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

Refer to NMFS No: WCRO-2019-00092

October 10, 2019

Hanh Shaw
Water Quality Standards Manager
U.S. Environmental Protection Agency
Region 10
1200 Sixth Avenue, Suite 155
Seattle, Washington 98101

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence Letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Idaho Water Quality Standards Mixing Zone Rules

Dear Ms. Shaw:

Thank you for your letter dated February 28, 2019, 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 U.S. Environmental Protection Agency's (EPA) proposed approval of the mixing zone provisions within Idaho's water quality standards. Your submittal included a final biological evaluation (BE) that analyzed the effects of the proposed action on five ESA-listed species and four designated critical habitats. The species and designated critical habitats included in the BE were: Snake River Basin steelhead (*Oncorhynchus mykiss*); Snake River fall and spring/summer Chinook salmon (*O. tshawytscha*); Snake River sockeye salmon (*O. nerka*); Southern Resident killer whale (*Orcinus orca*); and designated critical habitat for Snake River fall and spring/summer Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead.

In this biological opinion (Opinion), NMFS concludes that the action, as proposed, is not likely to jeopardize the continued existence of Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead. In addition, NMFS concludes the proposed action is not likely to result in adverse modification of designated critical habitat for these anadromous fish species. NMFS also concurs with the EPA's determination that the proposed action is not likely to adversely affect Southern Resident killer whale. Rationale for our conclusions is provided in the attached Opinion and concurrence letter.

As required by section 7 of the ESA, NMFS provides an incidental take statement (ITS) with the Opinion. The ITS describes reasonable and prudent measures (RPM) NMFS considers necessary or appropriate to minimize the impact of incidental take associated with this action. The take statement sets forth nondiscretionary terms and conditions, including reporting requirements, that the EPA and the applicant must comply with to carry out the RPM. Incidental take from actions that meet these terms and conditions will be exempt from the ESA take prohibition.

This document also includes the results of our analysis of the action's effects on essential fish habitat (EFH) pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and includes seven Conservation Recommendations to avoid, minimize, or otherwise offset potential adverse effects on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions. Section 305(b)(4)(B) of the MSA requires federal agencies provide a detailed written response to NMFS within 30 days after receiving these recommendations.

If the response is inconsistent with the EFH Conservation Recommendations, EPA must explain why the recommendations will not be followed, including the justification for any disagreements over the effects of the action and the recommendations. In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many Conservation Recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, in your statutory reply to the EFH portion of this consultation, NMFS asks that you clearly identify the number of Conservation Recommendations accepted.

Please contact Johnna Sandow, Boise NMFS, 208-378-5737, johnna.sandow@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: L . Macchio – EPA
M.A. Nelson – IDEQ
J. Pappani – IDEQ
K. Hendricks – USUSFWS
M. Lopez – NPT
C. Colter – SBT
J. Seo – SPT

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

EPA Approval of Idaho Mixing Zone
Rules

NMFS Consultation Number: WCRO-2019-00092

Action Agency: U. S. Environmental Protection Agency, Region 10

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?**
Snake River Basin steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No
Snake River spring/summer Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Snake River fall Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Snake River sockeye salmon (*O. nerka*)	Endangered	Yes	No	Yes	No
Southern Resident killer whale (*Orcinus orca*)	Endangered	No	No	N/A	N/A

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

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

Issued By:

Michael P. Tehan
Assistant Regional Administrator

Date: October 10, 2019

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

ACRONYMS

ACRONYMS	DEFINITIONS
1Q10	Once In 10 Years Daily Low Flow
7Q10	Once In 10 Years Lowest 7-Seven Day Average Flow
BE	Biological Evaluation
BLM	Bureau of Land Management
CGP	Construction General Permit For Stormwater
CWA	Clean Water Act
DCH	Designated Critical Habitat
DNA	Deoxyribonucleic Acid
DPS	Distinct Population Segment
DQA	Data Quality Act
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FCRONRW	Frank Church River Of No Return Wilderness
Guidance	Idaho Mixing Zone Implementation Guidance
HAPC	Habitat Areas of Particular Concern
HUC	Hydrologic Unit Code
ICIS	Integrated Compliance Information System
ICTRT	Interior Columbia Basin Technical Recovery Team
IDAPA	Idaho Administration Procedures Act
IDEQ	Idaho Department of Environmental Quality
IPDES	Idaho Pollutant Discharge Elimination System
ITS	Incidental Take Statement
LOEC	Lowest Observable Effect Concentration
mi^2	Square Miles
MOA	Memorandum of Agreement
MPG	Major Population Groups
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSGP	Multi-Sector General Permit For Stormwater
NMFS	National Marine Fisheries Service
NOEC	No Observable Effect Concentration
NPDES	National Pollutant Discharge Elimination System
NPT	Nez Perce Tribe
O.	*Oncorhynchus*
Opinion	Biological Opinion
PBF	Physical or biological feature
PCE	Primary Constituent Element

ACRONYMS	DEFINITIONS
PIT	Passive Integrated Transponder
POTW	Publicly or Privately Owned Treatment Works
RM	River Mile
RPA	Reasonable and Prudent Alternative
RPM	Reasonable and Prudent Measure
SBT	Shoshone-Bannock Tribes
SNRA	Sawtooth National Recreation Area
SPT	Shoshone Paiute Tribes
SRKW	Southern Resident Killer Whale
TIE	Toxicity Identification Evaluation
TMDLs	Total Maximum Daily Loads
TRE	Toxicity Reduction Evaluation
TSS	Total Suspended Solids
TU_a	Acute Toxic Units
TU_c	Chronic Toxic Units
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
VSP	Viable Salmonid Population
WET	Whole Effluent Toxicity
WQBELS	water quality based effluent limits
WQS	Water Quality Standards
WWTP	Wastewater Treatment Plants
ZID	Zone of Initial Dilution

1. INTRODUCTION

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

1.1 Background

The National Marine Fisheries Service (NMFS) prepared the biological opinion (Opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), and implementing regulations at 50 CFR 402. Updates to the regulations governing interagency consultation (50 CFR part 402) will become effective on October 28, 2019 [84 FR 50333]. Because this consultation was pending and will be completed prior to that time, we are applying the previous regulations to the consultation. However, as the preamble to the final rule adopting the new regulations noted, "[t]his final rule does not lower or raise the bar on section 7 consultations, and it does not alter what is required or analyzed during a consultation. Instead, it improves clarity and consistency, streamlines consultations, and codifies existing practice." Thus, the updated regulations would not be expected to alter our analysis.

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). A complete record of this consultation is on file at the Snake Basin Office, in Boise, Idaho.

1.2 Consultation History

In April, 2014, the Idaho Department of Environmental Quality (IDEQ) initiated negotiated rulemaking to revise the mixing zone provisions within Idaho's Water Quality Standards (WQS). The IDEQ hosted three negotiated rulemaking meetings, two of which were attended by NMFS. NMFS submitted comments on the draft negotiated rule language on May 14, 2014, and June 30, 2014.

The IDEQ announced a 30-day public comment period and published the proposed rule language in the September 3, 2014, Idaho Administrative Bulletin. NMFS submitted comments on the proposed mixing zone rule language on October 2, 2014. The Idaho legislature approved the revised mixing zone rule, and the rule became effective under state law on April 11, 2015. The IDEQ then developed a *Mixing Zone Implementation Guidance* (hereinafter referred to as "Guidance") to support interpretations of the mixing zone rule language. The draft Guidance was released for public comment on July 31, 2015, and NMFS provided comments on September 15, 2015. The IDEQ released its final Guidance in December 2016.

On October 26, 2016, the IDEQ submitted the rule for U.S. Environmental Protection Agency (EPA) review and action pursuant to Section 303(c) of the Clean Water Act (CWA). The EPA subsequently contacted NMFS and U.S. Fish and Wildlife Service (USFWS) to begin informal ESA consultation. On January 17, 2017, the IDEQ requested EPA recognize IDEQ as an "applicant" for the purposes of consultation under the ESA. EPA granted applicant status to the IDEQ on March 8, 2017. Noteworthy meetings and correspondence pertinent to this consultation are listed below.

- January 19, 2017: EPA met with NMFS and USFWS to introduce the proposed action and discuss the analysis methodology;

- February 28, 2017: EPA, NMFS, and USFWS met to discuss the draft biological evaluation (BE) outline, preliminary baseline analysis, and information gaps.

- May 16, 2017: EPA shared sections 1-4 of the preliminary draft BE with NMFS and the USFWS. These sections of the BE covered the introduction, proposed action, action area, species and critical habitat status, and environmental baseline.

- June 5, 2017: EPA shared updated sections of the preliminary draft BE, including a preliminary draft of the effects analysis (section 5 of the draft BE).

- June 8, 2017: NMFS provided comments for sections 1-4 of the preliminary draft BE.

- June 8, 2017: EPA, NMFS, and USFWS meet to discuss key issues raised during reviews of the preliminary draft BE sections and the effects analysis approach.

- July 6, 2018: IDEQ submits a spreadsheet of known discharge permits and mixing zone authorizations to the EPA and USFWS (NMFS received the spreadsheet on July 10, 2018).

- August 8, 2018: EPA, USFWS, NMFS met to review the status of the BE and discuss the effects analysis and preliminary determinations.

- August 13, 2018: IDEQ submits an "Implementation of the Idaho Mixing Zone Guidance" memorandum to EPA providing clarification of IDEQ's commitment to implement the Guidance and to use available scientific literature when evaluating sediment toxicity and attraction.

- September 19, 2018: EPA, NMFS, and USFWS met to discuss the status of the BE.

- October 19, 2018: EPA, NMFS, USFWS, and IDEQ met to discuss incidental take approach and conservation measures that could be incorporated into the proposed action.

- November 7, 2018: EPA shared a draft description of the conservation measures discussed during the October 19, 2018 meeting.

- November 13, 2018: NMFS provided comments on the draft conservation measures.

- November 26, 2018: NMFS provided EPA with comments pertaining to the EFH analysis and Southern Resident killer whale (SRKW) (*Orcinus orca*) analysis.

- December 14, 2018: EPA submitted a draft final BE to the USFWS and NMFS for review.

- February 6, 2019: EPA, NMFS, and USFWS participated in a conference call to discuss review comments on the draft BE.

- February 7, 2019: NMFS provided written comments regarding the draft BE to the EPA.

- February 28, 2019: EPA submitted a final BE to the USFWS and NMFS and requested initiation of consultation.

- March 26, 2019: NMFS informed the EPA that their submittal was sufficient and that the initiation date for formal consultation was February 28, 2019.

In evaluating the potential effects of mixing zone authorizations, NMFS relied on information in the following sources.

- 40 CFR 122: EPA Administered Permit Programs: The National Pollutant Discharge Elimination System (NPDES);

- 40 CFR 123: State Program Requirements;

- Idaho Administrative Procedures Act (IDAPA) 58.01.02: Water Quality Standards;

- Mixing Zone Implementation Guidance (IDEQ 2016);

- The IDAPA 58.01.25: Rules Regulating the Idaho Pollutant Discharge Elimination System (IPDES) Program;

- The IPDES: Effluent Limit Development Guidance (IDEQ 2017a); and

- The IPDES: User's Guide to Permitting and Compliance, Volume 2 – Publically owned treatment works (IDEQ 2017b).

A copy of the proposed action and terms and conditions section of the draft Opinion were provided to the EPA, IDEQ, Nez Perce Tribe (NPT), Shoshone Bannon Tribes (SBT), and the Shoshone Paiute Tribes (SPT) on July 2, 2019. NMFS did not receive comments from the NPT, SBT, or SPT. The EPA provided comments, which reflected input from the IDEQ, to NMFS on July 19, 2019. The EPA, IDEQ, and NMFS participated in meetings on July 29, August 13, 2019, and September 17, 2019, to discuss potential revisions to the draft terms and conditions with the goals of improving clarity and ensuring the extent of take was effectively monitored.

A complete record of this consultation is on file at the Snake Basin Office in Boise, Idaho.

1.3 Proposed Federal Action

"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). For EFH, a 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). "Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02).

The proposed action subject to this consultation is EPA's proposed approval of Idaho's mixing zone policy within the Idaho WQS (IDAPA 58.01.02). For this consultation, NMFS has identified Idaho's implementation of the mixing zone policy (i.e., authorization of mixing zones) as an interrelated/interdependent activity. To provide context for the proposed action, a brief overview of WQS and their implementation is included in Section 1.3.1. Sections 1.3.2 and 1.3.3 describe the proposed action and conservation measures, respectively. Lastly, Section 1.3.4 briefly describes the *Idaho Mixing Zone Implementation Guidance* (IDEQ 2016), which provides insight into how IDEQ intends to implement the mixing zone policy.

1.3.1 Overview of Water Quality Standards and Their Implementation

The CWA requires all states to adopt WQS to restore and maintain the physical, chemical, and biological integrity of the Nation's waters. At a minimum, state WQS must include beneficial use designations (e.g., cold water aquatic life, salmonid spawning, recreation, etc.), narrative and numeric criteria to protect beneficial uses, and an antidegradation policy. Numeric water quality criteria establish levels of individual pollutants (e.g., metals, organic pollutants, chlorine, ammonia, etc.) or parameters (e.g., dissolved oxygen, temperature, dissolved gas, etc.) that will generally protect the designated use of the waterbody. Numeric water quality criteria consist of three components: magnitude (the level of allowable pollutant, general expressed as a concentration), duration (the period of time over which the concentration is averaged), and frequency (how often the concentrations may exceed the protective level). Numeric criteria for toxic pollutants are generally set for acute (short-term) and chronic (long-term) exposures.

Any WQS adopted or revised after May 30, 2000, must be approved by EPA before being used as the basis for any CWA-related actions (e.g., for establishing effluent limits for discharge permits or wasteload allocations for total maximum daily loads [TMDLs]) (40 CFR 131.21). Once approved by EPA, a WQS is considered "effective for CWA purposes." The WQS are implemented through various regulatory programs under the CWA, including permitting of point source discharges (Section 402), permitting of discharges of dredge and fill material (Section 404), issuing water quality certifications (Section 401), and developing and implementing TMDLs (Section 303(d)).

States may include, at their discretion, implementation policies (e.g., mixing zones, variances, and low flows) within their WQS (40 CFR 131.13). These policies are also subject to EPA review and approval prior to becoming effective for CWA purposes. The mixing zone rule is an optional policy. A mixing zone is a defined area or volume of the receiving water where wastewater mixing occurs and where not all water quality criteria are met. The mixing zone provision is primarily implemented through point source discharge permits and section 401 water quality certifications.

On June 5, 2018, EPA approved the IPDES Program and authorized a phased transfer of permitting authority to the state beginning on July 1, 2018, with full program transfer occurring by July 1, 2021. Until the full program is transferred, both the EPA and IDEQ will serve as permitting authorities, meaning both agencies will have the authority to issue discharge permits in Idaho. The EPA will remain the permitting authority for facilities located within Indian reservations. The IPDES program will develop permits that comply with WQS that are effective for CWA purposes and that limit the amount of pollution point sources discharge into surface waters. Because the mixing zone policy is not effective for CWA purposes until approved by EPA, and because the IDEQ has proposed changes to the existing mixing zone policy, in part, as a result of comments received during a public comment period for the initial draft mixing zone guidance document (Burnell 2016), implementation of the policy as guided by the Guidance is interrelated/interdependent to the proposed action.

1.3.2 Mixing Zone Policy

Idaho's revised mixing zone rule and associated definitions are found in the Idaho WQS (IDAPA 58.01.02). In revising its mixing zone rule, the IDEQ repealed and replaced IDAPA 58.01.02.060.01 and 060.02, revised the "Zone of Initial Dilution (ZID)" definition, and added definitions for "bioaccumulative pollutants" and "thermal shock". A copy of the mixing zone policy (IDAPA 58.01.02.060) is included as Appendix A, with its key components briefly described in Table 1. The additions and revisions to definitions pertinent to the mixing zone policy are also summarized below.

Table 1. Brief descriptions of, and rule citations for, key concepts contained within Idaho's mixing zone rule.

Policy Concept	Rule Citation (58.01.02)	Description
Authorization Authority	060.01	Establishes IDEQ's authority to authorize mixing zones on a case-by-case basis.
Assimilative Capacity	060.01.a	Acknowledges that mixing zones are typically not authorized when no assimilative capacity exists. However, IDEQ may authorize mixing in circumstances where the discharge is consistent with approved plans or analyses.
Water Quality within the Mixing Zone	060.01.b	Identifies where numeric criteria can be exceeded within a mixing zone. Acute and chronic criteria can be exceeded within the ZID. Chronic criteria can be exceeded outside the ZID to the boundary of the regulatory mixing zone. Certain narrative criteria apply within the mixing zone.
Size	060.01.c	States mixing zones must be evaluated using the permitted design flow and must not be larger than is necessary.
Unreasonable Interference	060.01.d	Prohibits mixing zones from causing unreasonable interference with, or danger to, beneficial uses. The rule clarifies what constitutes "unreasonable interference" by providing a list of examples. These examples include, but are not limited to: blocking or impeding aquatic life passage; interfering with successful spawning, egg incubation, or rearing; or causing injury, thermal shock, lethality, loss of cold water refugia, or bioaccumulation of pollutants. The provision also restricts mixing zones for *Escherichia coli*.

Policy Concept	Rule Citation (58.01.02)	Description
Nested Mixing Zones	060.01.e	Allows for multiple mixing zones from a single outfall, each mixing zone being specific to one or more pollutants.
Multiple Mixing Zones	060.01.f	Acknowledges a single discharger may have more than one outfall. If mixing zones from these outfalls overlap, then the sum of the multiple mixing zones must not exceed requirements for a single point of discharge.
Adjacent Mixing Zones	060.01.g	Prohibits the overlapping of mixing zones from independent dischargers whose outfalls are in close proximity to each other.
Restrictions	060.01.h	Identifies physical size restrictions that mixing zones shall meet in flowing and non-flowing waters. Exceptions to these restrictions may be granted on a case-by-case determination.
Restriction Exceptions	060.01.i	Acknowledges that IDEQ may authorize mixing zones that are smaller or larger than the restrictions specified in 060.01.h. When a larger mixing zone is considered, the discharger is required to provide IDEQ with an analysis that demonstrates a larger mixing zone is needed.
Outfall Design	060.01.j	Requires dischargers to consider rapid mixing and avoidance of shore hugging plumes when designing and locating an outfall.
Points of Compliance	060.02	Allows IDEQ to identify alternative points of compliance when mixing zone analyses are not practicable (e.g., CWA 404 dredge and fill permits, stormwater, and nonpoint source discharges). In these circumstances, IDEQ will identify monitoring points to evaluate compliance with water quality criteria.

The IDEQ revised the definition of a ZID to include the concepts that mixing zones shall be no larger than necessary and sized to prevent unreasonable interference, or danger to, aquatic life. As defined, a ZID is,

> *"An area within a Department authorized mixing zone where acute criteria may be exceeded. This area shall be no larger than necessary and shall be sized to prevent lethality to swimming or drifting organisms by ensuring that organisms are not exposed to concentrations exceeding acute criteria for more than (1) hour more than once in three (3) years. The actual size of the ZID will be determined by the Department for a discharge on a case-by-case basis, taking into consideration mixing zone modeling and associated size recommendations and any other pertinent chemical, physical, and biological data available."*

The IDEQ defined "thermal shock" as "a rapid temperature change that causes aquatic life to become disoriented or more susceptible to predation or disease." This definition was added to the WQS in order to clarify what is considered unreasonable interference with regard to heat in a discharge.

The IDEQ developed a definition for bioaccumulative pollutants in order to clarify what pollutants are considered bioaccumulative and have the greatest potential to cause unreasonable interference to aquatic life. A bioaccumulative pollutant is defined as "A compound with a bioaccumulation factor of greater than one thousand (1,000) or a bioconcentration factor of greater than three hundred (300)." Pollutants that meet this definition are listed below (IDEQ 2016).

Aldrin
Alpha-BHC
Anthracene
Benzo(a) pyrene
Benzo(b) fluoranthene
Benzo(k) fluoranthene
Beta-BHC
Bis(2-ethylhexyl) phthalate
Chlordane
Chrysene
Dibenzo(a,h) anthracene
Dieldrin
Endrin
Endrin Aldehyde
Fluoranthene
gamma-BHC (lindane)
Heptachlor
Heptachlor Epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclohexane-Technical
Hexachlorocyclopentadiene
Ideno (1,2,3-cd) pyrene
Methylmercury
Methoxychlor
Polychlorinated biphenyl (PCB)
Pentachlorobenzene
Pyrene
Toxaphene
1,2,4,5-Tetrachlorobenzene
2,3,7,8-TCDD (dioxin)
4,4′-DDD
4,4′-DDE
4,4′-DDT
4-Bromophenyl phenyl ether
4-Chlorophenyl phenyl ether

Idaho WQS require the use of low flow design conditions (hereinafter referred to as critical conditions) when authorizing mixing zones (IDAPA 58.01.02.210.03.b). Critical conditions may be defined hydrologically (using common hydrologic statistics) or biologically (may be determined using EPA's computerized DFLOW model). Hydrologic-based critical conditions for the acute and chronic criteria are defined as the lowest 1-day flow with an average recurrence frequency of once in 10 years [1Q10] and the lowest 7-day average flow with an average recurrence frequency of once in 10 years [7Q10], respectively.

