenile salmon and steelhead at 23-26°C temperatures and to adult salmon and steelhead at 21-22°C temperatures with continuous (1-week) exposure. Short term exposure (less than 10 seconds) to 32°C temperatures can cause instantaneous lethality to salmonids. Salmonids can also experience short term thermal shock from a sudden change in temperatures from preferable temperatures (15-18°C) to stressful temperatures (26-30°C) (...) Colder water holds more dissolved oxygen than warmer water, so as stream temperatures increase, the amount of dissolved oxygen available for fish and other aquatic organisms decreases. Thermal stress can also make fish more susceptible to toxic substances that may be present. Warmer water can also lead to algal blooms that can further deplete the water's dissolved oxygen and cause changes in stream pH.

Consistent with the temperature TMDL for the lower Columbia and Snake rivers (EPA 2021d),[12] EPA evaluated absolute temperatures as well as a 0.1°C increase from each discharge. EPA considers a source impact of 0.1°C or less after mixing with the river "de-minimis" with insignificant effects to salmonids and other aquatic life. The 20°C numeric criterion and thresholds for instantaneous lethality (32°C) and thermal shock (25°C) are important benchmarks. The proposed permits would authorize the discharge of heat from each project only between June and October each year, because the TMDL, which is the basis for EPA proposing heat limits, applies only to the months of June to October. Because the Columbia and Snake Rivers are not impaired for temperature from November to May, the permits do not have a heat limit for that part of the year. However, the permits do require temperature monitoring year-round, and EPA intends to use that information to improve characterization of the effluent (EPA 2021e).

EPA used CORMIX to determine the point at which the facility discharges impacted conditions for salmonids in receiving water (EPA 2021a). EPA assumed that influent temperatures were at the water quality standard of 20°C and simulated the impacts from the expected heat discharges at The Dalles and Ice Harbor Dams, which had the highest effluent temperatures. Results showed rapid mixing of heat discharges within the first 15 meters from outfalls. Temperatures dissipate quickly due to dilution (Table 2.5-3).

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[12] The lower Columbia and lower Snake rivers have elevated temperatures in the summer and are listed as impaired for temperature on Washington and Oregon states' CWA Section 303(d) lists. In the BE, EPA described the issuance on May 18, 2020, of a TMDL for temperature in the lower Columbia and lower Snake Rivers. EPA subsequently issued a revised TMDL on August 13, 2021 (EPA 2021d). The revised TMDL determined that if all point sources discharged at their current heat load (design flow and maximum temperature), the TMDL allocation for the cumulative impact of all point sources would be attained. The TMDL establishes facility-wide heat wasteload allocations for all point sources to address temperature impairments, including for these facilities. The final NPDES permits will include Washington State's 401 certification conditions and have wasteload allocations consistent with the revised TMDL.

Table 2.5-3. Downstream maximum exposure temperatures in the action area from the proposed action (Table 37 in EPA 2021a).

Facility	Influent Temperature (°C)	Effluent Temperature (°C)	Distance Downstream (m)	Temp increase above influent (°C)/dilution factor	Downstream Temperature (°C)
Bonneville, The Dalles, John Day, McNary	20	24			
			5	3.4/1.9	24
			15	1.1/5.9	21
			49	0.3/23	20.3
			103	0.1/73	20.1
			500	0.0073/940	20
Ice Harbor, Lower Monumental, Little Goose, Lower Granite	20	27			
			5	2.1/2	22
			15	0.95/4	21
			50	0.30/13	20.3
			136	0.10/37	20.1
			500	0.0091/413	20

Despite the rapid dilution and dissipation of heat in receiving waters, river temperatures are likely to be elevated above the assumed 20°C inflow temperatures in the initial 15 meters downstream of the outfalls, to 21 to 24°C in lower Columbia River and 21 to 22°C in the lower Snake River. During summer, when inflow is warmer than 20°C, even slight warming of the water directly next to an outfall could add thermal stress to summer and early-fall migrating adults (e.g., SR summer-run Chinook; SR sockeye salmon; SR fall-run Chinook, and MCR, UCR and SR summer steelhead; Table 2.5-1). If ladder entrance conditions are degraded for any reason (e.g., during the latter portion of the spring spill period in early June), adults can stay in the tailrace for days to weeks. However, most fish would likely be more than 50 meters from the discharge points, where temperatures would be reduced to approximately 0.3°C above inflow temperatures. Nonetheless we expect that encountering tailrace temperatures that are warmed by heat discharges could result in increased stress and the potential for a slightly increased risk of prespawning mortality for some summer migrants during warmer years. This could affect an unknown, but likely very small number of adults from each summer-run ESU or DPS per incidence of delay, although not all would be likely to be killed.

Spring migrating juvenile salmonids from most interior and lower Columbia River ESUs and DPSs are not likely to encounter temperatures that reduce their condition or survival. Snake River fall Chinook salmon can migrate downstream throughout July and August, with some individuals likely to encounter heat discharges during September and October (Table 2.5-1). Although heat is not discharged to passage facilities or spillways, where juveniles are more likely to be present, it has a small incremental effect on temperature conditions below the dam, which are already stressful during these periods. Thus, we expect that some juvenile salmonids from the SR fall Chinook salmon ESU that pass the projects during June through October will experience reduced condition and survival as a result of heat discharges that are within the permit limits. We are unable to estimate the numbers of fish that will be injured or killed through this pathway, but assume that the magnitude of exposure to and the likelihood of an effect on condition or survival is a function of the expected maximum heat discharges into the action area (Table 15 in EPA 2021a). Juvenile salmonids passing through turbines quickly exit the units and move relatively quickly downstream and out of the mixing zone, substantially limiting their exposure to heat discharges.

Snake River fall Chinook salmon eggs, alevins, and fry could occur within the portions of the action area below the lower Snake River dams. Dauble et al. (1999) mapped fall Chinook redds near Lower Granite and Little Goose Dams. All appear to have been at least a 136-m horizontal distance from the discharge locations (EPA 2021a), and even further considering depth, and therefore would be subject to maximum increases in heat from the discharges of 0.1°C (Table 2.5-2). Fall Chinook salmon fry are not likely to be adjacent to cooling water outfalls at the dams, except perhaps on occasion during passage from an upstream spawning area, which would amount to a very short exposure. In addition, fall Chinook salmon eggs and fry are present during winter and early spring, when cooler water temperatures do not pose a risk of heat stress for these life stages. In fact slightly warmer temperatures can enhance egg and fry development by accelerating growth. Thus we do not expect the proposed permit limits for heat to have negative effects on these early life stages.

Effects of Total Suspended Solids

The proposed permits require monitoring for total suspended solids. The Washington water quality standards have narrative criteria that apply to TSS: "Toxic, radioactive, or deleterious material concentrations must be below those which have potential, either singularly or cumulatively, to adversely affect characteristic water uses, cause acute or chronic conditions to the most sensitive biota dependent upon those water, or adversely affect public health" (WAC 173-201A-260). Oregon water quality standards describe maximum concentrations for total dissolved solids in the Columbia River of 200 mg/L (river miles 120 to 147 and 218 to 309) or 500 mg/L (all other river miles) (OAR 340-041-0104(2)), as well as the following narrative criteria that apply to TSS: "Objectionable discoloration, scum, oily sheens, or floating solids, or coating of aquatic life with oil films may not be allowed" (OAR 340-041-0033(12)). EPA (2021a) determined that limits and monitoring are not needed for TSS because of relatively low levels of TSS and because other permit requirements (proper maintenance of backwash strainers) will minimize sediment intake from influent.

There is no known source of TSS that would be added or accumulated at the projects except for that collected in the backwash strainers. TSS concentrations were relatively high in outfall samples at Bonneville and The Dalles, and backwash of debris from strainers on cooling water intake lines are used at these projects. Outfall 002 at Bonneville has a relatively high TSS concentration of 33 mg/L, but this outfall does not operate with a backwash strainer and there is no known source of TSS. Outfalls 003 at Lower Monumental and 013 at Little Goose also have relatively high TSS levels. It is unclear whether there are sources of TSS at these projects or whether TSS was high in the influent. The proposed permits require quarterly monitoring of TSS in influent and effluent to evaluate whether TSS is a persistent problem and EPA states that this information will be used to further evaluate TSS in discharges and inform the next permit cycle.

TSS can have a variety of adverse effects on fish. Elevated TSS can reduce growth rates and disease resistance in fish, increase mortality, harm the development of eggs and larvae, alter migratory behavior, and reduce prey abundance (EPA 1986). Herbert and Merkens (1961) found that suspended solids at concentrations of 270 mg/L caused fin rot and concentrations of 90 to 270 mg/L decreased survival of rainbow trout, while no effects on survival, gill health, or fin health were observed at 30 mg/L. Herbert et al. (1961) found that TSS measurements above 1,000 mg/L were associated with reduced abundance of brown trout, whereas concentrations of about 60 mg/L had no effect. Similarly, Servizi and Martens (1992) reported that TSS concentrations of 240 to 2,550 mg/L caused a variety of effects including increased cough frequency and increased glucose levels in fish, but at 20 mg/L no adverse effects were found. In sum, EPA (2021a) determined that No Observed Effect Concentrations (NOECs) ranged from 20 to 60 mg/L.

We note that suspended solids and turbidity are a natural part of river ecosystems to varying degrees depending on the system, and can provide important benefits. In the Snake and Columbia rivers, high spring flows provide a number of benefits to outmigrating juveniles, including increasing turbidity, which can reduce predation by avian and piscivorous predators on juvenile migrants (Hostetter et al. 2012, NMFS 2020).

To analyze the likelihood of exposure to elevated TSS, EPA applied the maximum TSS measurement from any outfall and applied this to all the other outfalls at each facility. EPA calculated the maximum observed concentration and then applied dilution factors to calculate TSS concentrations at distances ranging from 15 to 500 meters downstream. Using this method, which we consider conservative, the highest TSS concentration was estimated to be 18.5 mg/L at a point 15 meters downstream of the discharge at Lower Monumental Dam. This concentration is lower than the NOEC range of 20 to 60 mg/L indicating very low risk of negative effects on juvenile or adult salmonids. As previously mentioned, SR fall Chinook and CR chum salmon eggs, alevins, and fry could also occur within the action area. We expect that these early life stages also would not be harmed by TSS discharges because individuals tend not to occur in close proximity to outfalls and estimated TSS concentrations in the receiving waters are low.

The BMP Plan requires inspection and maintenance procedures with recordkeeping for the backwash strainer because proper operation is necessary to maintain low TSS concentrations in the discharge. The BMP Plan also requires facilities to clean intake screens and racks to reduce sediment that may enter a project. Should TSS increase at any outfall in the future, the monitoring requirement would ensure that it would be detected quickly.

Based on the studies reviewed above, and because the estimated downstream concentrations are well below the 20 to 60 mg/L NOEC, EPA's inspection and maintenance procedures and reporting requirements will be adequately protective for salmonids. We do not expect there to be any injury or harm to individual salmon or steelhead as a result of permit issuance for TSS discharges.

Effects of Oxygen-Demanding Materials

The proposed permits require monitoring for oxygen-demanding materials, i.e., biochemical oxygen demand (BOD) and chemical oxygen demand (COD). There are no water quality standards in Washington for BOD or COD. The Washington water quality standard for dissolved oxygen (DO) for salmon spawning, rearing, and migration in the Columbia and Snake Rivers is 8.0 mg/L (WAC 173-201A-200 1(d)) and Oregon's dissolved oxygen criteria is 11.0 mg/L for spawning through fry emergence below Bonneville Dam from October 15 – May 15 (OAR 340-041-0016(1)(a)). The proposed permits do not impose effluent limits or monitoring requirements across all projects for BOD and COD, because BOD and COD concentrations are relatively low at the projects and facility operations are not expected to add amounts of BOD and COD that would indicate the need for permit effluent limitations (EPA 2021a). The exception to this is a requirement for quarterly COD monitoring in influent and effluent at two outfalls (013 and 015) in the navigation locks fill valve and drainage sumps at Little Goose, due to relatively high COD concentrations.

EPA (2021a) describes that BOD and COD are measures of the amount of degradable material that may deplete oxygen within a waterbody. COD is the measure of the oxygen equivalent of the organic matter in a sample that is susceptible to oxidation by a strong chemical oxidant. The result is expressed as a concentration of oxygen consumed. Materials that may contribute to the BOD include organic matter used as food by aerobic organisms; oxidizable nitrogen derived from nitrites, ammonia and organic nitrogen compounds which serve as food for specific bacteria; and certain chemically oxidizable materials (e.g., ferrous iron, sulfides, sulfite, etc.) which will react with dissolved oxygen or are metabolized by bacteria. The BOD in most effluents is derived principally from organic materials and from ammonia (which is itself derived from animal or vegetable matter). BOD and COD in effluent can lower the dissolved oxygen (DO) concentration in the receiving water to levels that are toxic to fish and other aquatic organisms. Low DO can affect survival and growth of fish and their prey. In addition, elevated organic matter in effluent can cause algal blooms (USEPA 1976).