1.3.3 Conservation Measures

The EPA and IDEQ have committed to a suite of conservation measures as a means of minimizing the potential for adverse impacts to ESA-listed species and designated critical habitats resulting from authorization of mixing zones. These conservation measures principally focus on enhancing communication and coordination. Also included in the list of conservation measures are existing IPDES program procedures, administered by IDEQ, as well as existing EPA oversight mechanisms that ensure compliance with the CWA and federal regulations that support minimizing adverse effects to ESA-listed species.

The IDEQ and EPA will ensure that appropriate coordination and communication with NMFS and the USFWS occurs. Each year, the IDEQ will share its annual Permit Issuance Plan (anticipated in January) along with any updates during the year with the EPA, NMFS, and the USFWS. The EPA will notify NMFS of permits discharging to waters within a hydrologic unit code (HUC) that supports ESA-listed anadromous species and/or designated critical habitat. This early coordination will provide NMFS an opportunity to identify permits of interest and offer information regarding potentially affected ESA-listed species and designated critical habitat. If requested by NMFS and/or the USFWS, the IDEQ will organize a meeting with EPA, NMFS, and the USFWS to discuss specific permits and/or coordination issues.

The IDEQ will ensure mixing zones are no larger than necessary and will ensure the permit fact sheets contain adequate rationale and analysis to support their conclusion that the authorized mixing zones do not unreasonably interfere with ESA-listed species. In particular, this rationale and supporting data will be provided when authorized mixing zones exceed 25 percent stream width or volume. The IDEQ is required to provide notice and copies of draft permits and associated fact sheets to NMFS (40 CFR 123.25(a)(28); 40 CFR 124.10(c)(1)(iv); IDEQ and EPA 2018). The existing IDEQ public comment process for draft permits[1] enables NMFS to raise concerns regarding proposed mixing zones that have the potential to adversely affect ESA-listed species and designated critical habitat. The IDEQ is required to address comments raised by NMFS and may include conditions recommended by NMFS to the extent they are determined necessary to ensure the mixing zone authorization avoids substantial impairment of fish, shellfish, or wildlife resources (40 CFR 123.25(a)(34); 40 CFR 124.59(b)).

The EPA retains oversight authority over state-implemented NPDES programs under Section 402(d) of the CWA, 33 U.S.C. § 1342(d) and retains authority to enforce permits. In this oversight role, the EPA will regularly review the IPDES program to ensure it is consistent with the CWA, federal regulations, applicable terms and conditions established during water quality standards consultations with the Services (i.e., NMFS and USFWS), and the authority delegated to Idaho. The EPA's oversight activities include review and comment of selected draft permits, including authorized mixing zones, on an ongoing basis, and in-depth assessments of the IPDES program through the Permit Quality Review and State Review Framework processes every 5 years.

Lastly, the *Memorandum of Agreement (MOA) Between the Environmental Protection Agency, Fish and Wildlife Service and National Marine Fisheries Service Regarding Enhanced Coordination Under the Clean Water Act and Endangered Species Act* is intended to enhance coordination between the EPA, NMFS, and the USFWS (66 FR 11202, 2001). According to the MOA, and as stated in the BE (EPA 2019), the EPA may make a formal objection, where consistent with its CWA authority, or take other appropriate action, where the EPA finds that a state NPDES permit will likely have more than a minor detrimental effect on federally-listed species or critical habitat. Consistent with the MOA, where the EPA determines the exercise of its objection authority is appropriate to protect endangered and threatened species, the EPA will act pursuant to its existing CWA authorities. (66 FR 11215).

1.3.4 Mixing Zone Implementation Guidance

In December 2016, the IDEQ issued its final Guidance, which is available at http://www.deq.idaho.gov/media/60179492/mixing-zone-implementation-guidance-1216.pdf. The Guidance provides insight into how IDEQ will interpret and apply the mixing zone rule language in its regulatory programs (e.g., IPDES and 401 certification). On August 13, 2018, the IDEQ water quality standards manager issued a memo to all surface water staff clarifying IDEQ's intentions when authorizing mixing zones under the 2016 Mixing Zone Guidance. Specifically, the memo stated the Guidance is considered a statement of how IDEQ intends to operate and is IDEQ's communication to the public, the regulated community, and other regulatory agencies, of how IDEQ intends to implement the Mixing Zone policy. Further, the memo stated that "All efforts should be made to adhere to the procedures as described in the guidance" (Essig 2018).

[1] Regardless of whether a facility is brand new or is seeking a permit reissuance, draft permits will always undergo a public comment process.

The Guidance is not incorporated by reference in the Idaho WQS, and EPA has no authority to review and approve the Guidance. Regardless, implementation of the Guidance is interrelated/interdependent to EPA's approval of the mixing zone policy. The IDEQ's development and issuance of the Guidance contemporaneous with the promulgation of the final mixing zone rule revisions coupled with the management memorandum to staff concerning the guidance, demonstrates reasonable certainty that IDEQ will follow the guidance when authorizing mixing zones.

The Guidance recognizes Chinook salmon, sockeye salmon, and steelhead are species of special concern in Idaho and that mixing zones in areas inhabited by these species warrant additional scrutiny. In addition, the Guidance notes that mixing zones in these areas may require modeling of the mixing zone using measured, rather than estimated, inputs to more precisely assess the size, configuration, and location of the mixing zone.

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 provides 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 non-discretionary 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 SRKW. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12).

2.1 Analytical Approach

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

This Opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for salmon (58 FR 68543) and steelhead (70 FR 52630) use the phrases "essential feature" and "primary constituent element (PCE)," respectively to identify features essential to the conservation of the species. The new critical habitat regulations (81 FR 7414) replace these with physical or biological feature (PBF). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this Opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species or destroy or adversely modify critical habitat:

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitats are adversely modified.

- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

The EPA's approval of Idaho's mixing zone rule does not authorize particular mixing zones. Similarly, the proposed mixing zone rule does not specify the number, location, timing, frequency, and magnitude of mixing zones that may be authorized by IDEQ. Rather, EPA's approval allows the IDEQ to authorize mixing zones when implementing CWA programs (as described in Section 1.3.1). The rule contains regulatory provisions that the IDEQ must adhere to when authorizing mixing zones. These provisions provide the basis for determining if, and to what extent, mixing zones may be authorized, and for establishing permit conditions to avoid or minimize potential adverse impacts associated with mixing.

The duration of the federal action is in perpetuity. That is, the mixing zone rule will remain in place and will be applied to CWA programs until it (or its component pieces), are repealed and replaced. Thus, our analysis of effects for species and their designated critical habitat extends from the date of this Opinion for as long as the mixing zone rule remains effective. We have employed the following assumptions as part of our analysis:

- Water quality criteria for aquatic life that are applicable for CWA purposes and numeric interpretations of narrative criteria are sufficiently protective of ESA-listed species and designated critical habitat.

- Criteria are met at the edge of the mixing zone, as required by the rule.

- Within the mixing zone, dilution is quick and even.

- Authorization of mixing zones will be done in a manner that is consistent with the Guidance.

- Discharges to areas with anadromous species or their designated critical habitat will receive a more rigorous analysis unless there is adequate justification for a less intensive analysis.

- Adequate rationale will be provided in the permit fact sheet justifying any deviations from the recommendations contained in the Guidance when mixing zones are proposed in waters that support ESA-listed species and/or designated critical habitat.

- Adequate rationale will be provided in the permit fact sheet demonstrating unreasonable interference will not occur when mixing zones are proposed in waters that support ESA-listed species and/or designated critical habitat.

- Large portions of the anadromous watersheds are located within federally-managed lands, and future mixing zone authorizations in those areas will likely be interrelated/interdependent to activities that require a federal authorization (e.g., mining plan of operations approval, etc.). Thus, analyzing the effects of future mixing zone authorizations will occur as interrelated/interdependent effects analysis for activities on federal lands.

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 (Table 2). The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. This Opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds that make up the designated area, and discusses the current function of the essential PBF that help to form that conservation value.

Table 2. Listing status, status of critical habitat designations and protective regulations, and relevant Federal Register decision notices for ESA-listed species and designated critical habitats considered in this Opinion.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon *(Oncorhynchus tshawytscha)*			
Snake River spring/summer-run	T 6/28/05; 70 FR 37160	10/25/99; 64 FR 57399	6/28/05; 70 FR 37160
Snake River fall-run	T 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	6/28/05; 70 FR 37160
Sockeye salmon *(O. nerka)*			
Snake River	E 6/28/05; 70 FR 37160	12/28/93; 58 FR 68543	ESA section 9 applies
Steelhead (*O. mykiss*)			
Snake River Basin	T 1/05/06; 71 FR 834	9/02/05; 70 FR 52630	6/28/05; 70 FR 37160

Note: Listing status: 'T' means listed as threatened under the ESA; 'E' means listed as endangered.

2.2.1 Status of the Species

This section describes the present condition of the Snake River spring/summer Chinook salmon evolutionarily significant unit (ESU), Snake River fall Chinook salmon ESU, Snake River sockeye salmon ESU, and the Snake River Basin steelhead distinct population segment (DPS). NMFS expresses the status of a salmonid ESU or DPS in terms of likelihood of persistence over 100 years (or risk of extinction over 100 years). NMFS uses McElhany et al.'s (2000) description of a viable salmonid population (VSP) that defines "viable" as less than a 5 percent risk of extinction within 100 years and "highly viable" as less than a 1 percent risk of extinction within 100 years. A third category, "maintained," represents a less than 25 percent risk within 100 years (moderate risk of extinction). To be considered viable, an ESU or DPS should have multiple viable populations so that a single catastrophic event is less likely to cause the ESU/DPS to become extinct, and so that the ESU/DPS may function as a metapopulation that can sustain population-level extinction and recolonization processes (ICTRT 2007). The risk level of the ESU/DPS is based upon the aggregate risk levels of its component individual populations and major population groups (MPGs).

Attributes associated with a VSP are: (1) Abundance (number of adult spawners in natural production areas); (2) productivity (adult progeny per parent); (3) spatial structure; and (4) diversity. A VSP needs sufficient levels of these four population attributes in order to: safeguard the genetic diversity of the listed ESU or DPS; enhance its capacity to adapt to various environmental conditions; and allow it to become self-sustaining in the natural environment (ICTRT 2007). These viability attributes are influenced by survival, behavior, and experiences throughout the entire salmonid life cycle, characteristics that are influenced in turn by habitat and other environmental and anthropogenic conditions. The present risk faced by the ESU/DPS informs NMFS' determination of whether additional risk will appreciably reduce the likelihood that the ESU/DPS will survive or recover in the wild.

2.2.1.1 Snake River Spring/Summer Chinook Salmon

The Snake River spring/summer Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653). Several factors led to NMFS' conclusion that Snake River spring/summer Chinook were threatened: (1) Abundance of naturally produced Snake River spring/summer Chinook runs had dropped to a small fraction of historical levels; (2) short-term projections were for a continued downward trend in abundance; (3) hydroelectric development on the Snake and Columbia Rivers continued to disrupt Chinook runs through altered flow regimes and impacts on estuarine habitats; and (4) habitat degradation existed throughout the region, along with risks associated with the use of outside hatchery stocks in particular areas (Good et al. 2005). On May 26, 2016, in the agency's most recent 5-year review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as threatened (81 FR 33468). NMFS released a final recovery plan for this species in November of 2017 (NMFS 2017a).

Snake River spring/summer Chinook salmon occupy the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. This ESU includes all naturally spawning populations of spring/summer Chinook in the mainstem Snake River (below Hells Canyon Dam) and in the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins (57 FR 23458), as well as the progeny of 15 artificial propagation programs (70 FR 37160). The hatchery programs include the South Fork Salmon River (McCall Hatchery), Johnson Creek, Lemhi River, Pahsimeroi River, East Fork Salmon River, West Fork Yankee Fork Salmon River, Upper Salmon River (Sawtooth Hatchery), Tucannon River (conventional and captive broodstock programs), Lostine River, Catherine Creek, Lookingglass Creek, Upper Grande Ronde River, Imnaha River, and Big Sheep Creek programs.

The historical Snake River ESU likely also included populations in the Clearwater River drainage and extended above the Hells Canyon Dam complex. Current runs returning to the Clearwater River drainages are not included in the Snake River spring/summer Chinook salmon ESU. Lewiston Dam on the lower mainstem of the Clearwater River was constructed in 1927 and blocked Chinook passage until the early 1940s (Matthews and Waples 1991). In the 1940s spring/summer Chinook salmon runs were reintroduced into the Clearwater system via hatchery outplants. As a result, when determining the status of Snake River spring/summer Chinook for ESA listing, NMFS concluded that even if a few native salmon survived the hydropower dams, "the massive outplantings of nonindigenous stocks presumably substantially altered, if not eliminated, the original gene pool" (Matthews and Waples 1991).

Life History. Snake River spring/summer Chinook salmon are characterized by their return times. Runs classified as spring Chinook salmon are counted at Bonneville Dam beginning in early March and ending the first week of June; summer runs are those Chinook adults that pass from June through August. Returning adults will hold in deep mainstem and tributary pools until late summer, when they move up into tributary areas and spawn.

Spring/summer Chinook spawn follow a "stream-type" life history characterized by rearing for a full year in the spawning habitat and migrating in early to mid-spring as age-1 smolts (Healey

1991). Eggs are deposited in late summer and early fall, incubate over the following winter, and hatch in late winter and early spring of the following year. Juveniles rear through the summer, and most overwinter and migrate to sea in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Snake River spring/summer Chinook salmon return from the ocean to spawn primarily as 4- and 5-year-old fish, after 2 to 3 years in the ocean. A small fraction of the fish return as 3-year-old "jacks," heavily predominated by males (Good et al. 2005).

Status of the Species. As previously described, the status of the species is determined based on the condition of VSP attributes (i.e., abundance, productivity, spatial structure, and diversity) of its constituent natural populations. Within the Snake River ESU, the Interior Columbia Technical Recovery Team (ICTRT) identified 28 extant and four extirpated or functionally extirpated populations of spring/summer-run Chinook salmon, listed in Table 3 (ICTRT 2003; McClure et al. 2005). The ICTRT aggregated these populations into five MPGs based on genetic, environmental, and life-history characteristics. Those MPGs include: Lower Snake River, Grande Ronde/Imnaha Rivers, South Fork Salmon River, Middle Fork Salmon River, and Upper Salmon River. For each population, Table 3 shows the current risk ratings that the ICTRT assigned to the four VSP parameters.

Spatial Structure and Diversity. Spatial structure risk is low to moderate for most populations in this ESU (NWFSC 2015) and is generally not preventing the recovery of the species. Spring/summer Chinook salmon spawners are distributed throughout the ESU albeit at very low numbers. Diversity risk, on the other hand, is somewhat higher, driving the moderate and high combined spatial structure/diversity risks for some populations. Several populations have a high proportion of hatchery-origin spawners, particularly in the Grande Ronde, Lower Snake, and South Fork Salmon MPGs (ICTRT 2007; ICTRT 2010; NWFSC 2015).

Abundance and Productivity. Historically, the Snake River drainage is thought to have produced more than 1.5 million adult spring/summer Chinook salmon in some years (Matthews and Waples 1991), yet by the mid-1990s counts of wild fish passing Lower Granite Dam dropped to less than 10,000 (IDFG 2007). Wild returns have since increased somewhat but remain a fraction of historic estimates. Between 2005 and 2015, the number of wild adult fish passing Lower Granite Dam annually ranged from 8,808 to 30,338 (IDFG 2016). Natural origin abundance has increased over the last 5 years for most populations in this ESU, but the increases have not been large enough to change population viability ratings for abundance and productivity; all but one population (Chamberlain Creek) remain at high risk of extinction over the next 100 years (NWFSC 2015). Many populations will need to see increases in abundance and productivity in order for the ESU to recover.

With the exception of the Chamberlain Creek population, all of the component populations of the Snake River spring/summer Chinook salmon ESU have an overall viability rating of high risk. Natural origin abundance has increased over the levels reported in a prior status review (Ford 2011) for most populations in this ESU, although improvements were not substantial enough to change the viability ratings (NWFSC 2015). Relatively high ocean survivals immediately before 2015 were a major factor in recent abundance patterns. Since the last status review in 2015, observations of coastal ocean conditions suggested that the 2015-2017 outmigrant year classes experienced below average ocean survival during a marine heatwave and its lingering effect, which led researchers to predict a corresponding drop in adult returns through 2019 (Werner et al. 2017). The negative impacts on juvenile salmonids associated with the marine heatwave had subsided by spring 2018, but other aspects of the ecosystem (e.g., temperatures below the 25 meter surface layer) had not returned to normal (Harvey et al. 2019).

Table 3. Summary of viable salmonid population parameter risks and overall current status for each population in the Snake River spring/summer Chinook salmon ESU (NWFSC 2015).

MPG	Population	VSP Risk Parameter		Overall Viability Rating
		Abundance/ Productivity	Spatial Structure/ Diversity	
South Fork Salmon River (Idaho)	Little Salmon River	*Insf. data*	Low	High Risk
	South Fork Salmon River mainstem	High	Moderate	High Risk
	Secesh River	High	Low	High Risk
	East Fork South Fork Salmon River	High	Low	High Risk
Middle Fork Salmon River (Idaho)	Chamberlain Creek	Moderate	Low	Maintained
	Middle Fork Salmon River below Indian Creek	*Insf. data*	Moderate	High Risk
	Big Creek	High	Moderate	High Risk
	Camas Creek	High	Moderate	High Risk
	Loon Creek	High	Moderate	High Risk
	Middle Fork Salmon River above Indian Creek	High	Moderate	High Risk
	Sulphur Creek	High	Moderate	High Risk
	Bear Valley Creek	High	Low	High Risk
	Marsh Creek	High	Low	High Risk
Upper Salmon River (Idaho)	North Fork Salmon River	*Insf. data*	Low	High Risk
	Lemhi River	High	High	High Risk
	Salmon River Lower Mainstem	High	Low	High Risk
	Pahsimeroi River	High	High	High Risk
	East Fork Salmon River	High	High	High Risk
	Yankee Fork Salmon River	High	High	High Risk
	Valley Creek	High	Moderate	High Risk
	Salmon River Upper Mainstem	High	Low	High Risk
	Panther Creek			***Extirpated***
Lower Snake (Washington)	Tucannon River	High	Moderate	High Risk
	Asotin Creek			***Extirpated***
Grande Ronde and Imnaha Rivers (Oregon/ Washington)	Wenaha River	High	Moderate	High Risk
	Lostine/Wallowa River	High	Moderate	High Risk
	Minam River	High	Moderate	High Risk
	Catherine Creek	High	Moderate	High Risk
	Upper Grande Ronde River	High	High	High Risk
	Imnaha River	High	Moderate	High Risk
	Lookingglass Creek			***Extirpated***
	Big Sheep Creek			***Extirpated***

Recovery of the Species. In order for the Snake River spring/summer Chinook salmon ESU to achieve a low risk of extinction and be a candidate for delisting, all five MPGs must attain viable status. In order to recover a species, the underlying limiting factors and threats to that species must be addressed. There are many factors that affect the VSP attributes of Snake River spring/summer Chinook salmon. Those have been, and continue to be, survival through the Columbia River system; degradation of estuarine, spawning, and rearing areas; interbreeding and competition with hatchery fish that far outnumber natural-origin fish; and ocean conditions including climate change. NMFS released a final recovery plan for this species in November 2017 (NMFS 2017a) that describes identified MPG-level recovery strategies as well as key and secondary habitat-related limiting factors and threats to this ESU for each population. The recovery strategy and current habitat limiting factors are summarized in Table 4.

Table 4. Summary of the Recovery Strategy and Habitat-related Limiting Factors for the Snake River spring/summer Chinook Salmon ESU.

MPG	Population	Recovery Plan Proposed Target	Limiting Factors								
			Riparian Condition	Excess Sediment	Passage Barriers	Low Summer Flow	Floodplain Connectivity	Instream Complexity Channel Alteration	Temperature	Toxics	Nutrient Deficiency
Lower Snake	Tucannon River	Highly Viable	✓	✓	✓	✓	✓	✓	✓		
	Asotin Creek	Reintroduction	✓	✓	✓		✓	✓	✓		
Grande Ronde And Imnaha Rivers	Wenaha River	Viable						✓			
	Lostine/Wallowa River	Viable	✓	✓	✓	✓		✓	✓		
	Minam River	Viable		✓				✓	✓		
	Catherine Creek	Viable	✓	✓	✓	✓		✓	✓		
	Upper Grande Ronde River	Maintained	✓	✓	✓	✓	✓	✓	✓		
	Imnaha River	Viable	✓	✓	✓	✓		✓	✓		
	Lookingglass Creek	Reintroduction	✓	✓	✓	✓		✓	✓		
	Big Sheep Creek	Reintroduction	✓	✓	✓	✓	✓	✓	✓		
South Fork Salmon River	Little Salmon River	Maintained	✓	✓	✓	✓			✓		
	SF Salmon River mainstem	Viable	✓	✓				✓	✓		
	Secesh River	Highly Viable		✓	✓						
	EFSF Salmon River	Maintained	✓	✓	✓			✓	✓		
Middle Fork Salmon River	Chamberlain Creek	Viable									✓
	Lower MF Salmon River	Maintained									✓
	Big Creek	Highly Viable		✓	✓	✓				✓	✓
	Camas Creek	Maintained	✓		✓	✓		✓			✓
	Loon Creek	Viable			✓						✓
	Upper MF Salmon River	Maintained									✓
	Sulphur Creek	Maintained				✓					✓
	Bear Valley Creek	Viable		✓				✓			✓
	Marsh Creek	Viable	✓			✓		✓			✓

MPG	Population	Recovery Plan Proposed Target	Limiting Factors								
			Riparian Condition	Excess Sediment	Passage Barriers	Low Summer Flow	Floodplain Connectivity	Instream Complexity Channel Alteration	Temperature	Toxics	Nutrient Deficiency
Upper Salmon River	NF Salmon River	Maintained	✓	✓	✓	✓		✓			
	Lemhi River	Viable	✓	✓	✓	✓	✓	✓	✓		
	Lower Salmon River Mainstem	Maintained	✓	✓	✓	✓	✓	✓	✓		
	Pahsimeroi River	Viable	✓	✓	✓	✓	✓	✓	✓	✓	
	EF Salmon River	Viable	✓	✓	✓	✓		✓	✓		
	Yankee Fork Salmon River	Maintained	✓				✓	✓			
	Valley Creek	Viable	✓	✓	✓	✓	✓	✓	✓		
	Upper Salmon River Mainstem	Highly Viable	✓	✓	✓	✓	✓	✓	✓		
	Panther Creek	Reintroduction			✓	✓		✓		✓	

2.2.1.2 Snake River fall-run Chinook Salmon

The Snake River fall Chinook salmon ESU was listed as threatened on April 22, 1992 (57 FR 14653). Several factors were responsible for the collapse of the species in the 19^{th} and 20^{th} centuries. First, fall Chinook salmon were harvested at high rates from the 1880s through the 1980s. Second, construction of the Swan Falls Dam and the Hells Canyon complex of dams in the early- to mid-1900s blocked access to the most productive spawning and rearing habitat and altered habitat conditions downstream. Construction of the Lewiston Dam on the Clearwater River in 1927 extirpated fall Chinook salmon within the Clearwater subbasin. Additional factors contributing to the decline of the species include: (1) Land use practices in the basin that have altered water quality, habitat quality and complexity, and reduced stream flows; and (2) high percentages of hatchery fish returning to natural spawning grounds (Good et al. 2005).