Potential sources of BOD and COD at the projects include oil and grease, which are oxygen-demanding substances. Sumps may also concentrate oxygen-demanding substances that may be present in pass-through water. Therefore, BOD and COD could be present in sump discharges and, to a lesser degree, dewatering and cooling water discharges. BOD and COD is also present in influent water, so may be part of the pass-through and leakage water. However the proposed permits do not cover pass-through water. The increased use and subsequent biodegradation of EALs could result in a marginal increase in BOD. However, traditional oil and grease-based lubricants also are oxygen-demanding substances so there is no reason to think that the increased use of EALs would be likely to increase BOD in a manner that would negatively affect fish condition or survival (EPA 2011).

EPA uses 310 mg/L as the toxicity benchmark for oxygen-demanding materials. EPA's modeling, using the conservative approach that assumes facilities are discharging at the highest measured concentration of BOD and COD at all outfalls, show that BOD and COD are well below any level of concern. Although BOD and COD were detected at 7 of the 8 projects, modeled concentrations in receiving waters were well below the toxicity benchmark level (maximum 18 mg/L of COD at Lower Monumental and 4.5 mg/L of BOD at Little Goose) (EPA 2021a). High dilution factors at outfalls quickly dissipate any BOD and COD that is discharged. Low DO does not tend to be a problem at the projects; a main reason is that during the spring and summer, the dams aerate outflows through turbulence and plunging flows that occur with spill. Low DO has been observed downstream of Bonneville and upstream of Lower Granite. Specific reasons for this low DO and sources of BOD and COD at these projects are not clear.

The proposed monitoring requirement at Little Goose for BOD and COD would help ensure that any elevation of BOD or COD at this project in the future would be detected and investigated quickly. Across all the projects, BOD and COD concentrations are relatively low, and facility operations are not expected to add significant amounts of BOD and COD. The proposed requirement to monitor BOD and COD at Little Goose Dam only (i.e., not at the other projects) will be protective for all life stages of salmonids. We do not expect any injury or harm from discharges of oxygen-demanding materials on salmon or steelhead or habitat elements such as prey species as a result of issuance of the proposed permits.

Effects of Impingement and Entrainment

EPA proposes to authorize operation of the cooling water intakes structures (CWIS) in the proposed permits. The permits seek to minimize adverse effects from CWIS on fish in compliance with Section 316(b) of the CWA, which requires use of the best technology available (BTA) to reduce impingement and entrainment of aquatic organisms. Impingement occurs when organisms become entrapped on the outer part of an intake screen and entrainment occurs when organisms pass through the screens and into the cooling water systems. The proposed permits require the eight projects to implement technologies and operations required by the most recent FPP, FOP, and associated NMFS and FWS CRS opinions to maximize fish passage through the facilities. These permit conditions reduce the risk of injury and death of juvenile salmon and steelhead at the screens.

The hydropower facilities considered here extract river water for power generation and then divert some of that water to cool equipment. Water withdrawn from the river is considered pass-through water and is not subject to regulation under the NPDES program. Therefore, the point of intake for the proposed NPDES permits is the point within the powerhouse at which cooling water is diverted, i.e., where water is extracted from the scroll case within the turbine unit (EPA 2021a). Therefore, only fish that enter the powerhouse because they were not routed into the juvenile bypass would be at risk of entrainment or impingement on the CWIS. Most of the injury or mortality of fish in the powerhouse that are not bypassed is due to passage through the turbines, e.g., from turbine shear or strike. However, some very small level of injury and mortality likely occurs from impingement or entrainment at the CWIS.

NMFS has issued criteria and guidelines for the safe, timely, and efficient passage of anadromous salmonids at Columbia and Snake River fish passage facilities; details may be found in Chapter 9 of NMFS (2011). Screen design criteria are the product of extensive research and development. The CRS opinion (NMFS 2020) includes operational requirements for the CWIS screens that are components of the turbine units at the mainstem projects associated with the proposed permits. BPA et al. (2020) describes juvenile passage survival rates ranging from 96 to 99 percent for yearling Chinook salmon and 94 to 99 percent for steelhead. Mortality due to impingement on or entrainment in CWIS is accounted for in these survival estimates. Furthermore, with the high spring and summer spill levels considered in the CRS Biop, and currently being implemented, the risk that juveniles will pass via the powerhouse and be exposed to a CWIS is even lower than under the conditions that resulted in the 94 to 99 percent survival estimates.

The Corps (2021) provides design information about the CWIS. The CWIS openings are approximately 19 inches in diameter and cooling water flows represent a very small proportion of the flow through the unit (4.5 cubic feet per second) with a velocity at the CWIS screen of 3.2 feet per second. During inspections from December to July or August in 2017 to 2021, small numbers of salmon and steelhead mortalities were found associated with CWIS (Corps 2021).

We conclude that despite using technologies and operations that minimize impingement and entrainment on the CWIS, very small numbers of juvenile salmon and steelhead from the SR, UCR, MCR, and LCR salmon ESUs and steelhead DPSs are likely to be killed or injured. This mortality and injury will not be concentrated on any one population or MPG, and will likely be distributed across all populations that travel past the dams. Thus, it is not likely that enough individuals from any single population or MPG would be killed or injured to affect abundance or productivity. We are unable to estimate the numbers of fish that will be injured or killed through impingement or entrainment on the CWIS. We assume that the magnitude of exposure to and the likelihood of an effect on condition or survival is a function of implementing the FOP at each project with respect to spillway and spillway weir operations and screen deployment and maintenance, which allow most juveniles to avoid the turbine units entirely (EPA 2021a, NMFS 2020).

Some invertebrate prey for juvenile salmonids (especially overwintering fall Chinook salmon) are likely to be entrained through turbine units and impinged or entrained on CWISs. However, the numbers affected are likely to be very small compared to the numbers available as prey and will not affect the condition or survival of individual salmonids.

Interactive and synergistic effects of multiple pollutants

The multiple pollutant discharges that would be authorized by the proposed permits do not act on aquatic organisms in isolation of one another. Mixtures of chemicals can have additive, synergistic, or antagonistic effects. An additive effect occurs when the individual toxic effects of chemicals in a mixture produce a biological effect that is the sum of the individual effects. Synergism occurs when the toxicity of a mixture is greater than that which would be expected from a simple additive effect. Antagonism occurs when the toxicity of multiple chemicals in a mixture is less than that expected from a simple additive effect (Rand 1995).

Many of the pollutants addressed in the proposed permits are not individual chemicals or compounds, e.g., oil and grease mixtures, pH, heat, and TSS and the concept that multiple stressors may act synergistically is important. For example, oil exposure can impair diffusion across gills and contribute to respiratory acidosis in fish, potentially compounding effects of low pH in the environment (Evans et al. 2005, Khursigara et al. 2019). pH affects many chemical and biological processes in water and thus affects toxicity of many pollutants. We therefore understand that the combinations of pollutants addressed in the proposed permits could reduce the tolerance of individual juveniles and adults to normal environmental disturbances (Khursigara et al. 2019), but based on the short exposure times for small numbers of individuals of each species, do not expect these effects to reduce the abundance, productivity, or life history diversity of the component populations or MPGs of the affected ESUs and DPSs.

Water temperature is known to affect toxicity of contaminants to aquatic organisms (either decreasing or, more often, increasing toxicity; Cairns 1975, Rand 1995). Fish metabolism increases at higher temperatures. Temperatures outside of an individual’s thermal tolerance window can impact metabolic capacities, available energy stores, and fitness (Khursigara et al 2019). Increased water temperatures accelerate rates of aerobic decomposition and result in higher BOD levels. And chronic exposure to pollutants can reduce the upper thermal tolerance limits of freshwater fish (Patra et al 2015).

The degree of synergistic effects on pollutant toxicity to the fish species considered in this opinion, and potentially to their prey species, are difficult to estimate because they will depend on the levels of specific pollutants and the magnitude and timing of exposures. EPA’s proposed requirements to implement BMPs will help to minimize toxic effects. Required inspections and monitoring of effluent will better define the discharges and potential timing and pathways of exposure to fish. The proposed permits would be issued for a period of 5 years and EPA proposes to use the additional monitoring data to inform decisions on requirements of any subsequently issued permits.

Species-specific effects of the proposed permits and discharges

Except as noted below, the effects of implementation of the proposed NPDES permits described in the above sections apply to all of the listed salmon and steelhead species considered in this opinion, because they migrate through the action area as juveniles and adults: SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, LCR Chinook salmon, LCR steelhead, LCR coho salmon, and CR chum salmon. The following species are affected differently due to their life histories and timing in the action area:

1. **CR chum salmon juveniles and adults.** Juvenile and adult CR chum salmon generally are not present in the action area during June through September and therefore very few individuals would be exposed to the permitted discharges of heat during the months when river temperatures are elevated (Table 2.5-1).

2. **SRB, UCR, MCR and LCR steelhead adults.** Adult steelhead, especially summer-run fish, are known to spend a significant amount of time moving up and down the mainstem during the period between freshwater entry and spawning ("exploratory" behavior) and therefore can be found passing through at least one of the eight dams at almost any time of year. A small proportion of adult SRB steelhead migrate into the hydrosystem in the summer and fall, and then overwinter between projects in the lower Snake River, resuming their upstream migration in the spring (DART 2021). Therefore adult steelhead have the potential to spend more time within the action area and to have higher exposure to discharges than adult salmon, which exhibit more directed migrations through the action area. The degree of exposure and likelihood of response would also depend on the discharge level and fish residency period; a brief release of a small volume of oil or grease would become diluted below levels of concern very quickly, but individual fish that spend longer periods in the action area would have a higher risk of acute or chronic exposure than would those moving quickly through the action area during a directed phase of the juvenile or adult migration.

3. **SR fall Chinook salmon juveniles**. Some SR fall Chinook salmon juveniles overwinter in the lower Snake River. These are subyearling (age-0) fish that tend to migrate downstream at a slower pace or at a later time than most. They pass one or more of the lower Snake River projects starting in July or August, then stop and rear over the winter in pelagic habitat within the reservoirs between lower Snake River dams, resuming their downstream migration the following spring (NMFS 2020). They are not likely to rear in the shallower, high velocity environments of the tailraces (Tiffan and Connor 2012).

   Discharges would be more likely to affect SR fall Chinook salmon subyearlings that move slowly downstream in the lower Snake River during fall and winter, when spill levels are low and juvenile bypass systems are not operating. These fish are also at higher risk of turbine passage and impingement on or entrainment into a CWIS. Overall, we expect that exposure of juvenile SR fall Chinook salmon to discharges would be fairly small because they move relatively quickly through the action area (500 meters below each project).

2.5.5 Effects on Designated Critical Habitats

The proposed permits would be likely to have small negative effects on the PBFs of designated critical habitats in the Columbia and Snake Rivers within the action area. Effects would occur up to 500 meters downstream of each dam but would likely be at measurable levels only within the first 100 to 300 meters (EPA 2021a). Effects of the proposed action on PBFs are listed in Table 2.5-4. In sum, the proposed permits would negatively affect water quality and potential prey (invertebrates and forage fish) in freshwater migration corridors for all of the salmon and steelhead species.

Table 2.5-4. Effects of the proposed NPDES permit limits on the physical and biological features of designated critical habitat.

ESU/DPS	Physical and Biological Feature (PBF)	Effects of the Proposed Action
SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, LCR Chinook salmon, LCR steelhead, LCR coho salmon, CR chum salmon	Freshwater Migration Corridors Substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food (juvenile migration corridor), riparian vegetation, space, safe passage	Discharges of oil and grease would continue to have a very small negative effect on water quality in juvenile and adult migration corridors as discussed in NMFS (2020). However, The PBF is likely to be impaired only within the first 15 meters of each outfall. Water quality within 5 meters of cooling water outfalls will continue to be negatively affected by added heat when river temperatures exceed 20^{o}C, but the effect will become very small within 49 to 50 meters downstream (Table 37 in EPA 2021a). This would affect PBFs in juvenile and adult migration corridors for SR summer-run Chinook salmon; SR sockeye salmon; and MCR, UCR, and SRB (i.e., summer-run) steelhead. Permitted levels of pH (within the water quality benchmark of 6.5 to 8.5 standard units) will not have negative effects on water quality. Based on modeled exposure concentrations of TSS and oxygen demanding substances (Tables 39 and 41 in EPA 2021a), the permitted discharges will not exceed the toxicity benchmarks for these parameters. Thus, we do not expect negative effects on water quality in juvenile or adult migration corridors.

ESU/DPS	Physical and Biological Feature (PBF)	Effects of the Proposed Action
		Implementation of the Fish Operating Plan for each project will minimize the risk of impingement and entrainment, protecting safe passage through the juvenile migration corridor.
SR fall Chinook salmon[13]	Freshwater spawning and rearing sites Spawning gravel, water quality, water quantity, cover/shelter, food, riparian vegetation, space	Spawning gravels for SR fall Chinook salmon that occur downstream of the permitted Snake River projects are sufficiently distant (vertically and horizontally) from outfalls that permitted discharges are not likely to have a negative effect on water quality in spawning areas. Food for reservoir rearing SR fall Chinook salmon (most likely invertebrate organisms) could be affected by the discharged constituents. Because exposure concentrations will be very small within a short distance from each dam as described above for freshwater migration corridors, the functioning of food in juvenile rearing areas is unlikely to be affected.