The Snake River fall Chinook salmon ESU occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. This ESU includes one extant population of fish spawning in the mainstem of the Snake River and the lower reaches of several of its major tributaries including the Tucannon, Grande Ronde, Clearwater, Salmon, and Imnaha Rivers. The ESU also includes four artificial propagation programs: the Lyons Ferry Hatchery and the Fall Chinook Acclimation Ponds Program in Washington; the Nez Perce Tribal Hatchery in Idaho; and the Oxbow Hatchery in Oregon and Idaho (70 FR 37160).

Life History. Snake River fall Chinook salmon enter the Columbia River in July and August, and migrate past the lower Snake River mainstem dams from August through November. Fish spawning takes place from October through early December in the mainstem of the Snake River, primarily between Asotin Creek and Hells Canyon Dam, and in the lower reaches of several of the associated major tributaries including the Tucannon, Grande Ronde, Clearwater, Salmon, and Imnaha Rivers (Connor and Burge 2003; Ford 2011). Spawning has occasionally been observed in the tailrace areas of the four mainstem dams (Dauble et al. 1999). Juveniles emerge from the gravels in March and April of the following year.

Until relatively recently, Snake River fall Chinook were assumed to follow an “ocean-type” life history (Dauble and Geist 2000; Good et al. 2005; Healey 1991; NMFS 1992) where they migrate to the Pacific Ocean during their first year of life, normally within 3 months of emergence from spawning substrate as age-0 smolts, to spend their first winter in the ocean. Ocean-type Chinook salmon juveniles tend to display a “rear as they go” rearing strategy in which they continually move downstream through shallow shoreline habitats their first summer and fall until they reach the ocean by winter (Connor and Burge 2003; Coutant and Whitney 2006). However, several studies have shown that another life history pattern exists where a significant number of smaller Snake River fall Chinook juveniles overwinter in Snake River reservoirs prior to outmigration. These fish begin migration later than most, arrest their seaward migration and overwinter in reservoirs on the Snake and Columbia Rivers, then resume migration and enter the ocean in early spring as age-1 smolts (Connor and Burge 2003; Connor et al. 2002; Connor et al. 2005; Hegg et al. 2013). Connor et al. (2005) termed this life history strategy “reservoir-type.” Scale samples from natural-origin adult fall Chinook salmon taken at Lower Granite Dam continue to indicate that approximately half of the returns overwintered in freshwater (Ford 2011). When overwintering in reservoirs, subyearling fish favor water less than 6 feet deep (Tiffan and Connor 2012).

Status of the Species. In the most recent status review, NMFS (2016a) lowered the species' risk of extinction from a moderate risk (i.e., maintained viability status) to a low risk (i.e., viable). This recommended change in viability is primarily due to substantial improvements in the abundance and productivity of the ESU through 2015. Even in light of the improvement in viability, NMFS determined the species should remain listed as threatened (81 FR 33468).

Spatial Structure and Diversity. Historically, this ESU likely consisted of two large populations; however, construction of the impassable Hells Canyon Dam complex extirpated the population that spawned in upstream sections of the mainstem Snake River (NMFS 2017b). The extant Lower Snake River fall Chinook salmon population consists of five historical major spawning areas (i.e., Upper Hells Canyon, Lower Hells Canyon, Clearwater River, Grande Ronde River, and Tucannon River). Currently, natural-original fish spawn in four of these major spawning areas. In the Tucannon, hatchery-marked recoveries account for virtually all of the redds, suggesting negligible natural-origin returns in that major spawning area. Because fish are able to access all of the major spawning areas, the spatial structure risk for the existing ESU is low and is not precluding recovery of the species.

There are several diversity concerns for Snake River fall Chinook salmon, leading to a moderate diversity risk rating for the Lower Snake population. One concern is the high proportion of hatchery fish spawning naturally; between 2010 and 2014, only 31 percent of spawners in the population were natural-origin, and hatchery-origin returns are widespread across the major spawning areas within the population (NWFSC 2015). The moderate diversity risk is also driven by changes in major life history patterns; shifts in phenotypic traits; high levels of genetic homogeneity in samples from natural-origin returns; selective pressure imposed by current hydropower operations; and cumulative harvest impacts (NWFSC 2015).

Abundance and Productivity. Historical abundance of Snake River fall Chinook salmon is estimated to have been 416,000 to 650,000 fish (NMFS 2006), but numbers declined drastically over the 20th century, with only 78 wild fish passing Lower Granite Dam in 1990 (WDFW and ODFW 2014). The first hatchery-reared Snake River fall Chinook salmon returned to the Snake River in 1981, and since then the number of hatchery returns has increased steadily, such that hatchery fish dominate the Snake River fall Chinook run. Natural returns have also increased.

The recent 10-year (2005–2014) mean abundance of natural-origin fall Chinook is 6,148 adult spawners. This is above the minimum viability goal of 4,200 spawners and is largely driven by relatively high numbers in the most recent 3 years (NWFSC 2015). In addition, observations of coastal ocean conditions suggest that the 2015–2017 outmigrant year classes experienced below-average ocean survival (NWFSC 2017). Current productivity estimated from 1990–2009 brood years is 1.5, meeting the ICTRT's abundance/productivity criteria for a viable population. This is lower than the proposed recovery criterion of 1.7 needed for highly viable status. These variations in conditions affecting early ocean survival coupled with high numbers of hatchery-origin fish on the spawning grounds introduce uncertainty in the future status of the species.

Recovery of the Species. NMFS (2017b) identified three scenarios for recovering this species. Recovery will either require the single population be "highly viable with high certainty" or will require reintroduction of a viable population above the Hells Canyon Dam complex (NWFSC 2015). To recover the species under a single population scenario, the Lower Snake population will need to have increased productivity and the diversity risks will need to be reduced. In order to achieve a low diversity risk, one or more major spawning areas must produce a significant level of natural-origin spawners with low influence by hatchery-origin spawners (NWFSC 2015).

The recovery plan identified ten management strategies for recovery of the species. These strategies address effects across the life cycle of the species (e.g., hatchery, habitat and hydropower, estuary, climate change, etc.); call for research, monitoring, and evaluation to better understand factors driving the abundance and productivity of the species, reduce uncertainty about the species status, and evaluate action effectiveness; and call for an adaptive management approach to recovery.

The recovery strategy for habitat is to maintain and improve spawning, incubation, rearing, and migration conditions by continuing ongoing actions and implement additional actions as appropriate. The recovery plan identified the following habitat limiting factors in freshwater: degraded water quality (i.e., elevated total dissolved gas, low dissolved oxygen, toxic pollutants, excess sediment, and excess nutrients), increased water temperatures, altered hydrologic regimes, low flows, loss of spawning and rearing habitat (either through blocked access or inundation), reduced habitat complexity and floodplain connectivity, and degraded riparian conditions. Actions to maintain and improve habitat have been, and will be, implemented primarily under consultations for the Columbia River Power System and the Hells Canyon Complex (NMFS 2017b).

2.2.1.3 Snake River Sockeye Salmon

This ESU includes all anadromous and residual sockeye salmon from the Snake River Basin in Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake captive propagation program. The ESU was first listed as endangered under the ESA in 1991, and the listing was reaffirmed in 2005 (70 FR 37160). Reasons for the decline of this species include high levels of historic harvest, dam construction including hydropower development on the Snake and Columbia Rivers, water diversions and water storage, predation on juvenile salmon in the mainstem river migration corridor, and active eradication of sockeye from some lakes in the 1950s and 1960s (56 FR 58619; ICTRT 2003).

Life History. Snake River sockeye salmon adults enter the Columbia River primarily during June and July, and arrive in the Sawtooth Valley peaking in August. The Sawtooth Valley supports the only remaining run of Snake River sockeye salmon. The adults spawn in lakeshore gravels, primarily in October (Bjornn et al. 1968). Eggs hatch in the spring between 80 and 140 days after spawning. Fry remain in the gravel for 3 to 5 weeks, emerge from April through May, and move immediately into the lake. Once there, juveniles feed on plankton for 1 to 3 years before they migrate to the ocean, leaving their natal lake in the spring from late April through May (Bjornn et al. 1968). Snake River sockeye salmon usually spend 2 to 3 years in the Pacific Ocean and return to Idaho in their 4^{th} or 5^{th} year of life.

Status of the Species. On May 26, 2016, in the agency's most recent 5-year review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as endangered (81 FR 33468).

Spatial Structure and Diversity. Within the Snake River ESU, the ICTRT identified historical sockeye salmon production in five Sawtooth Valley lakes, in addition to Warm Lake and the Payette Lakes in Idaho and Wallowa Lake in Oregon (ICTRT 2003). The sockeye runs to Warm, Payette, and Wallowa Lakes are now extinct, and the ICTRT identified the Sawtooth Valley lakes as a single MPG for this ESU. The MPG consists of the Redfish, Alturas, Stanley, Yellowbelly, and Pettit Lake populations (ICTRT 2007). The only extant population is Redfish Lake, supported by a captive broodstock program. Hatchery fish from the Redfish Lake captive propagation program have also been outplanted in Alturas and Pettit Lakes since the mid-1990s in an attempt to reestablish those populations (Ford 2011). The Northwest Fisheries Science Center (2015) reports some evidence of very low levels of early-timed returns in some recent years from outmigrating naturally-produced Alturas Lake smolts, but the ESU remains at high risk for spatial structure.

Currently, the Snake River sockeye salmon run is highly dependent on a captive broodstock program operated at the Sawtooth Hatchery and Eagle Hatchery. Although the captive brood program rescued the ESU from the brink of extinction, diversity risk remains high without sustainable natural production (Ford 2011; NWFSC 2015).

Abundance and Productivity. Prior to the turn of the 20th century (ca. 1880), around 150,000 sockeye salmon ascended the Snake River to the Wallowa, Payette, and Salmon River basins to spawn in natural lakes (Evermann 1896, as cited in Chapman et al. 1990). The Wallowa River sockeye run was considered extinct by 1905; the Payette River run was blocked by Black Canyon Dam on the Payette River in 1924; and anadromous Warm Lake sockeye in the South Fork Salmon River basin may have been trapped in Warm Lake by a land upheaval in the early 20th century (ICTRT 2003). In the Sawtooth Valley, the Idaho Department of Fish and Game eradicated sockeye from Yellowbelly, Pettit, and Stanley Lakes in favor of other species in the 1950s and 1960s, and irrigation diversions led to the extirpation of sockeye in Alturas Lake in the early 1900s (ICTRT 2003), leaving only the Redfish Lake sockeye. From 1991 to 1998, a total of just 16 wild adult anadromous sockeye salmon returned to Redfish Lake. These 16 wild fish were incorporated into a captive broodstock program that began in 1992 and has since expanded so that the program currently releases hundreds of thousands of juvenile fish each year in the Sawtooth Valley (Ford 2011) (Figure 1).

With the increase in hatchery production, adult returns to Sawtooth Valley have increased, ranging from a low of 257 adults in 2012 (including 52 natural-origin fish) to a high of 1,579 adults in 2014 (including 453 natural-origin fish) (NWFSC 2015). In 2015, the largest number of Snake River sockeye salmon in recent history (4,093 adults) passed Bonneville Dam; however, high instream water temperatures resulted in only 1 percent survival during migration to Lower Granite Dam. To avoid high instream water temperatures that existing in the upstream migratory corridor, adult salmon were captured at Lower Granite Dam and trucked to the Sawtooth Valley. The implications of this high mortality for the recovery of the species are uncertain and depend on the frequency of similar high water temperatures in future years (NWFSC 2015).

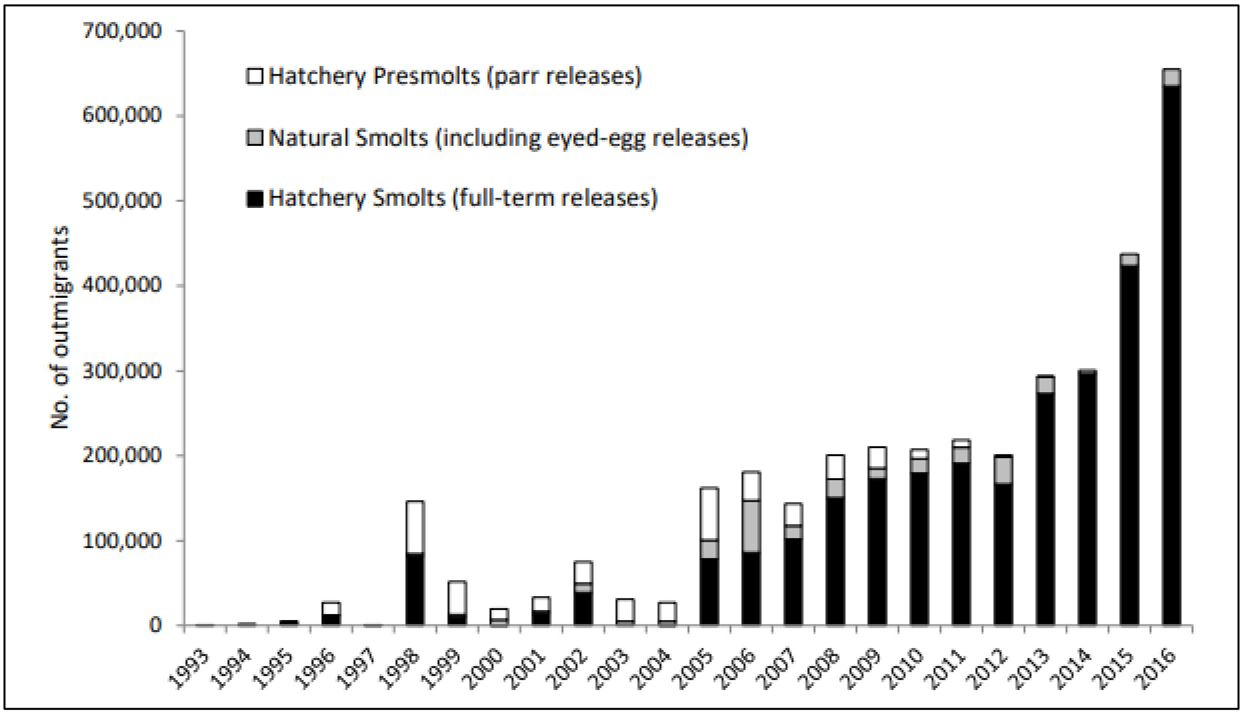

Figure 1. Estimated annual numbers of sockeye salmon smolt outmigrants from the Sawtooth Valley basin (Johnson et al. 2017).

In recent years, the total sockeye salmon returns to the Sawtooth Valley have been high enough to allow for some level of spawning in Redfish Lake; however, there are insufficient returns to support sustained outplanting (NMFS 2015a). The hatchery program remains focused on genetic conservation and building sufficient returns to allow for large scale reintroduction into Redfish Lake. Because returns are dominated by production from the captive spawning component and because levels of naturally produced sockeye returns remain extremely low (NWFSC 2015), the ESU remains at high risk for both abundance and productivity.

Recovery of the Species. NMFS released a final recovery plan for this ESU in 2015. The long-term recovery objectives for this ESU are framed in terms of natural production. The ICTRT (2007) set the minimum spawning abundance threshold at 1,000 natural-origin spawners, measured as a 10-year geometric mean, for the Redfish and Alturas Lake populations. For smaller lakes (Pettit, Yellowbelly, and Stanley), the minimum spawning abundance threshold is 500 natural-origin spawners.

The recovery scenario entails restoring at least two of the three historical lake populations to highly viable and one to viable status using Redfish Lake, Alturas Lake, and Petit Lake (NMFS 2015a). In order to achieve this, substantial increases in survival rates across all life history stages must occur (NWFSC 2015). In particular, juvenile and adult losses during travel through the Salmon, Snake, and Columbia River migration corridor continue to present a significant threat to species recovery (NMFS 2015a). NMFS (2015a) identified the following habitat limiting factors for this species: blocked access to natal lakes; elevated sediment; altered hydrologic regimes and reduced streamflow; increased stream temperatures and reduced thermal refugia; toxic contaminants; degraded riparian condition and instream habitat complexity; altered foodwebs; and reduced floodplain function.

2.2.1.4 Snake River Basin Steelhead

The Snake River Basin steelhead was listed as a threatened ESU on August 18, 1997 (62 FR 43937), with a revised listing as a DPS on January 5, 2006 (71 FR 834). Many factors led to NMFS' conclusion that Snake River Basin steelhead were threatened, including: (1) Abundance of naturally produced steelhead had dropped to a small fraction of historical levels; (2) parr densities declined and many river basins in Idaho were considered to be critically underseeded relative to the carrying capacity of streams; (3) short-term projections were for a continued downward trend in abundance; (4) hydroelectric development on the Snake and Columbia Rivers substantially impacted migrations; (5) habitat degradation and altered flow regimes existed throughout the region; and (6) proportion of hatchery fish in the ESU was high (Good et al. 2005; Ford 2011).

This DPS occupies the Snake River basin, which drains portions of southeastern Washington, northeastern Oregon, and north/central Idaho. This species includes all naturally-spawning steelhead populations below natural and manmade impassable barriers in streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho, as well as the progeny of six artificial propagation programs (71FR834). The hatchery programs include Dworshak National Fish Hatchery, Lolo Creek, North Fork Clearwater River, East Fork Salmon River, Tucannon River, and the Little Sheep Creek/Imnaha River steelhead hatchery programs. The Snake River Basin steelhead listing does not include resident forms of *O. mykiss* (rainbow trout) co-occurring with steelhead.

Life History. Adult Snake River Basin steelhead enter the Columbia River from late June to October to begin their migration inland. After holding over the winter in larger rivers in the Snake River basin, steelhead disperse into smaller tributaries to spawn from March through May. Earlier dispersal occurs at lower elevations and later dispersal occurs at higher elevations. Juveniles emerge from the gravels in 4 to 8 weeks, and move into shallow, low-velocity areas in side channels and along channel margins to escape high velocities and predators (Everest and Chapman 1972). Juvenile steelhead then progressively move toward deeper water as they grow in size (Bjornn and Rieser 1991). Juveniles typically reside in fresh water for 1 to 3 years, although this species displays a wide diversity of life histories. Smolts migrate downstream during spring runoff, which occurs from March to mid-June depending on elevation, and typically spend 1 to 2 years in the ocean.

Status of the Species. On May 26, 2016, in the agency's most recent 5-year status review for Pacific salmon and steelhead, NMFS concluded that the species should remain listed as threatened (81 FR 33468). The ICTRT identified 24 extant populations within this DPS, organized into five MPGs (ICTRT 2003). The ICTRT also identified a number of potential historical populations associated with watersheds above the Hells Canyon Dam complex on the mainstem Snake River, a barrier to anadromous migration. These populations were associated with the Hells Canyon MPG, which is extirpated. The five MPGs with extant populations are the Clearwater River, Salmon River, Grande Ronde River, Imnaha River, and Lower Snake River. In the Clearwater River, the historic North Fork population was blocked from accessing spawning and rearing habitat by Dworshak Dam. Table 5 shows the current risk ratings assigned to the populations' VSP parameters for each extant MPG.

Table 5. Summary of viable salmonid population parameter risks and overall current status for each population in the Snake River Basin steelhead DPS (NWFSC 2015). Risk ratings with "?" are based on limited or provisional data series.