The effects to PBFs described above will occur up to 500 meters downstream of each dam.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the rangewide species section (including information incorporated by reference from Sections 2.2.1, 2.3.1, 2.4.1, 2.5.1, 2.6.1, 2.7.1, 2.8.1, 2.9.1, 2.10.1, 2.11.1, and 2.12.1 in NMFS 2020).

[13] Because Columbia River chum salmon spawn more than 500 meters downstream of Bonneville Dam, their spawning and rearing sites should not be measurably affected by the proposed NPDES permits.

We adopt by reference here the section describing cumulative effects in EPA (2021a). Within the action area, non-Federal actions are likely to include activities associated with human population growth, water withdrawals (i.e., those pursuant to senior state water rights), and land use practices. Continuing commercial and sport fisheries, which have some incidental catch of listed species, will have adverse impacts through removal of fish that would contribute to spawning populations. These types of activities are generally expected to have adverse effects on PBFs of critical habitat.

As described in Section 1.3, Bonneville, The Dalles, John Day, and McNary projects have some outfalls that discharge into the state of Oregon and some outfalls that discharge into the state of Washington. Cumulative effects also include pollutants discharged from outfalls into waters of the state of Oregon, which are not a part of the proposed action.[14] We expect the effects of pollutant discharges from Bonneville, The Dalles, John Day, and McNary projects into Oregon waters to continue in the future and the effects of those discharges would be similar to the effects described in this opinion for pollutants of the same type and magnitude that are discharged to Washington.

Cumulative effects also include any non-federal restoration activities that result in cooler water and thermal refugia, and reduced pollutants in the action area. These have occurred in the past and are likely to continue in the future, although most restoration actions have some federal component and thus are not considered cumulative effects.

Based on the analysis above, the cumulative effects of future state and private activities will have a continued negative effect on ESA-listed fish and their habitats.

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. 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 Species

The action area is used by SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring Chinook salmon, UCR steelhead, MCR steelhead, CR chum salmon, LCR Chinook salmon, LCR coho salmon, and LCR steelhead. These species are all listed as threatened except for SR sockeye and UCR spring-run Chinook, which are listed

[14] The Oregon Department of Environmental Quality (ODEQ) has jurisdiction to issue NPDES permits to federal facilities in Oregon.

as endangered. These species are ESA-listed due to a combination of low abundance and productivity, reduced spatial structure, and/or decreased genetic and life history diversity.[15]

Individuals from most of the ESA-listed component populations must move through or use parts of the action area at some point during their life history. Many of the component populations of these ESUs and DPSs are at low levels of abundance or productivity; in many cases, decreases in the last few years are associated with poor ocean conditions. Several species have lost some of their historical population structure due to human activities, and the populations that remain in the available habitat face multiple limiting factors. Among the salmon and steelhead species, factors limiting recovery include blocked habitat, hydropower projects affecting mainstem habitat and fish passage, tributary (and for SR sockeye, natal lake) habitat, estuary habitat, harvest, hatcheries, predation, and additional factors (e.g, exposure to toxic contaminants and the effects of climate change including elevated river temperature and ocean conditions).

The environmental baseline is characterized by degraded floodplain and channel structure, altered sediment transport, altered hydrology, altered water quality, and altered fish passage due to dams and reservoirs. The operation of upstream water storage projects has altered the natural hydrograph in the action area; lower spring flows have resulted in increased travel times for juvenile salmonids during outmigration. The Columbia and Snake Rivers are impaired for temperature, toxics, and dissolved oxygen; the water and sediment in the action area have low to moderate levels of metals, pesticides, and low levels of other persistently toxic compounds, some of which bioaccumulate through food webs. Salmon and steelhead are exposed to high rates of natural predation during all life stages from fish, birds, and marine mammals. Avian and introduced fish predation on salmonids has been exacerbated by environmental changes associated with river development and altered flows. Shoreline development has reduced the quality of nearshore salmon and steelhead habitat by eliminating native riparian vegetation, displacing shallow water habitat with fill materials, and disconnecting the main channel from historic floodplain areas. The cumulative effects of state and private actions within the action area are anticipated to continue to have negative effects on ESA-listed salmonids.

The proposed NPDES permits, including numeric and narrative effluent limits, monitoring and reporting requirements, and best management practices, will have an overall small negative impact on the species through effects of oil and grease, additional heat, and impingement and entrainment on the CWIS screens. Factors we considered in reaching this conclusion include EPA's proposed permit limits, the available information on the toxicity of the permitted pollutants to salmon and steelhead, the low likelihood that adults or juveniles would occur close to outfalls, and the high dilution factors of receiving waters within about 100 to 300 meters of each outfall. For oil and grease discharges, very small numbers of juveniles and adults from each ESU and DPS are likely to encounter oil and grease at the acute effects concentration (1 mg/L) for brief periods of time (up to an hour), but numbers will be too low to affect the abundance or productivity of any of the component populations. For heat discharges, elevated temperatures in receiving waters close to outfalls are likely to increase stress for small numbers of juveniles and adults and to slightly increase the risk of prespawning mortality for small numbers of adults during warmer years. Both oil and grease and heat discharges dissipate quickly (within 100 to

[15] SR fall Chinook salmon was rated as viable in the most recent status review, but not recommended for delisting due to moderate diversity risk (NMFS 2016a).

300 m) to unmeasurably small levels, and so exposures will be very brief. The screens on the CWIS will continue to impinge and entrain and therefore cause the mortality of small numbers of the juveniles that pass downstream via turbine routes. Discharges within the proposed permit limits for pH, TSS, and BOD and COD discharges will not have negative effects on any life stage of the salmon and steelhead species considered in this opinion.

We do not expect that all populations or individuals will experience the effects of the proposed discharges equally. Oil and grease discharges at the permitted levels tend to be episodic and associated with small leaks and spills. Heat discharges would be more continuous in nature. Individuals from populations that pass more dams would have a greater risk of exposure, and SR fall Chinook juveniles or SRB, UCR, MCR, and LCR steelhead adults that overwinter in the reservoirs would have a greater potential for exposure. This could result in an increased risk of exposure to pollutants in the permitted discharges; however, exposure of steelhead adults and fall Chinook juveniles to discharges would likely be transitory, because individuals are not likely to occur close to the discharge outfalls except for brief periods while passing a dam. The location of the outfalls relative to passage routes (spillways, turbines, or juvenile bypass system passage for juveniles, and spillways, adult ladders or, rarely, navigation locks for adults) indicate that most juveniles and adults that pass a project would either not be exposed or would be exposed only briefly to discharges or CWIS screens. Exposures sufficient to elicit acute or chronic toxic responses would be rare. The small numbers of juveniles and adults that are likely to die as a result of the proposed action each year are not likely to measurably affect the abundance or productivity of the component populations, MPGs, or ESUs and DPSs.