MPG	Population	VSP Risk Parameter		Overall Viability Rating
		Abundance/ Productivity	Spatial Structure/ Diversity	
Lower Snake River	Tucannon River	High?	Moderate	High Risk?
	Asotin Creek	Moderate?	Moderate	Maintained?
Grande Ronde River	Lower Grande Ronde	N/A	Moderate	Maintained?
	Joseph Creek	Very Low	Low	**Highly Viable**
	Wallowa River	N/A	Low	Maintained?
	Upper Grande Ronde	Low	Moderate	**Viable**
Imnaha River	Imnaha River	Moderate?	Moderate	Maintained?
Clearwater River (Idaho)	Lower Mainstem Clearwater River*	Moderate?	Low	Maintained?
	South Fork Clearwater River	High?	Moderate	High Risk?
	Lolo Creek	High?	Moderate	High Risk?
	Selway River	Moderate?	Low	Maintained?
	Lochsa River	Moderate?	Low	Maintained?
	North Fork Clearwater River			*Extirpated*
Salmon River (Idaho)	Little Salmon River	Moderate?	Moderate	Maintained?
	South Fork Salmon River	Moderate?	Low	Maintained?
	Secesh River	Moderate?	Low	Maintained?
	Chamberlain Creek	Moderate?	Low	Maintained?
	Lower Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Upper Middle Fork Salmon R.	Moderate?	Low	Maintained?
	Panther Creek	Moderate?	High	High Risk?
	North Fork Salmon River	Moderate?	Moderate	Maintained?
	Lemhi River	Moderate?	Moderate	Maintained?
	Pahsimeroi River	Moderate?	Moderate	Maintained?
	East Fork Salmon River	Moderate?	Moderate	Maintained?
	Upper Mainstem Salmon R.	Moderate?	Moderate	Maintained?

*Current abundance/productivity estimates for the Lower Clearwater Mainstem population exceed minimum thresholds for viability, but the population is assigned moderate risk for abundance/productivity due to the high uncertainty associated with the estimate.

Spatial Structure and Diversity. Current steelhead distribution extends throughout the DPS and natural production is evident in the majority of populations. As such, the spatial structure ratings were low or very low. The only exception was the Panther Creek population, which was given a high risk rating for this parameter based on the lack of spawning in the upper section.

Both the life-history diversity and hatchery-spawner fractions are two important factors for assessing diversity risk. Snake River Basin steelhead exhibit diverse life-history strategies, including variations in fresh water and ocean residence times. Traditionally, fisheries managers have classified Snake River Basin steelhead into two groups, A-run and B-run, based on ocean age at return, adult size at return, and migration timing. A-run steelhead predominantly spend 1-year in the ocean; B-run steelhead are larger with most individuals returning after 2 years in the ocean. New information shows that most Snake River populations support a mixture of the two run types, with the highest percentage of B-run fish in the upper Clearwater River and the South Fork Salmon River; moderate percentages of B-run fish in the Middle Fork Salmon River; and very low percentages of B-run fish in the Upper Salmon River, Grande Ronde River, and Lower Snake River (NWFSC 2015). Maintaining life history diversity is important for the recovery of the species.

Large numbers of hatchery steelhead are released in the Snake River, and the relative proportion of hatchery adults in natural spawning areas near major hatchery release sites remains uncertain. Hatchery straying appears to be relatively low. Moderate diversity risks for some populations are driven by the high proportion of hatchery fish on natural spawning grounds and the uncertainty regarding these estimates (NWFSC 2015). Reductions in hatchery-related diversity risks would increase the likelihood of these populations reaching viable status.

Abundance and Productivity. Historical estimates of steelhead production for the entire Snake River basin are not available, but the basin is believed to have supported more than half the total steelhead production from the Columbia River basin (Mallet 1974, as cited in Good et al. 2005). Historical estimates of steelhead passing Lewiston Dam (removed in 1973) on the lower Clearwater River were 40,000 to 60,000 adults (Ecovista et al. 2003), and the Salmon River basin likely supported substantial production as well (Good et al. 2005). In contrast, at the time of listing in 1997, the 5-year mean abundance for natural-origin steelhead passing Lower Granite Dam, which includes all but one population in the DPS, was 11,462 adults (Ford 2011). Counts have increased since then, with between roughly 23,000 and 44,000 adult wild steelhead passing Lower Granite Dam in the most recent 5-year period (2011–2015) (NWFSC 2015).

Population-specific abundance estimates exist for some but not all populations. Of the populations for which we have data, three (Joseph Creek, Upper Grande Ronde, and Lower Clearwater) are meeting minimum abundance/productivity thresholds and several more have likely increased in abundance enough to reach moderate risk. Despite these recent increases in abundance, the status of many of the individual populations remains uncertain, and four out of the five MPGs are not meeting viability objectives (NWFSC 2015). In order for the species to recover, more populations will need to reach viable status through increases in abundance and productivity.

Recovery of the Species. NMFS released a final recovery plan for this species in November of 2017. Four of the five MPGs are not meeting specific recovery plan objectives based on the updated status information. Furthermore, the status of many individual populations remains uncertain. The Grande Ronde MPG is tentatively rated as achieving viable status (NWFSC 2015), although additional work is needed to have greater certainty in population-specific abundance and productivity estimates. In order to recover, each extant MPG should include viable populations with all major life history groups present. In addition, the viable populations should include proportional representation of large and very large populations historically present (NWFSC 2015). Because MPG viability may be achieved through several different combinations of viable populations, Table 6 below summarizes the number of populations within the MPG that must meet the highly viable, viable, and maintained viability statuses.

Table 6. The number of populations in each MPG, along with the number of populations needing to achieve each specific viability status in order for the MPG to be viable

MPG	Total # of Extant Populations	Highly Viable (# of Populations)	Viable (# of Populations)	Maintained (# of Populations)
Lower Snake	2	1	1	0
Grande Ronde	4	1	1	2
Imnaha River	1	1	0	0
Clearwater River	5	1	2	2
Salmon River	12	1	5	6

[1]A population's viability status is based on its extinction risk: highly viable (less than 1 percent risk of extinction in 100 years); viable (5 percent or less risk of extinction), and maintained (6–25 percent risk of extinction).

In order to achieve the recovery goals, the underlying limiting factors and threats must be addressed. The factors and threats limiting the recovery of Snake River Basin steelhead are substantially similar to those limiting the recovery of Snake River spring/summer Chinook salmon. Broadly speaking, the limiting factors include survival through the Columbia River system; blocked habitat; increased stream temperature and reduced thermal refugia; altered hydrologic regimes and reduced streamflow; toxic contaminants; degraded riparian condition and instream habitat complexity; altered foodwebs; and reduced floodplain function.

2.2.2 Status of Critical Habitat

In evaluating the condition of designated critical habitat, NMFS examines the condition and trends of PBFs which are essential to the conservation of the ESA-listed species because they support one or more life stages of the species. Proper function of these PBFs is necessary to support successful adult and juvenile migration, adult holding, spawning, incubation, rearing, and the growth and development of juvenile fish. Modification of PBFs may affect freshwater spawning, rearing or migration in the action area. Generally speaking, sites required to support one or more life stages of the ESA-listed species (i.e., sites for spawning, rearing, or migration) contain PBFs essential to the conservation of the listed species (e.g., spawning gravels, water quality and quantity, side channels, or food) (Table 7).

Table 7. Types of sites, essential physical and biological features, and the species life stage each PBF supports.

Site	Essential Physical and Biological Features	Species Life Stage
Snake River Basin Steelhead[a]		
Freshwater spawning	Water quality, water quantity, and substrate	Spawning, incubation, and larval development
Freshwater rearing	Water quantity & floodplain connectivity to form and maintain physical habitat conditions	Juvenile growth and mobility
	Water quality and forage[b]	Juvenile development
	Natural cover[c]	Juvenile mobility and survival
Freshwater migration	Free of artificial obstructions, water quality and quantity, and natural cover[c]	Juvenile and adult mobility and survival
Snake River Spring/Summer Chinook, Fall Chinook, & Sockeye Salmon		
Spawning & Juvenile Rearing	Spawning gravel, water quality and quantity, cover/shelter (Chinook only), food, riparian vegetation, space (Chinook only), water temperature, and access (sockeye only)	Juvenile and adult
Migration	Substrate, water quality and quantity, water temperature, water velocity, cover/shelter, food[d], riparian vegetation, space, and safe passage	Juvenile and adult

[a] Additional PBFs pertaining to estuarine, nearshore, and offshore marine areas have also been described for Snake River steelhead and Middle Columbia steelhead. These PBFs will not be affected by the proposed action and have therefore not been described in this Opinion.
[b] Forage includes aquatic invertebrate and fish species that support growth and maturation.
[c] Natural cover includes shade, large wood, log jams, beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
[d] Food applies to juvenile migration only.

Table 8 describes the geographical extent of critical habitat within the Snake River basin for each of the four ESA-listed salmon and steelhead species. In addition, designated critical habitat for these species includes the Columbia River from the Pacific Ocean to its confluence with the Snake River. Critical habitat includes the stream channel and water column with the lateral extent defined by the ordinary high-water line, or the bankfull elevation where the ordinary high-water line is not defined. Furthermore, critical habitat for the three salmon species includes the adjacent riparian zone, which is defined as the area within 300 feet of the line of high water of a stream channel or from the shoreline of standing body of water (58 FR 68543). The riparian zone is critical because it provides shade, streambank stability, organic matter input, and regulation of sediment, nutrients, and chemicals.

Table 8. Geographical extent of designated critical habitat within the Snake River for ESA-listed salmon and steelhead.

ESU/DPS	Designation	Geographical Extent of Critical Habitat
Snake River sockeye salmon	58 FR 68543; December 28, 1993	Snake River to its confluence with the Salmon River; Salmon River from its confluence with the Snake to its confluence with Alturas Lake Creek; Alturas Lake Creek; Valley Creek; Stanley, Redfish, Yellowbelly, Pettit, and Alturas Lakes; and all inlet/outlet creeks to those lakes.
Snake River spring/summer Chinook salmon	58 FR 68543; December 28, 1993. 64 FR 57399; October 25, 1999.	All Snake River reaches upstream to Hells Canyon Dam; all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Salmon River basin; and all river reaches presently or historically accessible to Snake River spring/summer Chinook salmon within the Hells Canyon, Imnaha, Lower Grande Ronde, Upper Grande Ronde, Lower Snake-Asotin, Lower Snake-Tucannon, and Wallowa subbasins.
Snake River fall Chinook salmon	58 FR 68543; December 28, 1993	Snake River to Hells Canyon Dam; Palouse River from its confluence with the Snake River upstream to Palouse Falls; Clearwater River from its confluence with the Snake River upstream to Lolo Creek; North Fork Clearwater River from its confluence with the Clearwater River upstream to Dworshak Dam; and all other river reaches presently or historically accessible within the Lower Clearwater, Hells Canyon, Imnaha, Lower Grande Ronde, Lower Salmon, Lower Snake, Lower Snake–Asotin, Lower North Fork Clearwater, Palouse, and Lower Snake–Tucannon subbasins.
Snake River Basin steelhead	70 FR 52630; September 2, 2005	Specific stream reaches are designated within the Lower Snake, Salmon, and Clearwater River basins. Table 21 in the Federal Register details habitat areas within the DPS's geographical range that are excluded from critical habitat designation.

Spawning and rearing habitat quality in tributary streams in the Snake River basin varies from excellent in wilderness and roadless areas to poor in areas subject to human land uses (NMFS 2016a; NMFS 2017a;). Intensive agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and maintenance, logging, mining, and urbanization have degraded critical habitat throughout much of the Snake River. Reduced summer streamflows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in non-wilderness areas. Human land use practices throughout the basin have caused streams to become straighter, wider, and shallower, thereby reducing rearing habitat and increasing water temperature fluctuations.

Many stream reaches designated as critical habitat are over-allocated, with more allocated water rights than existing stream flow. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increases summer stream temperatures, blocks fish migration, strands fish, and alters sediment transport (Spence et al. 1996). Reduced tributary streamflow has been identified as a major limiting factor for Snake River spring/summer Chinook and Snake River Basin steelhead in particular (NMFS 2017a).

Many stream reaches designated as critical habitat for these species are listed on the CWA 303(d) list for impaired water quality, such as elevated water temperature (IDEQ 2018a). Many areas that were historically suitable rearing and spawning habitat are now unsuitable due to high summer stream temperatures, such as some stream reaches in the Upper Grande Ronde. Removal of riparian vegetation, alteration of natural stream morphology, and withdrawal of water for agricultural or municipal use all contribute to elevated stream temperatures. Water quality in spawning and rearing areas in the Snake River has also been impaired by high levels of sediment and by heavy metal contamination from mine waste (e.g., IDEQ and EPA 2003; IDEQ 2001).

The construction and operation of water storage and hydropower projects in the Columbia River basin, including the run-of-river dams on the mainstem lower Snake and lower Columbia Rivers, have altered biological and physical attributes of the mainstem migration corridor. These alterations have affected juvenile migrants to a much larger extent than adult migrants. However, changing temperature patterns have created passage challenges for summer migrating adults in recent years, requiring new structural and operational solutions (i.e., cold water pumps and exit "showers" for ladders at Lower Granite and Lower Monumental dams). Actions taken since 1995 that have reduced negative effects of the hydrosystem on juvenile and adult migrants including:

- Minimizing winter drafts (for flood risk management and power generation) to increase flows during peak spring passage;
- Releasing water from storage to increase summer flows;
- Releasing water from Dworshak Dam to reduce peak summer temperatures in the lower Snake River;
- Constructing juvenile bypass systems to divert smolts, steelhead kelts, and adults that fall back over the projects away from turbine units;
- Providing spill at each of the mainstem dams for smolts, steelhead kelts, and adults that fall back over the projects;
- Constructing “surface passage” structures to improve passage for smolts, steelhead kelts, and adults falling back over the projects; and
- Maintaining and improving adult fishway facilities to improve migration passage for adult salmon and steelhead.

The condition of critical habitat will need to improve throughout its designation in order to recover Snake River Basin steelhead, Snake River sockeye salmon, Snake River fall Chinook salmon, and Snake River spring/summer Chinook salmon. Efforts for restoring designated critical habitat should focus on the habitat limiting factors identified in recently published recovery plans (NMFS 2017a; 2017b; and 2015a).

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

One factor affecting the rangewide status of Snake River salmon and steelhead and their critical habitat is climate change. For the period 1901–2016, the annual average temperature over the contiguous U.S. increased by about 1.8°F (1.0°C) (Vose et al. 2017). In the Pacific Northwest, annual average temperatures are predicted to increase by 4.67°F (2.59°C) in the mid-Century (2036–2065) relative to average annual temperatures documented for the near-present (1976–2005) (Wuebbles et al. 2017). The U. S. Global Change Research Program projects an increase in average annual temperature of 3.3°F to 9.7°F by 2070 to 2099 (CCSP 2014).

Several studies have revealed that climate change is occurring and accelerating and that it 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 cause the following:

- Warmer air temperatures, which in turn will result in diminished snowpack and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season;

- Lower stream flows in the June through September period due to smaller snowpacks;

- Higher flows in winter and possibly higher peak flows as a result of more precipitation falling as rain rather than snow; and

- Warmer water temperatures are expected to rise, especially during the summer months when lower flows co-occur with warmer air temperatures.

The above habitat impacts have negative implications for ESA-listed anadromous fishes in the Pacific Northwest (Climate Impacts Group 2004; Scheuerell and Williams 2005; Zabel et al. 2006; ISAB 2007). Long-term effects include, but are not limited to, depletion of important cold-water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species.

Anadromous salmonids have complex life cycles; they rely on productive freshwater, estuarine, and marine habitats for growth and survival, making them particularly vulnerable to environmental variation. Climate change is predicted to cause a variety of impacts to Pacific salmon (including steelhead) and their ecosystems (Mote et al. 2003; Crozier et al. 2008a; Martins et al. 2012; Wainwright and Weitkamp 2013). Ultimately, the effects of climate change on salmon and steelhead across the Pacific Northwest will be determined by the specific nature, level, and rate of change and the synergy between interconnected terrestrial/freshwater, estuarine, nearshore, and ocean environments.

The primary effects of climate change on Pacific Northwest salmon and steelhead include:

- Direct effects of increased water temperatures on fish physiology;
- Temperature-induced changes to streamflow patterns;
- Alterations to freshwater, estuarine, and marine food webs; and
- Changes in estuarine and ocean productivity.

While all habitats used by Pacific salmon will be affected, the impacts and certainty of the change vary by habitat type. Some effects (e.g., increasing temperature) affect salmon at all life stages in all habitats, while others are habitat-specific, such as streamflow variation in freshwater, sea-level rise in estuaries, and upwelling in the ocean. How climate change will affect each stock or population of salmon also varies widely depending on the level or extent of change, the rate of change, and the unique life-history characteristics of different natural populations (Crozier et al. 2008b). For example, a few weeks' difference in migration timing can have large differences in the thermal regime experienced by migrating fish (Martins et al. 2011).

2.2.3.1 Temperature Effects

Like most fishes, salmon are poikilotherms (i.e., cold-blooded animals); therefore, increasing temperatures in all habitats can have pronounced effects on their physiology, growth, and development rates (see review by Whitney et al. 2016). Increases in water temperatures beyond their thermal optima will likely be detrimental through a variety of processes, including increased metabolic rates (and therefore food demand), decreased disease resistance, increased physiological stress, and reduced reproductive success. All of these processes are likely to reduce survival (Beechie et al. 2013; Wainwright and Weitkamp 2013; Whitney et al. 2016).

By contrast, increased temperatures can increase growth and development rates. Examples of this include accelerated emergence timing during egg incubation stages, or increased growth rates during fry stages (Crozier et al. 2008a; Martins et al. 2011). Temperature is also an important behavioral cue for migration (Sykes et al. 2009), and elevated temperatures may result in earlier-than-normal migration timing. While there are situations or stocks where this acceleration in processes or behaviors is beneficial, there are also others where it is detrimental (Martins et al. 2012; Whitney et al. 2016).

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).

2.2.3.2 Freshwater Effects

Climate change is predicted to increase the intensity of storms, reduce winter snow pack at low and middle elevations, and increase snowpack at high elevations in northern areas. Middle and lower-elevation streams will have larger fall/winter flood events and lower late-summer flows, while higher elevations may have higher minimum flows.

How these changes will affect freshwater ecosystems largely depends on their specific characteristics and location, which vary at fine spatial scales (Crozier et al. 2008b; Martins et al. 2012). For example, within a relatively small geographic area (the Salmon River basin in Idaho), survival of some Chinook salmon populations was shown to be determined largely by temperature, while in others it was determined by flow (Crozier and Zabel 2006). Certain salmon populations inhabiting regions that are already near or exceeding thermal maxima will be most affected by further increases in temperature and, perhaps, the rate of the increases. The effects of altered flow are less clear and likely to be basin-specific (Crozier et al. 2008b; Beechie et al. 2013). However, flow is already becoming more variable in many rivers, and this increased variability is believed to negatively affect anadromous fish survival more than other environmental parameters (Ward et al. 2015). It is likely this increasingly variable flow is detrimental to multiple salmon and steelhead populations, and likely multiple other freshwater fish species in the Columbia River basin as well.

Stream ecosystems will likely change in response to climate change in ways that are difficult to predict (Lynch et al. 2016). Changes in stream temperature and flow regimes will likely lead to shifts in the distributions of native species and provide "invasion opportunities" for exotic species. This will result in novel species interactions, including predator-prey dynamics, where juvenile native species may be either predators or prey (Lynch et al. 2016; Rehage and Blanchard 2016). How juvenile native species will fare as part of "hybrid food webs," which are constructed from natives, native invaders, and exotic species, is difficult to predict (Naiman et al. 2012).

2.2.3.3 Estuarine Effects

In estuarine environments, the two big concerns associated with climate change are rates of sea level rise and water temperature warming (Wainwright and Weitkamp 2013; Limburg et al. 2016). Estuaries will be affected directly by sea-level rise: as sea level rises, terrestrial habitats will be flooded and tidal wetlands will be submerged (Kirwan et al. 2010; Wainwright and Weitkamp 2013; Limburg et al. 2016). The net effect on wetland habitats depends on whether rates of sea-level rise are sufficiently slow that the rates of marsh plant growth and sedimentation can compensate (Kirwan et al. 2010).

Due to subsidence, sea-level rise will affect some areas more than others, with the largest effects expected for the lowlands, like southern Vancouver Island and central Washington coastal areas (Verdonck 2006; Lemmen et al. 2016). The widespread presence of dikes in Pacific Northwest estuaries will restrict upward estuary expansion as sea levels rise, likely resulting in a near-term loss of wetland habitats (Wainwright and Weitkamp 2013). Sea-level rise will also result in greater intrusion of marine water into estuaries, resulting in an overall increase in salinity, which will also contribute to changes in estuarine floral and faunal communities (Kennedy 1990). While not all anadromous fish species are highly reliant on estuaries for rearing, extended estuarine use may be important in some populations (Jones et al. 2014), especially if stream habitats are degraded and become less productive. Preliminary data indicate that some Snake River Basin steelhead smolts actively feed and grow as they migrate between Bonneville Dam and the ocean (Beckman et al. 2018), suggesting that estuarine habitat is important for these ESA-listed fish species.

2.2.3.4 Marine Effects

In marine waters, increasing temperatures are associated with observed and predicted poleward range expansions of fish and invertebrates in both the Atlantic and Pacific Oceans (Lucey and Nye 2010; Asch 2015; Cheung et al. 2015). Rapid poleward species shifts in distribution in response to anomalously warm ocean temperatures have been well documented in recent years, confirming this expectation at short time scales. Range extensions were documented in many species from southern California to Alaska during unusually warm water associated with "the blob" in 2014 and 2015 (Bond et al. 2015; Di Lorenzo and Mantua 2016) and past strong El Niño events (Pearcy 2002; Fisher et al. 2015). For example, recruitment of the introduced European green crab increased in Washington and Oregon waters during winters with warm surface waters, including 2014 (Yamada et al. 2015). Similarly, the Humboldt squid dramatically expanded its range northward during warm years of 2004–09 (Litz et al. 2011). The frequency of extreme conditions, such as those associated with El Niño events or "blobs" is predicted to increase in the future (Di Lorenzo and Mantua 2016), further altering food webs and ecosystems.