With respect to synergistic or antagonistic effects, we understand that the combinations of the pollutants addressed in the proposed permits could reduce the tolerance of individual juveniles and adults to normal environmental disturbances (Khursigara et al. 2019). However, based on the short exposure times for small numbers of individuals of each species, we do not expect these effects to reduce the abundance, productivity, or life history diversity of the component populations or MPGs of the affected ESUs and DPSs.

Cumulative effects from future non-Federal activities are expected to perpetuate current effects on all 11 ESUs and DPSs. Within the action area, non-Federal actions are likely to include activities associated with human population growth, water withdrawals (i.e., those pursuant to senior state water rights), and land use practices. Continuing commercial and sport fisheries, which have some incidental catch of listed species, will have adverse impacts through removal of fish that would contribute to spawning populations. Cumulative effects also include any non-federal restoration activities that result in cooler water and thermal refugia, and reduced pollutants in the action area. These have occurred in the past and are likely to continue in the future, although most restoration actions have some federal component and thus are not considered cumulative effects.

Climate change is a substantial threat to all 11 ESUs and DPSs, especially during the marine rearing phase of their life cycles. We do not expect the proposed action to increase the scope and severity of those impacts or to exacerbate them to a degree that will affect the viability of the component populations. Although we expect mainstem temperatures to continue to warm, the effects of the permitted heat discharges in the context of climate change would be similar to those described for current climate conditions (Section 2.5.4). We expect that a small number of adults from summer and early-fall migrating ESUs and DPSs would experience additional thermal stress due to heat discharges and the effect would be most pronounced for the small subset of individuals that delay in a tailrace area for more than 1 to 2 days. Such thermal stress, for the small proportion of adults that might choose to spend substantial amounts of time in the vicinity of these outfalls, especially if it accumulates from multiple exposures to heat discharges at multiple projects, could raise the risk of prespawning mortality slightly for these individuals, but not to levels that would reduce population-scale abundance, productivity, or life history diversity.

Considering the effects of the action in conjunction with the existing status of the species and condition of the environmental baseline, and potential cumulative effects, NMFS has determined that the loss of a very small number of juvenile salmon and steelhead that may be caused by the proposed action will not negatively influence abundance or productivity at the population or MPG scale. For this reason, the viability of the respective ESUs and DPSs are also not likely to be affected. We do not think that the small localized effects of the pollutant discharges authorized by the NPDES permits will reduce likelihood of recovery or impede implementation of recovery actions identified in the recovery plans.

In short, 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 SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, CR chum salmon, LCR Chinook salmon, LCR steelhead, or LCR coho salmon. Accordingly, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of any of these species.

2.7.2 Critical Habitat

The environmental baseline includes a broad range of past and present actions and activities, including effects of the hydrosystem, that have affected the conservation value of critical habitat in juvenile and adult migration corridors for SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, CR chum salmon, LCR Chinook salmon, LCR steelhead, and LCR coho salmon; and in spawning and rearing habitat for SR fall Chinook. Water quality in the action area is currently affected by upstream development including municipalities, agricultural activities and other land management activities, current and past mining activities, and public and private development. These activities affect the current function of PBFs in the action area.

EPA's issuance of the proposed NPDES permits for the eight federal facilities will continue the small impairments of water quality that have occurred in the past. Some of the permit conditions (e.g., the use of EALs and requirements for inspections, monitoring, and preventative maintenance) are likely to reduce some of the negative effects on critical habitat, but continued degradation of water quality will occur up to about 100 to 300 meters downstream of each facility. These continued effects include effects to safe passage in migratory corridors with the potential for fish to become impinged or entrained on CWIS. Improvements include use of

EALs, and requirements for monitoring and reporting that would provide further information on discharges that occur over the next five years.

We expect that some future development activities by state or tribal and private entities will continue to have adverse effects on the conservation value of critical habitat in the action area.

In summary, the proposed discharges are expected to continue to have short-term, small negative effects on the functioning of the juvenile and adult migration corridors for all 11 species, and on spawning and rearing habitat for SR fall Chinook salmon, through reduced water quality. In addition, the proposed operation of CWISs are expected to continue to have small negative effects on safe passage in juvenile and adult migration corridors for fish that pass downstream via turbine routes. These effects will extend no further than 500 meters downstream from each federal facility.

Adding the effects of the action to the environmental baseline and the cumulative effects, and taking into account the status of critical habitat, the proposed action is not likely to appreciably diminish the value of designated critical habitat as a whole for the conservation of SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, CR chum salmon, LCR Chinook salmon, LCR steelhead, or LCR coho salmon.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of any of the 11 ESUs and DPSs of salmon and steelhead considered in this opinion, or destroy or adversely modify their 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). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows: (1) harm because of increased temperatures in the effluent; (2) reduced fitness from exposure to oil and grease; and (3) injury or death from entrainment or impingement on the CWIS. NMFS is reasonably certain the incidental take described here will occur because: (1) recent and historical surveys indicate ESA-listed species are known to occur in the action area; and (2) the proposed action includes activities that are reasonably certain to harm or kill juvenile and adult steelhead and salmon.

Due to the highly variable number of individual fish present in the action area at any given time, and difficulties in the ability to observe injury or mortality of fish, which may sink out of site, be consumed by predatory species, or have delayed death outside of the action area, we cannot determine the number of ESA-listed fish that will be killed, injured or otherwise adversely affected. In such circumstances we use a habitat-based surrogate to account for the amount of take, which is called an "extent" of take. The extent of take is causally related to the harm that occurs, and is an observable measure for monitoring, compliance, and re-initiation purposes. These surrogates function as effective reinitiation triggers because they are clear, measurable limits that can be readily monitored for any exceedances, so reinitiation could be triggered at any time during the period covered by the NPDES permits.

Incidental Take from Exposure to Oil and Grease
We are unable to estimate the numbers of fish that will be injured or killed by the oil and grease discharges from the CRS projects, and thus we rely on a surrogate to define the limit of the extent of take. The extent of take is daily maximum oil and grease concentrations at or below 5 mg/L at any discharge point. This is an appropriate surrogate for this pathway because it is measurable and is causally related to the take.

Incidental Take from Increased Temperatures
It is not possible to count the number of fish that are injured or harmed by the increase in temperatures, and thus we rely on a surrogate to define the limit to the extent of take. The extent of take for this pathway is the expected maximum heat discharges into the action area for the CRS projects as a result of the permitted discharges (Table 15 in EPA 2021a). This is an appropriate surrogate for this pathway because it is measurable and is causally related to the take.

Incidental Take from Impingement or Entrainment on the CWIS
It is not possible to count the number of fish that are injured or harmed by impingement or entrainment on the CWIS, and thus we rely on a surrogate to define the limit to the extent of take. The extent of take for this pathway is described by implementation of and adherence to the FOP requirements at each project with respect to spillway and spillway weir operations and screen deployment and maintenance (EPA 2021a, NMFS 2020).

The surrogates described above can be monitored and reported. For this reason, the surrogates function as effective reinitiation triggers.

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 SR spring/summer Chinook salmon, SRB steelhead, SR sockeye salmon, SR fall Chinook salmon, UCR spring-run Chinook salmon, UCR steelhead, MCR steelhead, LCR Chinook salmon, LCR steelhead, LCR coho salmon, or CR chum salmon, or the destruction or adverse modification of their 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 following reasonable and prudent measure and term and condition is appropriate to minimize the impacts of incidental take associated with the proposed issuance of the NPDES permits:

- Forward to NMFS any monitoring plans and reports generated under EPA's proposed Best Management Practices Plan (Section 2.3.4 in EPA 2021a).

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

- The EPA should send copies of all monitoring plans and reports annually to the Columbia Hydropower Branch Chief, Interior Columbia Basin Office, West Coast Region, NOAA Fisheries.

2.10. Reinitiation of Consultation

This concludes formal consultation for the Issuance of NPDES Permits for Eight Federal Dams on the lower Columbia and lower Snake Rivers.

As 50 CFR 402.16 states, 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 if: (1) The amount or extent of incidental taking specified in the ITS is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the 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 (4) a new species is listed or critical habitat designated that may be affected by the action.

2.11 "Not Likely to Adversely Affect" Determinations

On May 20, 2021, NMFS received a request from EPA for a written concurrence that proposed issuance of NPDES Permits for eight federal dams on the Lower Columbia and Lower Snake Rivers is not likely to adversely affect (NLAA) the southern DPS of eulachon and their critical habitat designated under the Endangered Species Act (ESA). NMFS prepared this response to EPA's request pursuant to section 7(a)(2) of the ESA, implementing regulations at 50 CFR 402, and agency guidance for preparation of letters of concurrence.

On March 18, 2010, NMFS listed the southern DPS eulachon (hereafter "eulachon") as a threatened species (75 FR 13012), reaffirming this conclusion in its most recent 5-year status review (NMFS 2016b). Critical habitat was designated on October 20, 2011 (76 FR 65324). More information on the biology, ecology, and status of this species can be found in the recovery plan (NMFS 2017b).

Eulachon spawn in rivers south of the Nass River in British Columbia to, and including, the Mad River in California. Four "subpopulations" are considered in NMFS' recovery plan as a minimum set of "populations" that are needed to meet biologically based and threats-based delisting criteria: the Klamath River, the Columbia River, the Fraser River, and the British Columbia coastal rivers.

Starting in 1994, there was an abrupt decline in the abundance of eulachon returning to all subpopulations, including the Columbia River. Despite a brief period of improved returns in 2001 to 2003, the returns and associated commercial landings were at low levels from the mid-1990s through the 2000s. Eulachon abundance in monitored rivers improved in the 2013 to 2015 return years, before declining again in 2016 through 2019, most likely due to recent poor ocean conditions. However, for 2020 the run in the Columbia River improved moderately, probably due to favorable ocean conditions. Due to potential impacts on water quality in the tailrace of Bonneville Dam, we consider eulachon to be a species that could be adversely affected by the action.

The final listing rule identified several potential factors that may have resulted in the decline or may be limiting recovery of eulachon (Table 2.11-1).

Table 2.11-1. Threats to the viability of southern DPS of eulachon and Biological Review Team ratings (NMFS 2017b).

Threat	Level of Threat
Climate change impacts on ocean conditions	High
Ocean fisheries bycatch	High to moderate

Threat	Level of Threat
Climate change impacts on freshwater habitat	Moderate
Predation	Moderate
Water quality	Moderate to low
Dams and water diversions	Moderate to very low
Shoreline construction	Moderate to very low
Dredging	Moderate to very low

The Columbia River and its tributaries support the largest eulachon run in the world (Hay et al. 2002). Eulachon use the mainstem Columbia River within the action area to migrate to spawning grounds as adults and to emigrate from freshwater into marine waters as larvae. Large spawning aggregations of eulachon have been observed in the mainstem Columbia River and in the Cowlitz, Lewis, and Sandy Rivers (Craig and Hacker 1940); Grays River (Smith and Saalfeld 1955); Kalama River (DeLacy and Batts 1963); Elochoman River; and in Skamokawa Creek (WDFW and ODFW 2001). Smith and Saalfeld (1955) stated that eulachon were reported to spawn up to the Hood River on the Oregon side of the Columbia River before the construction of Bonneville Dam (in 1938), but were not known to ascend beyond Cascade Rapids until 1896 when the locks and canal were built for steamboat passage. The upstream extent of eulachon distribution is the Bonneville pool, and they travel downstream to the plume.

When adult eulachon reach the tailrace of Bonneville Dam, small numbers are able to pass upstream via either the adult fishways designed for salmon and steelhead or through the locks. Some of those that do pass "fall back" downstream through turbines or juvenile bypass systems. In 1953, eulachon were observed spawning in Tanner Creek on the Oregon side of the Columbia River near the base of Bonneville Dam. The Corps has reported the following observations of adult eulachon in the smolt monitoring facility on the upstream side of Bonneville Dam (NMFS 2014):

- 1988 – 8,200 adults
- 2003 – 2 adults
- 2005 – 5 adults
- 2014 – 455 adults

No eulachon were reported at Bonneville Dam during 2015 to 2019. Based on the small numbers reported in most years, it is likely that only a very small number of adult eulachon would be exposed to the permitted concentrations of oil and grease, heat, pH, TSS, and oxygen demanding substances in the vicinity of the tailrace outfalls each year. Because these fish would be actively migrating, exposure would be very brief and no injury or mortality is expected. In addition, adult eulachon are present during winter and spring when background river temperatures and biological oxygen demand are low.[16] In addition, based on the very low numbers of adults seen

[16] Adult migrations can occur as early as November or as late as June. Spawning can occur on a diversity of substrates throughout the lower river, peaking between January and March, but beginning in December. Eggs are

at Bonneville Dam since 1988, we do not expect any to become impinged on the CWIS screens. Thus all effects of the issuance of the NPDES permits are likely to be insignificant.

NMFS designated critical habitat in the Columbia River up to Bonneville Dam (76 FR 65324).