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). These effects will certainly occur, but predicting the composition or outcomes of future trophic interactions is not possible with current models.

Wind-driven upwelling is responsible for the extremely high productivity in the California Current ecosystem (Bograd et al. 2009; Peterson et al. 2014). Minor changes to the timing, intensity, or duration of upwelling, or the depth of water-column stratification, can have dramatic effects on the productivity of the ecosystem (Black et al. 2015; Peterson et al. 2014). Current projections for changes to upwelling are mixed: some climate models show upwelling unchanged, but others predict that upwelling will be delayed in spring, and more intense during summer (Rykaczewski et al. 2015). Should the timing and intensity of upwelling change in the future, it may result in a mismatch between the onset of spring ecosystem productivity and the timing of salmon entering the ocean, and a shift toward food webs with a strong sub-tropical component (Bakun et al. 2015).

Columbia River anadromous fishes also use coastal areas of British Columbia and Alaska and midocean marine habitats in the Gulf of Alaska, although their fine-scale distribution and marine ecology during this period are poorly understood (Morris et al. 2007; Pearcy and McKinnell 2007). Increases in temperature in Alaskan marine waters have generally been associated with increases in productivity and salmon survival (Mantua et al. 1997; Martins et al. 2012), thought to result from temperatures that are normally below thermal optima (Gargett 1997). Warm ocean temperatures in the Gulf of Alaska are also associated with intensified downwelling and increased coastal stratification, which may result in increased food availability to juvenile salmon along the coast (Hollowed et al. 2009; Martins et al. 2012). Predicted increases in freshwater discharge in British Columbia and Alaska may influence coastal current patterns (Foreman et al. 2014), but the effects on coastal ecosystems are poorly understood.

In addition to becoming warmer, the world's oceans are becoming more acidic as increased atmospheric carbon dioxide is absorbed by water. The North Pacific is already acidic compared to other oceans, making it particularly susceptible to further increases in acidification (Lemmen et al. 2016). Laboratory and field studies of ocean acidification show that it has the greatest effects on invertebrates with calcium-carbonate shells, and has relatively little direct influence on finfish; see reviews by Haigh et al. (2015) and Mathis et al. (2015). Consequently, the largest impact of ocean acidification on salmon will likely be the influence on marine food webs, especially the effects on lower trophic levels (Haigh et al. 2015; Mathis et al. 2015). Marine invertebrates fill a critical gap between freshwater prey and larval and juvenile marine fishes, supporting juvenile salmon growth during the important early-ocean residence period (Daly et al. 2009, 2014).

2.2.3.5 Uncertainty in Climate Predictions

There is considerable uncertainty in the predicted effects of climate change on the globe as a whole, and on the Pacific Northwest in particular. Many of the effects of climate change (e.g., increased temperature, altered flow, coastal productivity, etc.) will have direct impacts on the food webs that species rely on in freshwater, estuarine, and marine habitats to grow and survive. Such ecological effects are extremely difficult to predict even in fairly simple systems, and minor differences in life-history characteristics among stocks of salmon may lead to large differences in their response (e.g., Crozier et al. 2008b; Martins et al. 2011, 2012). This means it is likely that there will be "winners and losers," meaning some salmon populations may enjoy different degrees or levels of benefit from climate change while others will suffer varying levels of harm.

Climate change is expected to impact anadromous fishes during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty. In additional to physical and biological effects, there is also the question of indirect effects of climate change and whether human "climate refugees" will move into the range of salmon and steelhead, increasing stresses on their respective habitats (Dalton et al. 2013; Poesch et al. 2016).

2.2.3.6 Summary

Climate change is expected to impact Pacific Northwest anadromous fishes during all stages of their complex life cycle. In addition to the direct effects of rising temperatures, indirect effects include alterations in stream-flow patterns in freshwater and changes to food webs in freshwater, estuarine, and marine habitats. There is high certainty that predicted physical and chemical changes will occur; however, the ability to predict bio-ecological changes to fish or food webs in response to these physical/chemical changes is extremely limited, leading to considerable uncertainty. As we continue to deal with a changing climate, management actions may help alleviate some of the potential adverse effects (e.g., hatcheries serving as a genetic reserve and source of abundance for natural populations, increased riparian vegetation to control water temperatures, etc.).

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 homogenous, effects of climate change are expected to decrease the capacity of critical habitat to support successful spawning, rearing, and migration. How climate change will affect each population of salmon varies widely depending on the level or extent of change, the rate of change, and the unique life-history characteristics of the populations (Crozier et al. 2008a). Current research looking at species-specific vulnerability to climate change will help guide future species recovery planning efforts.

Habitat restoration 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).

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 Idaho WQS apply to all surface waters within Idaho's boundaries; however ESA-listed species and designated critical habitat under NMFS' jurisdiction are only located in the Salmon River basin and in portions of the Lower Snake and Clearwater Basins (Figure 2). The IDEQ may authorize mixing zones in any surface waterbody so long as the authorization is compliant with the mixing zone rule provisions. Although effects of mixing zones are limited to discrete areas within the mixing zone boundary, it is impossible to know where mixing zones may be authorized in the future. As such, for the purposes of this Opinion, the action area includes all surface waters in Idaho that are: (1) Occupied by ESA-listed anadromous fish; (2) designated as critical habitat; or (3) are located upstream of occupied or designated critical habitat where authorized mixing zones may extend to surface waters that support ESA-listed resources.

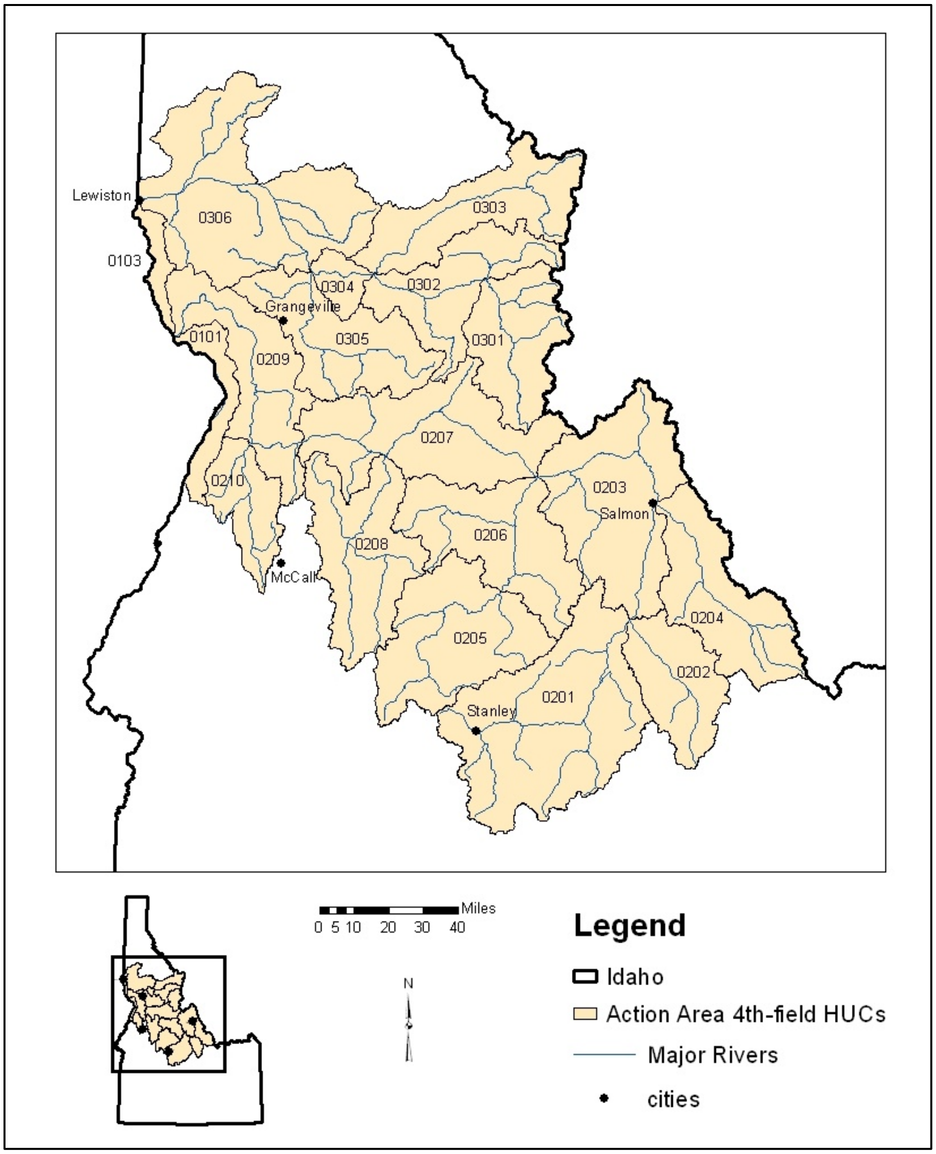

Figure 2. Fourth-field HUCs supporting listed salmon, steelhead, and/or designated critical habitat. Each HUC is labeled with the last 4 digits of the 8-digit HUC code. The first 4 digits are 1706, Lower Snake subregion.

2.4 Environmental Baseline

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 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The action area is used by all freshwater life history stages of threatened Snake River Basin steelhead, Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, and the endangered Snake River sockeye salmon (Table 9). At the subbasin level, designated critical habitat occurs wherever Chinook salmon are present. The geographical extent of streams with the action area designated as critical habitat is described for each of these species in Table 8.

Table 9. Fourth field HUCs containing listed salmon, steelhead, and designated critical habitat (DCH).

HUC	HUC Name	Snake River Spring/Summer Chinook Salmon & DCH	Snake River Fall Chinook Salmon & DCH	Snake River Sockeye Salmon & DCH	Snake River Basin Steelhead & DCH
17060101	Hells Canyon	✓	✓		✓
17060103	Lower Snake-Asotin	✓	✓	✓	✓
17060201	Upper Salmon	✓		✓	✓
17060202	Pahsimeroi	✓			✓
17060203	Middle Salmon-Panther	✓		✓	✓
17060204	Lemhi	✓			✓
17060205	Upper Middle Fork Salmon	✓			✓
17060206	Lower Middle Fork Salmon	✓			✓
17060207	Middle Salmon-Chamberlain	✓		✓	✓
17060208	South Fork Salmon	✓			✓
17060209	Lower Salmon	✓	✓	✓	✓
17060210	Little Salmon	✓			✓
17060301	Upper Selway				✓
17060302	Lower Selway		✓		✓
17060303	Lochsa		✓		✓
17060304	Middle Fork Clearwater		✓		✓
17060305	South Fork Clearwater		✓		✓
17060306	Clearwater		✓		✓
17060308	Lower North Fork Clearwater[1]		✓		✓

[1]Only the North Fork Clearwater River below Dworshak Dam.

Historic and contemporary anthropogenic activities along with natural events (e.g. fires, landslides, etc.) have shaped the status of the species and designated critical habitat within the action area. Hatchery practices, fisheries, and land uses impact the species directly as well as indirectly through impacts to their designated critical habitats. Each of these are discussed in the following sections.

2.4.1 Hatcheries

There are numerous hatchery programs distributed through the action area. These programs are operated to either provide fish for fisheries and/or to supplement spawners to help rebuild depressed natural populations. There are twelve spring/summer Chinook salmon, four fall Chinook salmon, eight steelhead, and one sockeye salmon hatchery programs in Idaho that currently produce fish for release in the action area (NMFS 2017a; NMFS 2017b NMFS 2015a).

Several major uncertainties exist regarding the effects of hatchery programs on natural-origin populations. These uncertainties include a limited understanding of the impact of hatchery releases on natural-origin population abundance, productivity, and genetic integrity, as well as the effects of ecological interactions between hatchery and natural-origin ESA-listed fish in the tributary and mainstem environments. Hatchery practices have evolved as the status of natural populations changes, and new plans are being implemented and evaluated as a result of recent ESA consultations on Hatchery Genetic Management Plans. A comprehensive assessment of hatchery benefits and risks is now underway across the Snake River basin. This assessment is expected to result in operational refinements and changes that benefit listed species (NMFS 2019).

2.4.2 Harvest

Harvest within the action area is minimal relative to that which occurs in the Pacific Ocean and mainstem Columbia River. Sports fisheries targeting hatchery steelhead and Chinook salmon occur in the Snake, Clearwater, Salmon, Little Salmon, and South Fork Salmon Rivers. Sports fisheries are expected to continue into the future and will continue to be actively managed based on forecasted returns. These fisheries pose a threat to ESA-listed species due to the potential for direct or indirect mortality that may occur with natural origin fish are incidentally caught; however, the impacts from these catch and release fisheries are unclear (NWFSC 2015; NMFS 2017a).

2.4.3 Habitat

The quality of aquatic habitat for salmon and steelhead in Idaho varies from excellent in wilderness and roadless areas to poor in areas subject to intensive human land uses. Past and current land uses that have degraded or continue to degrade habitat conditions include dam construction and operation, agriculture, forestry, mining, livestock grazing, water diversions, urbanization, wetland draining and conversion, and road construction (many with impassable culverts) and maintenance (Rhodes et al. 1994; National Research Council 1996; Spence et al. 1996; Lee et al. 1997; NMFS 2017a). In many watersheds, land management and development activities have reduced connectivity between streams, riparian areas, floodplains, and uplands; elevated fine sediment yields; reduced large woody material; reduced riparian shading; altered channel complexity; altered the quantity and timing of stream flows; and reduced water quality.

Water quality in the action area has been degraded by point and non-point sources of pollution. Mixing zones are commonly authorized for point source discharges, although they may also be authorized in 401 certifications of federal permits for activities considered to be non-point sources of pollution (e.g., discharges of dredge or fill material permitted in accordance with Section 404 of the CWA). In 2017, EPA queried the Integrated Compliance Information System (ICIS) database and identified about 400 NPDES permitted facilities in Idaho. Less than 25 percent of these were for individual permits. The remaining permitted facilities were granted coverage under general permits. There are seven types of general permits in Idaho including the multi-sector general permit for stormwater discharges (MSGP), construction general permit for stormwater discharges (CGP), aquaculture general permit, suction dredge general permit, drinking water treatment facilities general permit, groundwater remediation facilities general permit, and concentrated animal feeding operations general permit.

NMFS obtained discharge location information for individual permits, MSGP permits, drinking water aquaculture general permits located within the action area using information from EPA's ICIS database (which included facilities listed as of April 2019) and the "Idaho NPDES Permits" webpage (to identify facilities not included in ICIS or to obtain locational information not included in ICIS). Figure 3 shows the locations of permitted individual, MGSP, drinking water treatment, and aquaculture discharges in the action area. Discharges permitted under the CGP, groundwater remediation general permit, suction dredging general permit, and confined animal feeding operations general permit are not mapped because locational information for those facilities was not readily available. The majority of the permitted discharges shown on Figure 3 are MSGP facilities (39 percent), followed closely by sewerage treatment facilities (36 percent). There are four NPDES-permitted mine discharges (6 percent) and one industrial discharge facility.

EPA gathered mixing zone information for facilities in the action area by examining readily available technical fact sheets and state-issued 401 certifications for the NPDES permits. Using this information, EPA (2019) summarized the range of characteristics of authorized mixing zones by discharge type (Table 10). The BE contains additional facility-specific details (EPA 2019). In addition, NMFS has previously consulted on a number of individual NPDES permits or cleanup actions that involved authorized mixing zones (NMFS 2003; NMFS 2004; NMFS 2018).

Substantial habitat restoration and protective actions at the federal, state, and local levels have been implemented in Idaho to improve degraded habitat conditions and restore fish passage. Habitat conditions are improving in some areas as a result of those actions along with implementation of better land and water management practices. Still habitat alterations in some areas are extensive and more restoration work is necessary for recovery of the species. Furthermore, uncertainty regarding the long-term impacts of climate change and the ability of ESA-listed fish to adapt to a rapidly evolving environment amplifies the need to restore degraded habitats (NMFS 2017a).

Sections 2.4.3.1 through 2.4.3.3 provide a more specific review of habitat conditions for each of the three major basins (Clearwater River, Snake River, and Salmon River) within the action area.

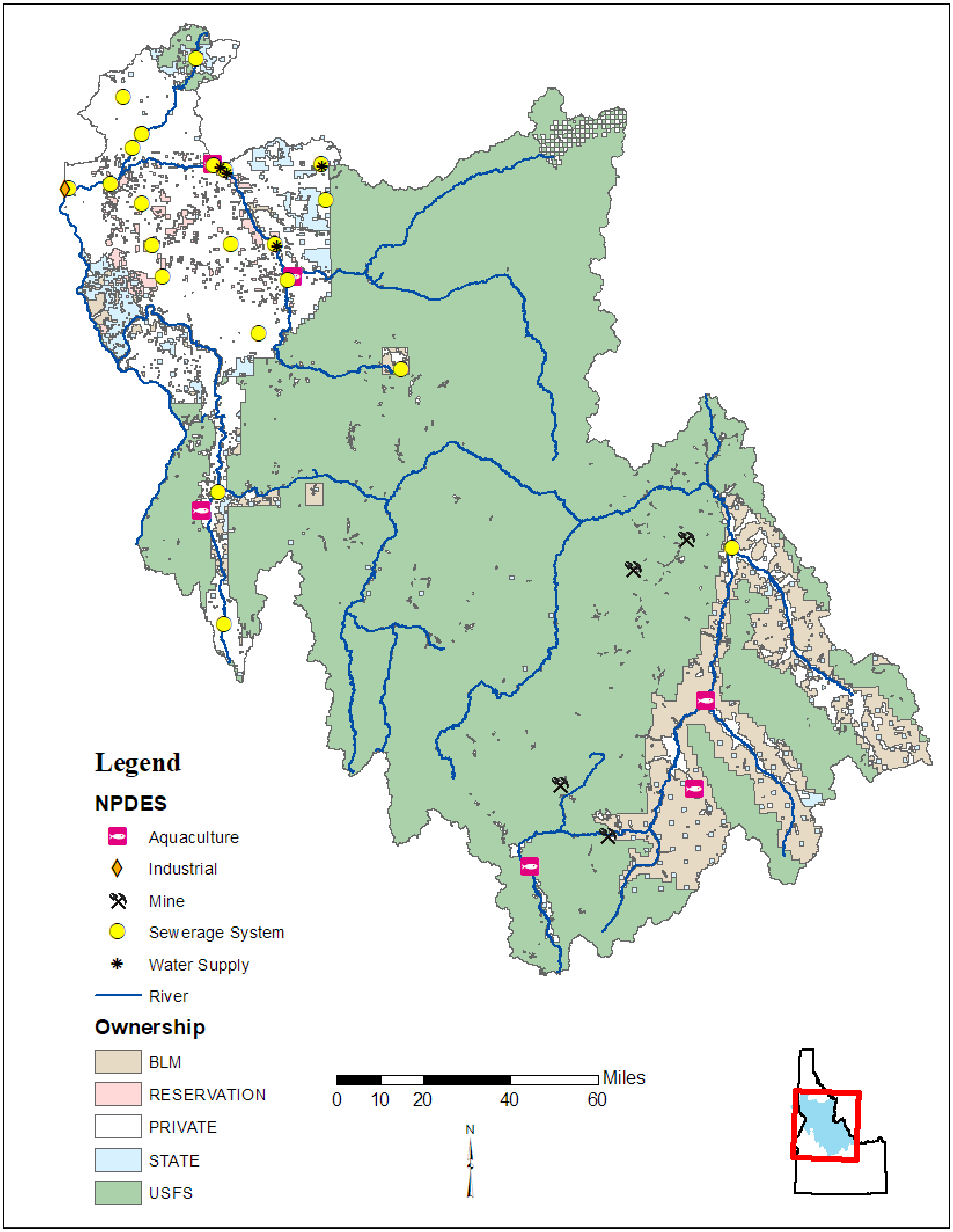

Figure 3. The NPDES facilities in the action area.

Table 10. Generalized discharge and mixing zone characteristics by discharge categories.

Type of Discharge	Pollutants of Concern	Mixing Zone Authorizations (common pollutants and size[1])
Sewerage Treatment	Organic matter (biological oxygen demand), total suspended solids (TSS); *Escherichia coli*; pH; oil and grease; ammonia; chlorine (if used in the disinfection process); metals; nutrients (nitrogen and phosphorus).	Most common for ammonia and chlorine; typically limited to 25 percent.
Water Supply	TSS, chlorine, pH, aluminum, temperature, total trihalomethanes	Most common for chlorine; typically limited to 25 percent or less.
Mining Operations & Industrial Discharges	Metals, TSS, pH, temperature, whole effluent toxicity,	Most common for metals, temperature, and whole effluent toxicity; Sizes vary widely and may, although uncommon, be up to 100 percent.
Hatcheries/ Aquaculture Facilities	Chlorine, formalin, potassium permanganate, providone-iodine, organic matter, and TSS.	The Idaho general permit does not authorize mixing zones for these discharges.
MSGP	TSS, metals, organic compounds, petroleum hydrocarbons	While dilution is allowed, no mixing zone sizes are specified.

[1]Mixing zone size is represented by the percent of the receiving stream's critical flow. Critical flow is defined in the Idaho WQS.

2.4.3.1 Clearwater River

The Clearwater River drains approximately a 9,645 square mile (mi^2) area, of which roughly 6,950 mi^2 are within the action area. There are four major tributaries that drain into the mainstem of the Clearwater River: the Lochsa, Selway, South Fork Clearwater, and North Fork Clearwater Rivers. Only the lower 2 miles of the North Fork Clearwater River, below Dworshak Dam, are included in the action area. Dworshak Dam was completed in 1972 and eliminated access to one of the most productive systems for anadromous fish in the basin. The mouth of the Clearwater River is located on the Washington-Idaho border at the town of Lewiston, Idaho, where it enters the Snake River.

More than two-thirds of the total acreage of the Clearwater River basin is evergreen forests, largely in the mountainous eastern portion of the basin. The western third of the basin is part of the Columbia plateau and is composed almost entirely of crop and pastureland. Land ownership in the action area portion of this basin is illustrated in Figure 4. Approximately 62 percent of the land is federally owned (U.S. Forest Service [USFS], Bureau of Land Management [BLM], and U.S. Army Corps of Engineers), 32 percent is privately owned, and the remaining 6 percent is split almost evenly between state and tribal ownership. Private land in the subbasin is primarily managed by small forest landowners, timber companies, agricultural companies, and farming and ranching families. Urban land uses comprise only a very small fraction of the basin. Lewiston is the largest urbanized area, with a population of about 33,000 (U.S. Census Bureau 2019a). Over 50 percent of the federally-owned land is designated as wilderness. The designated wilderness areas include the Frank Church River of No Return Wilderness (FCRONRW), Selway-Bitterroot Wilderness, and Gospel Hump Wilderness.

Both historic and present-day land uses have significantly altered aquatic habitat in portions of the Clearwater River basin. Those land uses include timber harvest, road construction, agriculture, mining, and water impoundments and diversions. Aquatic habitat with the least amount of human alteration lies in the Selway River and parts of the Lochsa River drainage (NMFS 2017a). Land and aquatic resources in these areas, and other portions of the basin, benefit from protections afforded through the following designations: inventoried roadless areas, wilderness areas, or wild and scenic rivers.

Timber harvest in the basin began in the late 1800s, but substantial harvest didn't begin until the late 1920s. Commercial timber harvest peaked in the 1980s and experienced sharp declines in the 1990s (USFS 2014). Extensive road networks were constructed to support the timber harvest industry, and many roads remain on the landscape today. Timber harvest still occurs on federal, state, and private lands, although much lower volumes of wood are removed.

Agriculture primarily affects the western third of the basin on lands below 2,500 feet in elevation, primarily on the Camas Prairie both south and north of the mainstem Clearwater and the Palouse. Additional agriculture is found on benches along the main Clearwater and its lower tributaries such as Lapwai, Potlatch, and Big Canyon Creeks. Hay production in the meadow areas of the Red River and Big Elk Creek in the American River watershed accounts for most of the agriculture in the South Fork Clearwater. Total cropland and pasture in the subbasin exceeds 1,150 mi^2. Agriculture is a particularly large part of the economy in Nez Perce, Latah, Lewis, and Idaho Counties, which all have large areas of gentle terrain west of the Clearwater Mountains. Small grains are the major crop, primarily wheat and barley. Landscape dynamics, hydrology, and erosion in these areas are primarily determined by agricultural practices (Ecovista et al. 2003). Grazing occurs in some lower-elevation areas of the USFS lands; however the majority of lands managed by the USFS are not subjected to cattle or sheep grazing. Grazing occurs on private lands that are managed for agriculture but only in uncultivated areas.

Gold was discovered in the basin in the mid-1800s and placer mining boomed. Dredging of stream bottom materials and hydraulic mining of hillsides were commonly used methods and had significant environmental impacts in the basin. Mines are distributed throughout the basin, although there are very few in the Selway drainage. The highest density of mining claims occur in the South Fork Clearwater River subbasin (Ecovista et al. 2003). Recent mining activity primarily consists of small scale suction dredging, placer and lode operations, and aggregates sources (IDEQ et al. 2004).

According to the Idaho Department of Water Resources dam database, there are eighty dams within the boundaries of the action area in the Clearwater basin. The vast majority of dams are located in the Clearwater subbasin. Only seven of these dams have storage capacities greater than 100 acre feet. Dworshak Dam is the largest concrete dam in the U.S. and its construction was authorized primarily for flood control, although it also provides power generation and recreation services. Currently, water releases from Dworshak Dam are used to enhance downstream flows and cool water temperatures. Small-scale irrigation, primarily using removable instream pumps, is relatively common for hay and pasture lands scattered throughout the lower elevations portions of the subbasin, but amounts have not been quantified. The only large-scale irrigation/diversion system within the Clearwater basin is operated by the Lewiston Orchards Irrigation District and is located in the lower portion of the Clearwater basin.

The land uses described above have impacted water quality in the basin. Within the basin, permitted point source discharges include: nineteen sewerage systems (the largest of which is for the City of Lewiston), four drinking water treatment facilities, three hatcheries, one municipal separate storm sewer system, and seventeen MSGP facilities. Since 2009, two new individual NPDES permits were issued, both were for sewerage systems. In addition, one NPDES permit application has been submitted in the Clearwater basin; however it is for an existing stormwater discharge. Refer to Table 10 for a summary of the types of pollutants these discharges contribute to streams. Agricultural areas also deliver fertilizer, herbicides, and pesticide residues to stream and rivers. Similarly, road networks contribute sediment and chemicals associated with runoff (metals and oil and grease). Our understanding of many chemicals, alone or in combination with other chemicals is incomplete, especially when considering exposure of rearing juveniles to multiple contaminants or when considering their interactions with other stressors, food web-mediated effects, and effects in complex mixtures (NMFS 2017b).

As required by the CWA, the IDEQ periodically conducts a comprehensive analysis of Idaho's waterbodies to determine whether they meet state water quality criteria and support beneficial uses. The IDEQ prepares an "Integrated Report" to list the current conditions of all state waters [CWA 305(b)] as well as those waters that are water quality limited or impaired [CWA 303(d)]. Water quality limited streams or lakes listed under Section 303(d) of the CWA either fail to meet their designated beneficial uses or exceed state water quality criteria. At the time this Opinion was drafted, the 2014 Integrated Report was the most recent EPA-approved comprehensive review of the condition of Idaho's waters (IDEQ 2017c). In the Clearwater basin portion of the action area, about 4,600 stream miles (44 percent) are fully supporting their beneficial uses, 2,150 stream miles (21 percent) have not been assessed, and 3,700 stream miles (35 percent) are not supporting their beneficial use. The most significant causes of surface water impairment in the basin include temperature, sediment, and habitat alteration (Figure 3) (IDEQ 2017c).

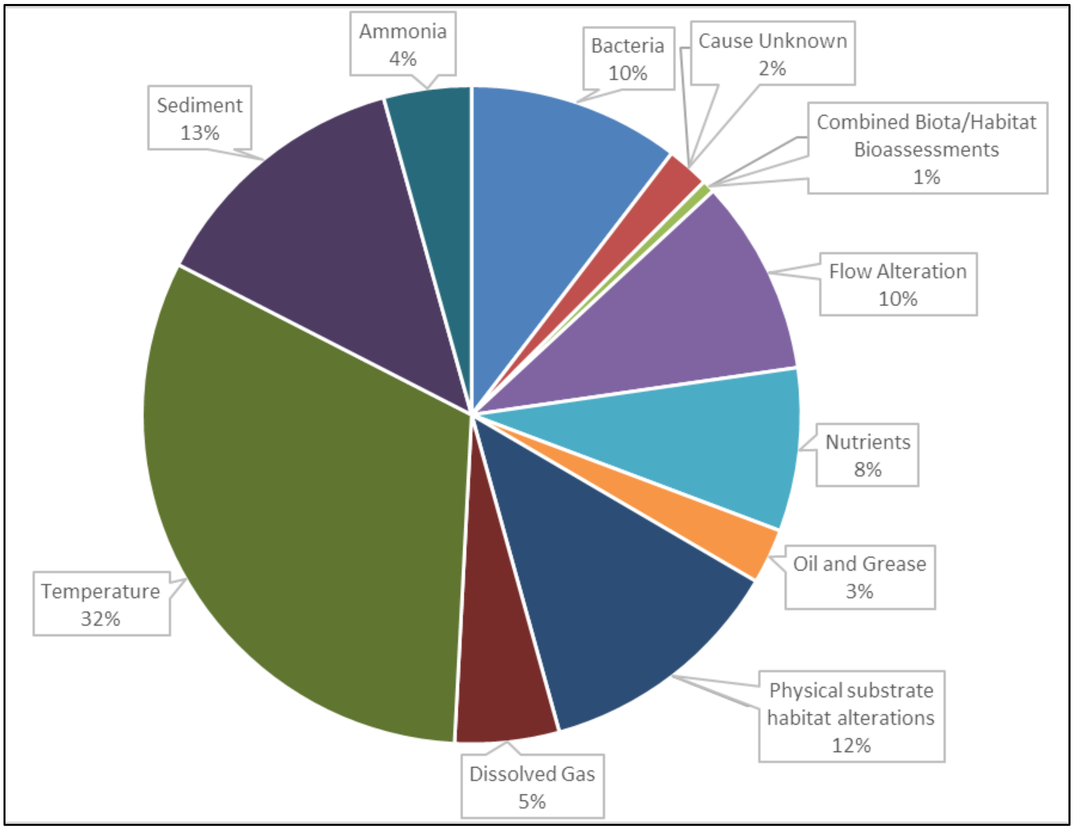

Figure 4. Causes of impairment to surface waters in the Clearwater basin (excluding all surface water upstream of Dworshak Dam (IDEQ 2017c).

The primary habitat-related limiting factors identified in the recently published recovery plan (NMFS 2017a) that have arisen from historic and current land uses include excess sediment, degraded riparian conditions, passage barriers, high water temperatures, and degraded instream habitat complexity.

Species Presence in the Clearwater Basin. Snake River sockeye salmon do not inhabit the Clearwater River basin and spring/summer Chinook salmon returning to the Clearwater River basin are not considered part of the listed ESU. Currently, Snake River fall Chinook salmon spawn in the mainstem Clearwater River, and historical information suggests that the Selway River and other tributaries also supported the species (NMFS 2017b). Snake River Basin steelhead are dispersed throughout the Clearwater River basin and use many streams for spawning and rearing.

2.4.3.2 Snake River

The action area encompasses 109 miles of the Snake River, extending from Lewiston (river mile [RM] 138) upstream to the Hells Canyon Dam (RM 247). The lower 38 miles of the river form the border between Washington and Idaho, and the upper 71 miles for the border between Idaho and Oregon. Two subbasins, the Hells Canyon (HUC 17060103) and the Lower Snake-Asotin (HUC 17060101), comprise the action area in this drainage and together they encompass roughly 520 mi^2 in Idaho. Major tributaries of this Snake River reach include the Clearwater, Imnaha, Salmon, and the Grande Ronde Rivers, as well as Asotin Creek. Together, these tributaries drain a combined area of approximately 19,280 mi^2, and have a profound influence on water quality and hydrologic conditions of the Snake River (Nez Perce Tribe and Ecovista 2004).

The upper part of the drainage is forested, mountainous terrain with a deep canyon cut by the Snake River, while the lower part consists of grassland plateaus. Landownership is a mix of federal (47 percent), private (40 percent), state (12 percent), and NPT (1 percent). Private land is concentrated in the agricultural and urban areas of the lower Snake-Asotin subbasin and of the northern most portion of the Hells Canyon subbasin, near Wolf and Dry Creeks. The vast majority of USFS land is designated as the Hells Canyon National Recreation Area, and a substantial portion of this is further designated as the Hells Canyon National Wilderness Area. In addition, approximately 68 miles of the Snake River, below Hells Canyon Dam, is protected under the Wild and Scenic Rivers Act. These designations afford additional protections in order to preserve the natural character of the area. The Craig Mountain Cooperative Management Area encompasses a large swath of the southeastern portion of the Lower Snake-Asotin subbasin. This area is managed by the NPT, BLM, Idaho Department of Lands, the Nature Conservancy, and private landowners in a manner that provides for the protection and enhancement of wildlife habitat (NPT and Ecovista 2004).

Both historic and present-day land uses have altered aquatic habitat in this area. Those land uses include agriculture, grazing, timber harvest, transportation, urban development, and mining. In addition, construction of the Hells Canyon Dam in 1967 substantially altered the hydrology, water quality, and habitat of the Snake River. Cultivated land in the Lower Snake Asotin subbasin is comprised primarily of dryland crops including wheat; barley; and a legume, oilseed or fallow crop. In the Hells Canyon subbasin, agricultural activity is largely focused on hay production. Livestock grazing is one of the main land uses at Craig Mountain and throughout privately owned lands in the subbasin (NPT and Ecovista 2004). Timber harvest on USFS lands has been relatively limited due to the vast amount of area with Wilderness and National Recreation Area designations. Conversely, timber has been harvested on many of the state and private forest lands in the basin. Gold was discovered on river bars of the Snake River in the 1860s and some placer mining ensued. Placer mining was relatively unsuccessful, although remnants of the activities still remain. Hard rock mining for gold, silver, copper, iron, and lead, occurred through the basin. Currently, only sand, gravel, and stone are mined in the lower portion of the basin.

Operation of the Hells Canyon Complex of dams and, to a lesser degree, operation of numerous small diversions to support irrigation, livestock, and domestic uses, have altered the hydrology in the basin. Water storage and releases associated with operations of the Hells Canyon Complex have altered the naturally high peak flows that naturally occurred in the spring as well as altered the daily and hourly flow fluctuations that would otherwise occur naturally. To minimize the impacts of fluctuating flows on spawning fall Chinook salmon, the Idaho Power Company operates the complex of dams to provide stable flows downstream of Hells Canyon Dam. In addition to altered flows, the complex of dams and irrigation withdrawals have altered the natural temperature regime in the Snake River. Water temperatures are cooler from October through January and are warmer from May through September (NMFS 2017b). These altered thermal regimes can potentially impact migration, gamete viability, physiological development, and may result in mortality. Inflows from larger tributaries such as the Salmon River and Clearwater River help ameliorate some of these potential effects.

The vast majority of the area is undeveloped, with few, scattered rural communities. Between 2010 and 2018, population growth was greatest in Nez Perce County (approximately 3 percent), with the vast majority of growth occurring in Lewiston and nearby communities. The Clearwater Paper Lewiston Mill is the only industrial point source discharger in this portion of the action area. It discharges treated effluent to the Snake River at RM 140 (near the confluence with the Clearwater River). In addition, EPA has proposed issuance of a discharge permit for multiple parties within the Lewiston urbanized area that are responsible for the discharge of stormwater to the Snake River. There are also point source discharges regulated by the state of Washington in Clarkson and other urbanized areas (e.g., Asotin) that discharge to the Snake River or its tributaries. Together, these point source discharges coupled with nonpoint source discharges (e.g., runoff from roads and agriculture) have profound impacts on water quality.

Of the 750 stream miles delineated in the Integrated Report for this portion of the action area, approximately 17 percent fully support their beneficial use, 57 percent have not been assessed, and 26 percent do not support their beneficial use (IDEQ 2017c). The leading causes of impairment in these two subbasins are temperature, bacteria, and nutrients (Figure 3). The mainstem Snake River is impaired for temperature, mercury, total dissolved gas, and low dissolved oxygen. The primary habitat limiting factors in the Snake River below Hells Canyon Dam, extending to Lewiston include elevated water temperature, reduced dissolved oxygen, elevated total dissolved gas, altered flows, interruption of geomorphic processes (e.g. sediment transport), and alteration of nearshore rearing habitat (NMFS 2017b).

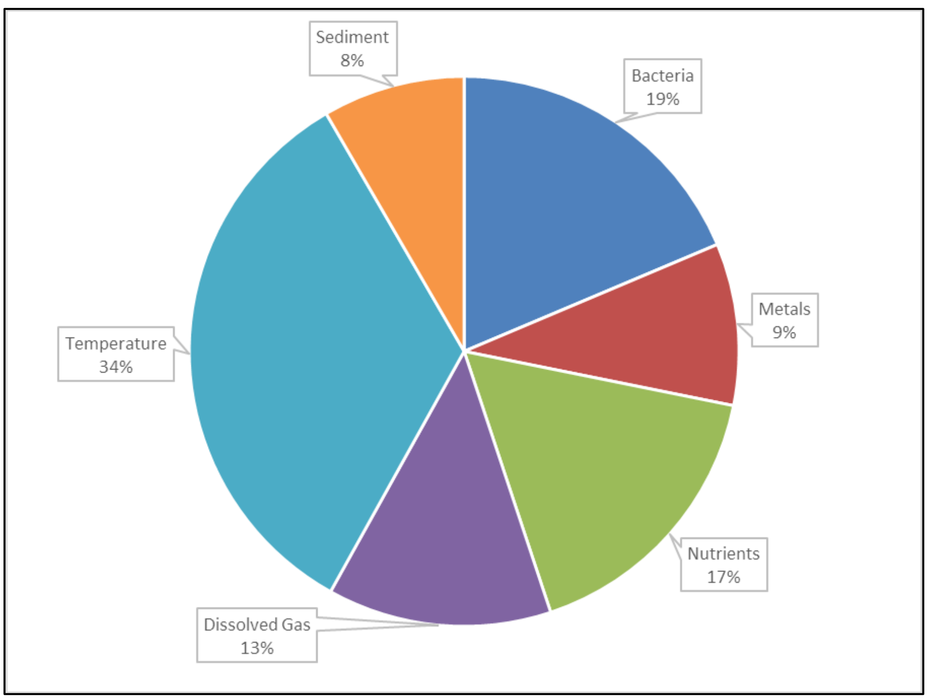

Figure 5. Causes of impairment to surface waters in the Hells Canyon and Lower Snake-Asotin Subbasins (IDEQ 2017c).

Species Presence in the Snake River Basin. The Snake River is used as an adult and juvenile migration corridor by all four Snake River anadromous species. Juvenile spring/summer and fall Chinook salmon and steelhead also rear in the mainstem Snake River. Snake River fall Chinook salmon are the only species that spawn in the mainstem Snake River. Spring/summer Chinook and Snake River Basin steelhead spawn in tributaries to the Snake River when stream gradients allow for adult upstream movement. Juvenile spring/summer Chinook salmon and Snake River Basin steelhead also use tributary habitats for rearing.

2.4.3.3 Salmon River

The Salmon River flows 410 miles north and west through central Idaho to join the Snake River. The Salmon River is the largest subbasin in the Columbia River drainage, excluding the Snake River, and has the most stream miles of habitat available to anadromous fish. The total subbasin is approximately 14,000 mi^2 in size. Major tributaries include the Little Salmon River, South Fork Salmon River, Middle Fork Salmon River, Panther Creek, Lemhi River, Pahsimeroi River, and East Fork Salmon River.

Public lands account for approximately 91 percent of the Salmon River basin, with most of this being in federal ownership and managed by seven National Forests or the BLM. Five designated wilderness areas (i.e., FCRONRW, Selway-Bitterroot, Sawtooth, Hells Canyon, and Gospel-Hump) encompass about 7,700 mi^2, which is roughly 60 percent of the USFS land. Specific management guidelines for wilderness areas generally prohibit motorized activities and allow natural processes to function in an undisturbed manner. Both the Middle Fork Salmon River (in its entirety) and the mainstem Salmon River (from its confluence with the North Fork Salmon River, extending 125 miles downstream to Long Tom Bar) are designated wild and scenic rivers.

Public lands within the basin are managed to produce wood products, domestic livestock forage, and mineral commodities; and to provide recreation, wilderness, and terrestrial and aquatic habitats. Approximately 9 percent of the basin is privately owned. Private lands are primarily in agricultural cultivation and uncultivated land is grazed. These areas are concentrated in valley bottom areas within the upper and lower portions of the basin.

Both historic and current land uses have significantly altered aquatic habitat in the Salmon River basin. Those land uses include timber harvest, agriculture (including diversion of water), mining, and urbanization. The subbasins with the least amount of human alteration include the Upper Middle Fork Salmon, Lower Middle Fork Salmon, and Middle Salmon-Chamberlain. This is to be expected because the vast majority of these subbasins are designated wilderness.

Timber harvest and associated road building has severely impacted aquatic habitats. Extensive logging and road construction occurred in the South Fork Salmon River subbasin in the 1950s and 1960s. In the mid-1960s, heavy rain events in this watershed resulted in devastating sediment loads in tributaries and the mainstem South Fork Salmon River (Nelson and Burns 2005), decimating spring/summer Chinook salmon and steelhead populations. Extensive logging and associated roadbuilding has also occurred in the Little Salmon River subbasin.

Agriculture and grazing are prevalent in the Upper Salmon, Lemhi, Pahsimeroi, Middle Salmon-Panther, Little Salmon, and Lower Salmon subbasins. Livestock grazing (cattle, sheep, and horses) has been widespread in portions of the basin for well over a century. Heavy grazing degrades riparian vegetation and compacts streambanks which in turn can cause substantial changes to aquatic habitats (e.g., overwidened and shallow streams, eroded streambanks, increased fine sediment, elevated temperatures, etc.) (Spence et al. 1996). Impacts from historic as well as current grazing practices still exist on the landscape. Both the BLM and USFS have consulted with NMFS on their issuance of grazing permits, and implementation of best management practices (e.g., pasture rotation, installation and maintenance of riparian exclosures, stubble height restrictions, and timing of use) is required to minimize impacts. Grazing practices on private lands are not regulated and vary widely.