Physical and Biological Features of Eulachon Critical Habitat

The NMFS designated critical habitat for the southern DPS of eulachon on October 11, 2011 (76 FR 65324). Critical habitat includes portions of 16 rivers and streams in California, Oregon, and Washington. We designated all of these areas as migration and spawning habitat for this species. Specific PBFs, and the essential features associated with the PBFs for eulachon designated in 2011 include:

Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Sturdevant 1999), cumaceans (Smith and Saalfeld 1955), mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn. The only physical and biological feature within the action area for this consultation is the freshwater and estuarine migration corridor within 500 meters downstream from Bonneville Dam. The permitted discharges from Bonneville are likely to have insignificant effects on the water quality component of this PBF within the action area.

Based on the above analysis, NMFS concurs with EPA that the proposed action is not likely to adversely affect southern DPS eulachon and its designated critical habitat because all the effects of the proposed action are insignificant.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to

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fertilized and drift downstream, adhering to sand and small gravels, and hatch in 3 to 8 weeks depending on water temperatures. Larvae are transported downstream and after rearing in the lower river for an unknown amount of time, move to the ocean (NMFS 2017b).

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

This analysis is based, in part, on the EFH assessment provided by the EPA and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce. In this case, NMFS concluded that the proposed action would not adversely affect EFH for Pacific groundfish, coastal pelagic species, and highly migratory species. Thus, consultation under the MSA is not required for these habitats.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in the Introduction section to the biological opinion. The action area includes areas designated EFH for various life-history stages of two Pacific Coast salmon species: Chinook salmon and coho salmon (PFMC 2014). There are no habitat areas of particular concern (HAPCs) within the action area for this consultation.

Freshwater EFH for Pacific Coast salmon (Chinook and coho) consists of four major components: 1) spawning and incubation, 2) juvenile rearing, 3) juvenile migration corridors, and 4) adult migration corridors and holding habitat, and overall, can include any habitat currently or historically occupied within Washington, Oregon, and Idaho. The important components of Pacific salmon marine EFH are: 1) estuarine rearing, 2) ocean rearing; and 3) juvenile and adult migration. Freshwater EFH for Pacific Coast Chinook and coho salmon found within the action area for this consultation includes juvenile migration corridors and adult migration corridors (PFMC 2014). Freshwater EFH for Pacific Coast Chinook salmon found within the action area for this consultation also includes spawning and incubation and juvenile rearing areas.

3.2 Adverse Effects on Essential Fish Habitat

As described in detail in the preceding opinion, the proposed action is expected to affect EFH components in the mainstem Columbia River, within 500 meters downstream of each mainstem dam. We conclude that the proposed action will have the following adverse effects on EFH designated for Pacific Coast Chinook and coho salmon:

- Juvenile and adult migration corridor habitat will be reduced in small pockets of habitat below the dams containing harmful pollutant concentrations and /or elevated temperatures. If encountered, these areas will create stress (reduced fitness), harm, and could affect fish condition and/or survival.
- Juvenile migration corridor habitat will be reduced through increased harm to juvenile salmonids that are impinged on or entrained in CWISs during turbine passage, and through potential harm to a small proportion of the juvenile salmonid prey base (food sources like zooplankton and benthic invertebrates affected by discharged pollutants).

3.3 Essential Fish Habitat Conservation Recommendations

NMFS has determined that no practical measures are available to address these adverse effects.

3.4 Supplemental Consultation

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

4. Data Quality Act Documentation and Pre-Dissemination Review

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the EPA, the Corps, and any contractors the Corps uses for maintenance of the permitted projects. Other interested users could include the Washington State Department of Ecology, Indian Tribes, ports, recreational and commercial vessel owners, recreational and commercial fishers, and environmental organizations. The document will be available within two weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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Appendix A

The following table (A-1) shows median and mean tailrace egress times for juvenile salmonids at the lower Snake and lower Columbia River CRS dams. These values cover distances that are up to six times longer than the action area for this consultation. That is, the downstream acoustic (or radiotelemetry) array was located 1.0 to 3 km below each dam rather than at 500 meters.

Table A-1. Tailrace egress times (hours) for juvenile salmonids at the lower Snake and lower Columbia River projects. Data sources are provided in the table notes, referenced next to each study year. Project names are abbreviated as: LGR = Lower Granite Dam; LGO = Little Goose Dam; LMN = Lower Monumental Dam; IHA = Ice Harbor Dam; MCN = McNary Dam; JDA = John Day Dam; TDA = The Dalles Dam; BON = Bonneville Dam.

Project (Study Year)	Yearling Chinook			Subyearling Chinook			Steelhead		
	Median	Mean	SE	Median	Mean	SE	Median	Mean	SE
LGR									
(2018)[a]	0.27	2.00	0.86	0.62	2.15	0.29	0.27	2.93	2.27
LGO									
(2012)[b]	0.58	1.35	0.06	0.78	1.41	0.05	0.68	1.12	0.10
(2013a)[c]				1.23	3.37	0.55			
LMN									
(2013)[c]				0.67	1.16	0.20			
IHA									
(2005)[d]	0.05						0.04-0.05		
MCN									
(2012)[e]	0.41	2.87	0.33	0.38	3.01	0.29	0.34	1.85	0.37

Table A-1, *continued*. Tailrace egress times (hours) for juvenile salmonids at the lower Snake and lower Columbia River projects. Data sources are provided in the table notes, referenced next to each study year. Project names are abbreviated as: LGR = Lower Granite Dam; LGO = Little Goose Dam; LMN = Lower Monumental Dam; IHA = Ice Harbor Dam; MCN = McNary Dam; JDA = John Day Dam; TDA = The Dalles Dam; BON = Bonneville Dam.

Project (Study Year)	Yearling Chinook			Subyearling Chinook			Steelhead		
	Median	Mean	SE	Median	Mean	SE	Median	Mean	SE
JDA									
(2012)[f]	0.50	2.80	0.28	0.48	2.95	0.16	0.46	6.22	0.48
TDA									
(2012)[g]				0.24	1.15	0.14			
BON									
(2012)[h]				0.36	1.31	0.18			

[a] Skalski et al. 2019. Tailrace acoustic array was located 2 km below Lower Granite Dam.

[b] Skalski et al. 2013a. Tailrace acoustic array was located 1.5 km below Little Goose Dam.

[c] Skalski et al. 2014. Tailrace acoustic arrays were located 1.5 km below Little Goose Dam and 2 km below Lower Monumental Dam.

[d] Axel et al. 2007. Tailrace radiotelemetry array was located 1 km below Ice Harbor Dam. Tailrace egress tested under two spill conditions with significantly different results for juvenile steelhead.

[e] Skalski et al. 2013b. Tailrace acoustic array was located 2 km below McNary Dam.

[f] Skalski et al. 2013c. Tailrace acoustic array was located 3 km below John Day Dam.

[g] Skalski et al. 2013d. Tailrace acoustic array was located 2 km below The Dalles Dam.

[h] Skalski et al. 2013e. Tailrace acoustic array was located 1 km below Bonneville Dam.

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