The diversion of water, primarily for agricultural use within the Salmon River basin, has had a major impact on aquatic habitat, particularly in the Lemhi, Pahsimeroi, and mainstem Salmon Rivers, as well as several other tributaries of the Salmon River. Water has been appropriated to irrigate approximately 147,000 acres in the upper Salmon River drainage. The ratio of amount of water appropriated and remaining flow suggests that current base flow is less than half of historical levels (NMFS 2016b). This drainage-wide flow reduction has resulted in higher water temperatures, increased fine sediment in stream substrates, reduced the amount and availability of invertebrate forage, and impaired fish passage. A major problem is localized stream dewatering. Partial and seasonal barriers have been created on a few of these streams. Partial to complete barriers to anadromous fish exist on the Lemhi, Pahsimeroi, and upper Salmon Rivers at water diversions for irrigation. In addition to water diversions, numerous small pumping operations for private use occur throughout the subbasin. Impacts of water withdrawal on fish production are greatest during the summer months, when streamflows are critically low (IDFG et al. 1990).

Mining, though no longer a major land use as it was historically, it is still very prevalent in parts of the Salmon River basin. Historically, hydraulic and placer mining was widely used in portions of the basin. This technique was later succeeded by shaft, adit, and open pit mining techniques. Two large mines have existing permits that allow for operation – the Idaho Cobalt Project and Thompson Creek Mines. A proposed mine (Stibnite Gold Project) is currently undergoing environmental reviews. Other large mines, such as the Blackbird, Grouse Creek, and Beartrack are closed, although they continue to discharge to surface waters. Impacts from mining include severe stream alterations in substrate composition, channel displacement, bank and riparian destruction, and loss of instream cover and pool-forming structures. All of these impacts are typical of large-scale dredging and occur with other types of mining. Natural stream channels within the Yankee Fork, East Fork South Fork, and Bear Valley Creek, have all had documented spawning and rearing habitat destroyed by dredge mining. Furthermore, heavy metal pollution from mine wastes and drainage can eliminate all aquatic life and/or block access to valuable habitat as seen in Panther Creek (IDFG 1990) and in the East Fork South Fork Salmon River.

Much of the Salmon River basin is undeveloped with few and sparsely populated areas. Salmon and Challis are the largest urban areas with populations of 3,100 and 1,088, respectively (U.S. Census Bureau 2019a). According to the U.S. Census Bureau (2019b), the population in Custer

County (which includes Challis and Riggins) decreased by about 2 percent between 2010 and 2018. Urbanization and road construction in the basin is most often located in the wider valley bottoms. Many state highways and rural roads parallel rivers and streams. New infrastructure, and ongoing maintenance of existing infrastructure has resulted in the removal of riparian vegetation, restriction of floodplain access, and filling of wetlands.

The land uses described above have impacted water quality in the basin. Within the basin, permitted point source discharges include: three sewerage systems, five mines, four hatcheries/aquaculture facilities, and six MSGP facilities. At least two of the mines have multiple points of discharge with mixing zones (e.g., Grouse Creek has two points of discharge and Thompson Creek Mine has three points of discharge). Since 2009, only one new discharger, Idaho Cobalt, has received a discharge permit in this drainage. The City of Whitebird submitted a permit application; however, a discharge permit has not been issued to date. Refer to Table 10 for a summary of the types of pollutants these discharges contribute to streams. Agricultural areas also deliver fertilizer, herbicides, and pesticide residues to stream and rivers. Similarly, road networks contribute sediment and chemicals associated with runoff (metals and petroleum hydrocarbons).

Of the 17,160 stream miles delineated in the Integrated Report (IDEQ 2017c) for the Salmon River basin, approximately 55 percent fully support their beneficial use, 27 percent have not been assessed, and 18 percent do not support their beneficial use (Table 11). The leading causes of impairment are temperature and sediment (Figure 5). Available temperature data indicates water temperatures in the Salmon River mainstem, upstream of the North Fork Salmon River are sufficiently high to stress rearing juvenile Chinook salmon and steelhead, to impair upstream migrating and spawning adult Chinook salmon, and to impair upstream migrating sockeye salmon (NMFS 2016b). Reach-specific information can be obtained from the IDEQ Integrated Report website (http://deq.idaho.gov/water-quality/surface-water/monitoring-assessment/integrated-report/).

Table 11. Summary of the status of streams in the Salmon River basin (IDEQ 2017c).

Subbasin Name	Fully Supporting[1] (%)	Not Assessed[2] (%)	Not Supporting[3] (%)
Upper Salmon	50	32	18
Pahsimeroi	27	44	28
Middle Salmon-Panther	56	34	10
Lemhi	32	38	30
Upper Middle Fork Salmon	81	12	7
Lower Middle Fork Salmon	63	23	15
Middle Salmon-Chamberlain	63	30	7
South Fork Salmon	54	1	46
Lower Salmon	39	44	17
Little Salmon	90	1	9

[1]Fully supporting streams are those listed in Categories 1 and 2 of the Integrated Report.
[2]Not assessed stream are those listed in Category 3 of the Integrated Report.
[3]Not supporting streams are those listed in Categories 4 and 5 of the Integrated Report.

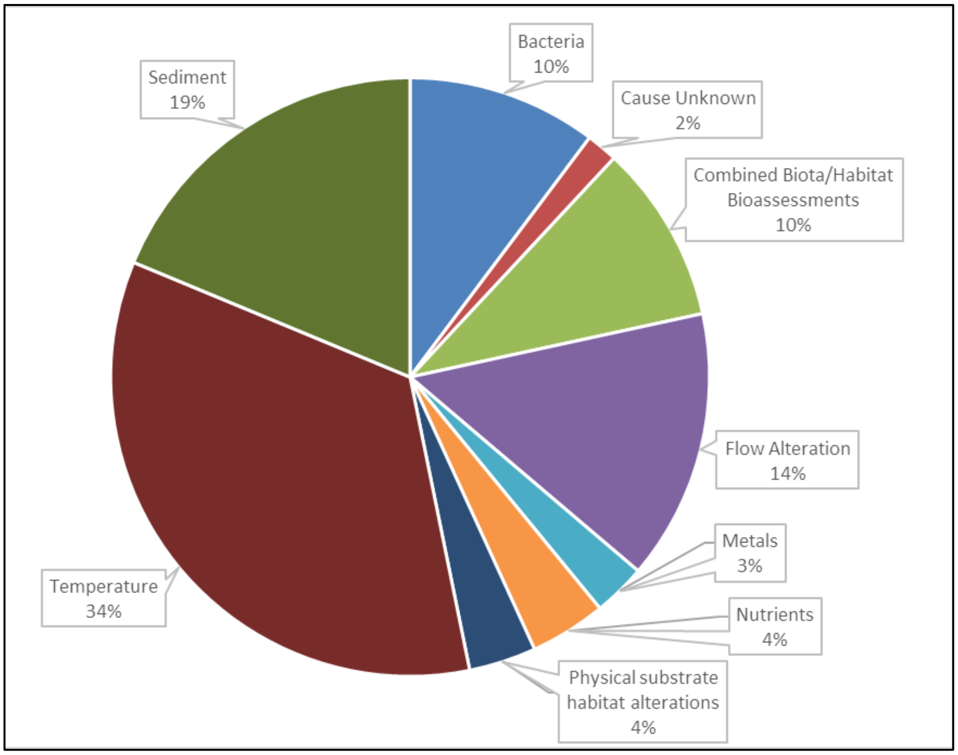

Figure 6. Causes of impairment to surface waters in the Salmon River Basin (IDEQ 2017c).

Restoration actions in the Salmon River basin have included fencing and riparian planting and streambank restoration; road obliteration, decommissioning, and other road-related actions to reduce sediment inputs; culvert removal or replacement, floodplain and stream channel restoration; reconnecting tributaries to mainstems; screening and modification of water diversions; habitat protection through acquisitions, conservation easements, and other methods; and cessation of certain land uses activities in some areas to allow habitats to recover (BPA et al. 2013, 2016; NMFS 2017a). These actions have been targeted toward addressing limiting factors, and best available science indicates that they have and will continue to improve habitat functions and that fish population abundance and productivity will improve.

Species Presence in the Salmon River Basin. All adult and juvenile anadromous species utilize the mainstem Salmon River as a migration corridor, although fall Chinook salmon use is limited to the reach below the South Fork Salmon River confluence. Adult fall Chinook salmon, spring/summer Chinook salmon, and steelhead spawn in the mainstem Salmon River. Spring/summer Chinook salmon and steelhead also spawn in tributary streams. Juvenile Chinook salmon and steelhead also use the mainstem Salmon River and its tributaries as rearing habitat. Adult sockeye salmon spawn in lake habitats and within small areas of a few select streams. Juvenile sockeye salmon rear primarily in their natal lakes prior to emigration.

2.4.4 Future Anticipated Effects of Completed Federal Formal Consultations

The environmental baseline includes the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early section 7 consultation. Some of the projects are large (large action area, multiple species), such as the consultation on the Mitchell Act, operation and maintenance of the Bureau of Reclamation's upper Snake River projects, 2018–2027 *U.S. v Oregon* Management Agreement, and Bonneville Power Administration's Habitat Improvement Program. Other types of federal projects are smaller in scale and include grazing allotments, special use permits, and bank stabilization to name a few.

Effects of these projects will be neutral or have short- or even long-term adverse effects on viability. Consultations on flow management actions and irrigation projects are expected to continue into the future. Some restoration actions will have negative effects during construction, but these are expected to be minor, occur only at the project scale, and persist for a short time (no more, and typically less, than a few weeks). Over the longer term, these restoration projects will improve the functioning of the PBFs safe passage, spawning gravel, substrate, water quantity, water quality, cover/shelter, food, and riparian vegetation. Projects implemented for other purposes will be neutral or have short- or even long-term adverse effects on some of these same PBFs. However, all of these actions, including any RPAs, have undergone section 7 consultation and were found to meet the ESA standards for avoiding jeopardy of the species and avoiding adverse modification of critical habitat.

2.4.5 Effects of Climate Change

As discussed in the Section 2.2.3, climate change will affect baseline conditions in the future. Climate change is expected to alter hydrologic processes through decreased snowpack, early spring runoff, greater frequency of winter flooding, higher winter flows, and lower summer baseflows (Rieman and Isaak 2010). Although not statistically significant, Klos et al. (2015) found positive trends in increasing spring precipitation, earlier peak streamflow, decreased April 1 snowpack, and longer fire seasons in Idaho. Effects of climate change will not be spatially homogenous. Higher elevation areas will be less affected because temperatures in these areas should be maintained well below freezing for most of the winter and early spring. Conversely, mid- to lower-elevation areas will be more susceptible to effects of climate change effects.

Decreased flows and increased air temperatures are likely to result in increased summer stream temperatures in the action area of 1° to 4°C (maximum weekly mean temperature) by the 2030 to 2069 period and 2° to 6°C by the 2070 to 2099 period (Beechie et al. 2013). Increased stream temperatures may result in: (1) An overall depletion of cold water mainstem areas for spawning, rearing, and migration; (2) variation in quality and quantity of tributary rearing habitat; (3) alterations to migration patterns; (4) accelerated embryo development; (5) premature emergence of fry; (6) increased competition with other fish species; and (7) decreased resilience to disease and other stressors. Climate change will exacerbate conditions in the action area where mainstem water temperatures already exceed criteria for salmonids and where cold water refugia associated with tributary streams are somewhat impaired by land uses such as water diversions or possibly point source discharges of heat. In addition, exposure to sub-optimal water temperatures make fish more vulnerable to sublethal or lethal effects associated with contaminant exposure.

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The EPA's proposed approval of Idaho's mixing zone provisions will have no direct effects to ESA-listed species or their habitat in and of itself. However, Idaho's implementation of the rule through authorization of mixing zones will indirectly affect ESA-listed species and their designated critical habitat. Mixing zones are regulatory constructs that represent defined areas where water quality criteria do not have to be met. These areas initiate at the discharge point and include a portion of the effluent plume that extends downstream (Figure 7). The effluent plume, on the other hand encompasses the entire plume within the receiving water until the point where equilibrium, or 100 percent mixing, is achieved. Mixing zones allow for exceedances of numeric water quality criteria as well as numeric interpretations of narrative criteria in discrete locations near the point of discharge. For example, the narrative criterion for toxic substances[2] is often implemented through numeric expressions of whole effluent toxicity (WET). In discharge permits, mixing zones may be authorized for parameters that do not meet water quality criteria at the end-of-pipe (i.e., in the effluent itself).

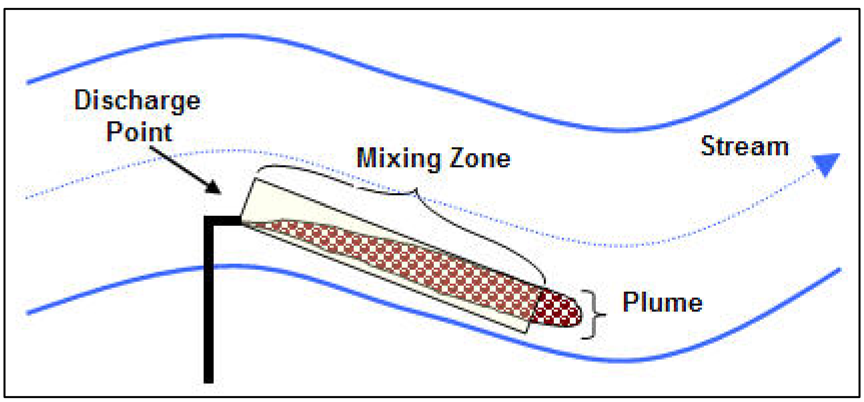

Figure 7. Diagram of a mixing zone relative to discharge plume (Source: ODEQ 2019).

As described in the environmental baseline section of this Opinion, mixing zones have been authorized for a number of point source discharges in anadromous watersheds. For example, sewerage treatment systems generally have authorized mixing zones for chlorine (if used in the treatment process) and ammonia. The industrial discharger, Clearwater Paper, has authorized mixing zones for pH, temperature, and biological oxygen demand to name a few. Various mines have authorized mixing zones for metals (e.g., copper and zinc), temperature, and WET. NMFS consulted on a few of these discharges (NMFS 2004; NMFS 2018), and while we found that adverse effects were likely, those effects were not likely to jeopardize the species and were not likely to adversely modify critical habitats.

---

[2] The narrative criterion for toxic substances states: "Surface waters of the state shall be free from toxic substances that impair designated beneficial uses." (IDAPA 58.01.02.200.02).

It is not feasible to predict when, where, and what type of mixing zones will be authorized in the future. Since 2009, four permits were issued to new facilities in the action area, and two permit applications for new facilities in the action area were received. These permits were for sewerage treatment facilities for small, rural communities, municipal separate storm sewer system permits, a mine, and an aquaculture facility. In addition, NMFS is aware of one potential new mine (Stibnite Gold Project) that will discharge to surface waters if the plan of operations is permitted. This information suggests there is low likelihood of mixing zones being authorized for new types of facilities with different effluent characteristics from those that currently exist within the action area. For our effects analysis, we considered the potential for additional, new mixing zone authorizations in the future. Considering the low number of new discharge facilities that have been permitted over the past the past 10 years, federal ownership of the vast majority of land in the action area, and relatively little urbanization, we have assumed that doubling the number of existing mixing zone authorizations would be a relatively conservative assumption to include in our analysis.

The following effects analysis evaluates whether the mixing zone provisions and processes for authorizing mixing zones provide adequate protection of ESA-listed species and designated critical habitats. Our analysis first focuses on general considerations that play a significant role in evaluating the impact of mixing zones on both species and aquatic habitats. Then, we examine specific pathways of effect that mixing zones may have on ESA-listed species and designated critical habitat. Because the action is programmatic in nature and because we are not able to predict when or where mixing zones will be authorized in the future (beyond those already included in the environmental baseline), our effects analysis is necessarily general, although it is informed by existing, site-specific consultations.

2.5.1 General Considerations

Six key over-arching factors must be considered when evaluating the potential effects of implementation of the mixing zone rule on ESA-listed species and/or designated critical habitat. These are described below and include: (1) IDEQ’s discretionary authority in conditioning or denying mixing zones; (2) the requirement for assimilative capacity; (3) the use of critical conditions in establishing water quality based effluent limits (WQBELs); (4) size limitations specified in rule; (5) requirement that mixing zones not unreasonably interfere with beneficial uses; and (6) EPA oversight responsibilities and the requirement that NMFS be given an opportunity to review draft discharge permits.

2.5.1.1 Discretionary Authority

The IDEQ has authority to grant mixing zones on a case-by-case basis and to specify the size, configuration, and location of a mixing zone (IDAPAP 58.01.02.060.01). This authority is supplemented by IDAPA 58.01.02.060.01.c, which states that IDEQ will “not authorize a mixing zone that is determined to be larger than is necessary considering siting, technological, and managerial options available to the discharger.” These provisions emphasize that mixing zones are not guaranteed and that their necessity must be demonstrated in order to be authorized by IDEQ. When evaluating the necessity and size of a mixing zone, the IDEQ may consider siting (e.g., where the point of discharge is located, whether a diffuser will be used, etc.), technological (e.g., treatment types, process alternatives, etc.), and/or managerial (reduce discharge volume, improve process efficiency, etc.) options (IDEQ 2016). If, after considering these options, water quality criteria cannot be met at the end of the pipe, then a mixing zone may be considered.

2.5.1.2 Assimilative Capacity

Mixing zones may only be considered when the receiving waterbody has assimilative capacity. Assimilative capacity exists when the quality of the receiving water is better than the criteria necessary for protection of the beneficial use(s). The mixing zone provisions prohibit IDEQ from authorizing a mixing zone for any pollutant when the receiving water does not meet water quality criteria for that pollutant. An exemption to this prohibition is when the permitted discharge (and its associated mixing zone) is consistent with the wasteload allocations in an approved TMDL or other water quality plan (IDAPA 58.01.02.060.01.a). In these instances, facilities may be authorized to discharge pollutants at levels greater than the criteria.

2.5.1.3 Critical Conditions

In determining the size of the mixing zone, permitting authorities need to characterize the critical conditions of the effluent and receiving stream in terms of their flow and quality. Consideration of these critical conditions will ensure that the discharge of pollutants will seldom cause an exceedance of water quality criteria outside of the regulatory mixing zone. Table 12 summarizes the critical conditions that are taken into account when assessing the need for and determining the size of a mixing zone.

Table 12. Effluent and Receiving Stream critical conditions typically used when developing WQBELs.

Consideration	Effluent	Receiving Waterbody
Critical Flow	Publically owned treatment works[1] (POTW): maximum design flow Non-POTW: production flow	Acute Criteria: 1Q10 or 1B3[2] Chronic Criteria: 7Q10 or 4B3[2]
Pollutant Concentrations	If <20 data points, maximum If >20 data points, 95th percentile	90th to 95th percentile
Factors Affecting Pollutant toxicity	Conservative estimates such as: pH: 95th percentile Temperature: 95th percentile Hardness: 5th percentile	Conservative estimates such as: pH: 95th percentile Temperature: 95th percentile Hardness: 5th percentile

[1]A POTW is a term used for a sewage treatment plant that is owned, and usually operated, by a government agency. For purposes of this Opinion, we apply the POTW term to all municipal sewage treatments, regardless of their ownership.
[2]The 1B3 is a biologically-based 1-day average low flow event which occurs every 3 years, on average. Similarly, the 4B3 is a biologically-based 4-day average low flow event which occurs, on average, every 3 years.

Utilization of critical conditions essentially results in pairing of the worst-case scenario of the effluent (i.e., maximum discharge volumes coupled with maximum concentrations) with the worst-case scenario of the receiving stream (i.e., lowest flow volumes available for dilution coupled with high pollutant concentrations). The assumption is that if criteria are met during these paired critical conditions, then the criteria will be met outside of the mixing zone under all other conditions that are likely to occur.

In addition, conservative estimates of physical or chemical factors that influence pollutant toxicity will be used when authorizing mixing zones. For example, ammonia toxicity depends on temperature and pH; cadmium, chromium, lead, nickel, silver, and zine toxicity depends on hardness; and copper toxicity depends on a suite of parameters (e.g., dissolved organic carbon, pH, temperature, etc.). Table 12 identifies examples of conservative estimates that will often be used when IDEQ evaluates WQBELs and associated mixing zones for a select number of these parameters.

2.5.1.4 Size Restrictions

The mixing zone policy establishes limits on mixing zone sizes for flowing and non-flowing waters. For flowing waters, the width of the mixing zone will not exceed 25 percent of the stream width and the volume used for mixing will not include more than 25 percent of the available volume during critical conditions. For non-flowing waters, mixing zones for new discharges must be the smaller of either: (1) Less than 5 percent of the total open surface area of the water body; or (2) 100 meters from the point of discharge. For non-flowing waters, mixing zones for existing discharges to non-flowing waters, the total horizontal area of the mixing zone shall not exceed ten percent of the lake surface area.

Exceptions to the size restrictions described above may occur (IDAPA 58.01.02.060.01); however, IDEQ's flexibility in deviating from these restrictions is tempered by other provisions of the rule. The two most important rule provisions that bound IDEQ's discretion include the requirements that mixing zones not be larger than necessary (IDAPA 58.01.02.060.01.c) and that mixing zones not cause unreasonable interference with, or danger to, beneficial uses (IDAPA 58.01.02.060.01.d). For example, a smaller mixing zone may be authorized if the larger 25 percent volume is either: not necessary or if it results in unreasonable interference with beneficial uses. Conversely, the IDEQ may authorize a larger mixing zone, if the larger mixing zone is: (1) Deemed necessary given siting, technological, and managerial options available to the discharger; and (2) does not cause unreasonable interference with, or danger to, beneficial uses. Information specific to the mixing zone size and rationale for deviating from the size restrictions identified in the rule will be included in the fact sheets accompanying draft IDPES permits. Inclusion of this information in documents that are released for public comment will allow NMFS to examine whether proposed mixing zones are sized appropriately to minimize adverse impacts to ESA-listed anadromous fish and designated critical habitat.

There are only a few waterbodies in the action area with potential for classification as non-flowing and that are occupied by ESA-listed anadromous fish and/or are designated critical habitat. Those waterbodies include five lakes in the Upper Salmon basin (i.e., Stanley, Redfish, Yellowbelly, Pettit, and Alturas Lakes) and the Lower Granite Reservoir. Based on readily available information, the water transit time in Lower Granite Reservoir is less than 10 days (Fish Passage Center 2016); therefore, this reservoir is classified as a flowing water under the mixing zone rule. NMFS is not aware of any existing point source discharges to non-flowing waters in the action area. Furthermore, all of the lakes in the Upper Salmon basin are protected within the Sawtooth National Recreation Area (SNRA), which was designated by Congress (Public Law 92-400 [86 Stat. 612], August 22, 1972) in order to "assure the preservation and protection of the natural, scenic, historic, pastoral, and fish and wildlife values…" Considering this protection, it is unlikely that point source discharges to these lakes will be authorized in the future.

2.5.1.5 Protection of Beneficial Uses

The mixing zone rule offers far-reaching ability to protect threatened and endangered species and critical habitat (IDAPA 58.01.02.060.01.d) by prohibiting mixing zones (either individually or in combination with other mixing zones) from causing unreasonable interference with, or danger to, beneficial uses. According to the rule, "unreasonable interference" for aquatic life beneficial uses includes:

- Impairment to the integrity of the aquatic community, including interfering with successful spawning, egg incubation, rearing, or passage of aquatic life;

- Heat in the discharge that causes thermal shock, lethality, or loss of cold water refugia;

- Bioaccumulation of pollutants (as defined in Section 010) resulting in tissue levels in aquatic organisms that exceed levels protective of human health or aquatic life; and,

- Lethality to aquatic life passing through the mixing zone;

The rule states that the definition of unreasonable interference "is not limited to" just these examples, thereby affording IDEQ the authority to identify other situations that would be considered unreasonable interference. Consequently, IDEQ has the authority to ensure that potential adverse effects to ESA-listed species or designated critical habitat as a result of authorizing mixing zones are prevented or minimized to the greatest extent possible.

2.5.1.6 NMFS Review of Draft Permits and EPA Oversight of IPDES

As described in Section 1.3.3 of this Opinion, Idaho is obligated to provide notice and copies of draft permits to NMFS for comment (40 CFR 124.10(c)(1)(iv)). The justification for mixing zone authorizations will be included in draft fact sheets. Where mixing zones utilizing more than 25 percent of the critical flow volume are proposed in streams with ESA-listed species and/or designated critical habitat, the IDEQ will provide information that supports their determination that unreasonable interference will not occur.

By reviewing draft permits and associated fact sheets, NMFS has an opportunity to evaluate mixing zone authorizations on a case-by-case basis and identify any concerns regarding any aspect of the draft permit, including the proposed mixing zones. The IDEQ is required to address comments raised by NMFS and may include conditions recommended by NMFS to the extent they are determined necessary to ensure the mixing zone authorization avoids substantial impairment of fish, including ESA-listed species ((40 CFR 123.25(a)(34); 40 CFR 124.59(b)). If concerns are not addressed satisfactorily, NMFS can elevate the issue(s) to the EPA. The EPA may utilize its oversight authority to ensure the permit complies with the CWA and appropriately reflects any terms and conditions established during WQS consultations with NMFS and the USFWS. In addition, EPA has a statutory responsibility to carry out programs for the conservation of listed species and to ensure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat. If necessary, EPA may formally object to the permit and may assume permitting authority.

The review and oversight requirements and processes described above provide mechanisms by which adverse effects associated with mixing zone authorizations can be minimized to the greatest extent possible.

2.5.2 Effects to Species

As previously stated, authorized mixing zones are discrete areas in the stream where criteria may be exceeded. Those criteria may be for a single toxic pollutant, a mixture of toxic pollutants, temperature, ammonia, etc. Whether lethal or ecologically relevant sublethal effects manifest in an individual fish exposed to chemicals, altered temperatures, or other physiochemical conditions in a mixing zone depends on a variety of factors. Those factors include, but are not limited to: characteristics of the individual exposed (e.g., species, life stage, health, etc.) and characteristics of the exposure (single chemical, chemical mixture, chemical concentration(s), duration of exposure, frequency of exposure, etc.). There is a substantial amount of literature devoted to the various potential lethal and sublethal effects fish may experience when exposed to chemicals, ammonia, or elevated temperatures.

For purposes of this Opinion, it is neither practical nor possible to describe the myriad of potential effects that could occur if species are exposed to chemicals or other water quality conditions above criteria. Instead, we focus our analysis on whether the mixing zone provisions and authorization procedures will provide adequate protection of ESA-listed species and designated critical habitat. The Guidance (IDEQ 2016) provided useful information regarding IDEQ's interpretation of the rule provisions and insight into how mixing zone requests will be analyzed in the future.

Mixing zones authorize the legal addition of greater pollutant concentrations than what would otherwise be allowed absent an authorized mixing zone. As a result of mixing zone authorizations, fish have the potential to be exposed to greater concentrations of chemicals in the water column, sediments, and biota. Chemical-specific exposure pathways are a function of both the environmental fate and transport of chemicals as well as organism life history strategies. Contaminants in the water column may be inadvertently ingested when foraging or they may enter the body at the water-gill interface. Fish may also ingest contaminants that are absorbed to sediments or that have accumulated in biota (e.g., algae or macroinvertebrates).

NMFS (2014) concluded that a number of criteria were likely to cause adverse effects to aquatic life. Considering this, and considering NMFS has concluded that site-specific discharges with authorized mixing zones may adversely affect ESA-listed fish (NMFS 2004; NMFS 2018), it stands to reason that the implementation of the mixing zone rule will also result in adverse effects to ESA-listed species. Recognizing that exposures to concentrations above criteria could result in adverse effects, the question then becomes whether the proposed rule and its implementation will effectively minimize those adverse effects. The pathways by which authorized mixing zones may affect ESA-listed fish include: water column toxicity, sediment toxicity, bioaccumulation, altered thermal regimes, and passage barriers.

2.5.2.1 Water Column Toxicity

Both acute and chronic toxicity may occur as a result of mixing zone authorizations for individual contaminants or for contaminant mixtures (i.e., WET). Acute toxicity occurs when an organism experiences toxic effects after a single or short-term (i.e., 96 hours or less) exposure to a contaminant or mixture of contaminants. Chronic toxicity occurs when organisms experience toxic effects (e.g., mortality, reduced growth, reduced reproduction) after long-term exposures to a contaminant or contaminant mixture.

Acute Toxicity. Acute criteria may be exceeded in the ZID. The mixing zone provisions stipulate that the ZID must be sized to prevent lethality to swimming or drifting organisms by ensuring organisms are not exposed to concentrations exceeding acute criteria for more than 1-hour, more than once in three years. Furthermore, as previously described, lethality to aquatic life passing though the mixing zone would be considered unreasonable interference (IDAPA 58.01.02.060.01.d.iv). These two aspects of the Idaho WQS make it clear that the rule prohibits discharges from causing lethality to organisms passing through the mixing zone.

Section 2.2.1 of the Guidance (IDEQ 2016) recommends four scenarios to prevent lethality to passing organisms. These scenarios were adopted from the EPA's Technical Support Document for Water Quality-based Toxics Control (1991). The scenarios listed below protect aquatic life passing through a mixing zone by limiting contaminant concentrations, the size of the ZID, and duration of exposure to concentrations above acute criteria.

1. The acute criteria are met at end-of-pipe.

2. The discharge is of high velocity (>3 meters per second) and the ZID is less than 50 times the discharge length scale in any direction.

3. The discharge is of low velocity (<3 meters per second) and the most restrictive of the following conditions is met:

    a. The acute criterion will be met within 10 percent of the distance from the edge of the outfall to the boundary of the mixing zone (when the acute-to-chronic ratio is equal to 10 or more) in any spatial direction.

    b. The ZID will be less than 50 times the discharge length scale[3] in any spatial direction (this requirement must be met for each port in a multiport diffuser).

    c. The acute criterion will be met within a distance of five times the local water depth in any horizontal direction from the outfall.

[3] The discharge length scale is the square-root of the cross-sectional area of any discharge outlet.

4. A drifting organism, when traveling through the path of maximum exposure, would pass through the acute mixing zone within 15 minutes.

Organisms moving through a mixing zone would experience peak exposure concentrations at the point of discharge and exposure concentrations would diminish with increasing distance downstream from the source. While there is no quantitative threshold on the maximum effluent concentration that may be discharged when a ZID is authorized, compliance with Scenarios 2 through 4 above should ensure that acute criteria are met within a few minutes travel time under practically all conditions. By limiting the duration of exposure to concentrations above the acute criterion, organisms moving through the mixing zone are not expected to experience acute lethality.

The above scenarios do not protect against repeat exposures nor do they address sublethal effects from acute exposures. This is because acute criteria are typically derived utilizing the lethal concentration killing 50 percent of the test organism (LC_{50}) toxicity data. It is not possible to predict the behavior of individual fish and know with certainty that fish will not volitionally remain in a mixing zone area, including a ZID. Depending on the location and size of the ZID, it is possible that fish could be exposed to concentrations for sufficient periods of time that would elicit a sublethal or potentially result in delayed mortality.

However, application of other rule provisions on a case-by-case basis can help minimize these types of effects. For example, the integrity of the aquatic community is required to be protected and mixing zones should not interfere with successful spawning, incubation, rearing, or migrating aquatic life. This provision would enable mixing zones to be restricted if they are thought to contribute to reduced population productivity or abundance.

Chronic Toxicity. When conducting site-specific consultations on EPA-issued discharge permits, NMFS has found that mixing zones for chronic criteria may adversely affect individual ESA-listed fish (NMFS 2018; NMFS 2004). The proposed mixing zone rule does not explicitly contain provisions regarding chronic toxicity; however, it requires minimizing the size of mixing zones and protecting spawning, egg incubation, rearing, and passage of aquatic life.

When fry emerge from the gravels, they generally disperse and establish home territories (Quinn 2005). Juvenile steelhead and Chinook salmon typically maintain a relatively small home area (Edmundson et al. 1968); however, they may expand or change their home area in response to individual growth (larger fish prefer faster, deeper water), competition, changing stream conditions, etc. (Hillman et al. 1987). If mixing zones are authorized in high quality spawning or rearing habitat, incubating embryos and fish inhabiting these areas could be exposed to chemical concentrations above applicable criteria for extended periods of time. This could result in a number of individuals experiencing sublethal effects that reduce their chances of survival.

In order to reduce the potential for, and extent of, adverse effects, the Guidance recommends the discharger and IDEQ permit writers characterize the biological community prior to authorizing a mixing zone (Section 2.2) and specifies that the duration of exposure should be considered. Furthermore, authorization of mixing zones in spawning areas is discouraged and may be either prohibited during certain times of the year or within areas that provide spawning and rearing habitat (Section 2.2.5).

Mixture Toxicity. The effect of exposure to chemical mixtures on organisms depends on the chemicals in the mixture as well as the timing of the overlapping exposures. The mode of toxic action of each chemical in the mixture dictates how that specific mixture affects the organism. There are three general possible outcomes upon the exposure to a mixture of chemicals (Eaton and Gilbert 2008):

1. Antagonistic: When the effect of one or more chemicals interferes with the effect of the other chemical(s) in the mixture. For example, 4 + 4 = 6. This situation is more likely when chemicals act by a different mode of toxic action.

2. Additive: When the effect of one or more chemicals adds to the effect of the other chemical(s) in the mixture. For example, 4 + 4 = 8. This situation is more likely when chemicals act by the same mode of action.

3. Synergistic: When the effect of one or more chemicals enhances the effect of the other chemical(s) in the mixture. For example, 4 + 4 = 10. This situation is more likely when chemicals produce the same biological effect but do not necessarily act by the same mode of action.

Spehar and Fiandt (1986) exposed rainbow trout and *Ceriodaphnia dubia* (a daphnid) to a mixture of five metals and arsenic, each at their acute criteria concentration. There were no survivors in these tests. In chronic tests, adverse effects were observed at mixture concentrations of one-half to one-third the approximate chronic toxicity threshold of fathead minnows (*Pimephales promelas*) and daphnids. Considering how chronic criteria are developed, this study suggests that mixtures of contaminants whose individual concentrations are below their no effect concentration may contribute significantly to the chronic toxicity of a mixture. Other studies have found metal mixtures to be less toxic than the sum of their single-metal toxicities (Finlayson and Verrue 1982; Hansen et al. 2002; Norwood et al. 2003; Vijver et al. 2011; Mebane et al. 2012). Synergism has been shown with pesticides (Norwood et al. 2003; Laetz et al. 2009) and other contaminants (Dorchin and Shanas 2013).

The toxicity of wastewater can be determined through WET tests, which are designed to integrate both the toxicity of the individual compounds and the interactions of these compounds in the evaluation of overall effects to organisms. In addition to providing insight into the aggregate toxicity of an effluent, WET tests allow for detection of toxicity caused by compounds that do not have effluent limits or that are not individually monitored.

The WET tests use standard aquatic test organisms (e.g., rainbow trout, fathead minnow, and *C. dubia*) to evaluate the cumulative toxicity of effluents. An acute toxicity test is defined as a test of 96 hours or less in duration in which lethality or immobility is the measured endpoint. A chronic toxicity test is defined as a long-term test in which sublethal effects, such as fertilization, growth, and reproduction, are usually measured, in addition to lethality. Traditionally, chronic tests are full life-cycle tests or a shortened test of about 30 days known as an early life stage test.

However, the duration of most of the EPA chronic toxicity tests have been shortened to 7 days by focusing on the most sensitive life-cycle stages.

In laboratory WET tests, an effluent sample is collected, diluted, and placed in test chambers with the chosen species. For the acute tests, the number of live organisms remaining in each test concentration and in the control is recorded after 24, 48, 72, and 96 hours. At test termination, the number of dead organisms is recorded and an LC_{50} is calculated. For chronic tests, organisms are placed in test chambers of various dilutions for specified periods of time. At various times during the exposure period, the organisms in each chamber are observed. At test termination, the lowest effluent concentration that causes a significant adverse impact on the most sensitive endpoint (e.g., mortality, reduced fertilization, reduced growth, lower fecundity) for that test is calculated.

Dilution water and quality assurance/quality control are important components of WET testing. Dilution water may either be standard laboratory water and/or the receiving water. The receiving water is used to dilute the effluent in some cases because it more closely simulates effluent and receiving water interactions. The EPA methods manuals recommend six dilutions, including the control, to determine the magnitude of toxicity. An example of a dilution series used in WET tests is 100, 50, 25, 12.5 and 6.25 percent effluent, and a control. Use of a standard control water and a reference toxicant test are both recommended to ensure quality assurance in chronic testing. Each of the chronic tests has minimum acceptability criteria for each endpoint that is measured in the controls (i.e., 80 percent survival and minimum criteria for growth, reproduction, and fertilization). The acute tests also have criteria of acceptability measured in the controls.

Since Idaho does not have a numeric criterion for WET; the IDEQ (2016; 2017a) will use recommendations in the *Technical Support Document for Water Quality-based Toxics Control* (EPA 1991) to develop effluent limits protective of the narrative toxics criterion. The WQBELs for WET will be expressed as toxic units. A toxic unit is the reciprocal of the percentage of effluent that causes a specific measured acute or chronic endpoint. The calculations for acute toxic units (TU_a) and chronic toxic units (TU_c) are:

$TU_a = 100/LC_{50}$
$TU_c = 100/NOEC, 100/IC_{25}, \text{ or } 100/LOEC$

Where:
NOEC = no observable effect concentration (used for survival endpoints)
IC_{25} = inhibition concentration causing a 25 percent reduction in a sublethal endpoints (e.g., growth, mobility, or reproduction)
LOEC = lowest observable effect concentration

The recommended magnitudes for WET are one TU_c and 0.3 TU_a for the most sensitive test species. Effluent limits for WET using these numeric thresholds are developed in the same manner as for the chemical criteria. Mixing zones for WET are also evaluated and authorized in the same manner as for individual pollutants. If there is no reasonable potential to exceed the TU_a or TU_c, then IDEQ will establish a trigger value equal to the dilution factor and will require WET monitoring (IDEQ 2018b).

The IDEQ has flexibility in determining the necessity and size of a mixing zone for WET. In addition, the IDEQ has discretion of when to require WET testing; however, there are some instances where WET testing is explicitly required (IDAPA 58.01.25.105.12). Specific conditions that, if met by a discharger, would require WET testing (IDEQ 2017a) and potential WET WQBEL development include:

- Facility is a POTW with a flow greater than or equal to one million gallons per day.
- Facility is a POTW with an approved pretreatment program.
- Facility uses, stores, produces, or transfers any hazardous substance listed in 40 CFR 302.4 with a statutory code of 1 (CWA §311(b)(2)) or 2 (CWA §307(a)).
- Facility's effluent contains any toxic pollutant listed in 40 CRF 122, Appendix D for which no water quality criteria exist for aquatic life protection listed in 40 CFR 131.36(b)(1).
- Facility belongs to an industrial category identified in 40 CFR 122, Appendix A (NPDES Primary Industry Categories)[4].
- Facility's effluent is suspected to be toxic because of apparent detrimental impact to aquatic life in the receiving water.
- The IDEQ determines that the facility has the potential to discharge toxics in toxic amounts.

In addition, the IDEQ will require WET testing if it is necessary to determine support of beneficial uses (IDEQ 2017b, 2018b). This assessment may include consideration of effluent variability, environmental baseline condition of the receiving water and relative contribution of the discharge to the receiving water, and other receiving water characteristics (e.g., presence of a sensitive beneficial use).

There is substantial literature identifying adverse effects that can occur when exposed to contaminant mixtures. Existing discharges have monitored WET of effluent for a number of years. Linear interpolation of data from chronic WET tests associated with Grouse Creek Mine discharges has estimated mortality and reduced growth effects at effluent concentrations as low as 4 and 7 percent, respectively, in a mixture with laboratory water (NMFS 2018).

NMFS (2014) recognizes that some species used for WET testing can be more tolerant of chemical exposures than salmonids. Furthermore, WET testing does not account for other potential sublethal effects, nor does it account for delayed effects. However, our ability to predict the combined effects of chemicals in mixtures is limited. As such, WET testing is a practical and reasonable approach to evaluating mixture toxicity of effluent even in light of its limitations.

[4] Industrial categories include, but are not limited to, aluminum forming, inorganic chemicals manufacturing, organic chemicals manufacturing, ore mining, pesticides, petroleum refining, pulp and paper mills, and timber products processing.

It is not possible to predict the behavior of individual fish and know with certainty that fish will not volitionally remain in a mixing zone area. Depending on the location and size of the mixing zone, it is possible that fish could be exposed to mixtures of contaminants for sufficient periods of time that would elicit sublethal or potentially lethal effects. Furthermore, we do not know when, where, or to what extent mixing zones will be authorized in the future. For these reasons, coupled with adverse effects from exposure to chemical mixtures being documented in scientific literature as well as in facility WET testing, we conclude that mixing zone authorizations for WET are likely to result in adverse effects to ESA-listed species.

Similar to what have been previously described, there are mixing zone provisions that can minimize the potential impact to ESA-listed fish from mixture toxicity. For example, the integrity of the aquatic community is required to be protected and mixing zones should not interfere with successful spawning, incubation, rearing, or migrating aquatic life. This provision would enable mixing zones for WET to be restricted if they are thought to contribute to reduced population productivity or abundance.

2.5.2.2 Sediment Toxicity

Sediment includes the material in the bottom of a water body and includes clay, silt, sand, gravel, and decaying organic matter. Many contaminants are insoluble in water, and as a result adsorb to organic or inorganic particulates and eventually settle onto the stream bottom (Collier et al. 2002; Yi et al. 2011; NMFS 2014). Contaminants that can accumulate in sediments include, but are not limited to, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, dioxin, metals, pesticides, herbicides, and ammonia (MacDonald et al. 2000a, 2000b; Yi et al 2011; Ipeaiyeda and Onianwa 2018). The degree to which contaminants accumulate in sediments is dependent on a variety of factors including, pH, redox conditions, oxidation states of elements, particle size, organic matter content, and iron and manganese oxides and hydroxides (Moberly et al. 2008).

Contaminated sediments are a pathway of exposure for fish either through direct contact or from ingestion of prey that become contaminated. Particulate forms of toxicants are either immediately bioavailable through resuspension or are a delayed source of toxicity through bioaccumulation or when water quality conditions favor dissolution. Specifically, contaminated sediments are expected to influence: (1) The intra-gravel life stages of listed salmon and steelhead; (2) the food source of listed salmonids; and (3) the fish through direct ingestion or deposition on the gill surfaces of particulate forms of toxicants.

Sediments near sites where there are continuing discharges of contaminants into the water can potentially function as a long-term repository and a continuing source of exposure to fish (Ipeaiyeda and Onianwa 2018; Bian et al. 2016). We are not able to predict with any degree of certainty whether the elevated contaminant concentrations authorized as a result of allowance for mixing would result in concentrations in bed sediments that are elevated to levels posing appreciable risks to listed salmonids or their prey. However, literature cited in this section suggests that sediment contamination does results from some point source discharges.

The rule does not explicitly address sediment or pore water toxicity, and the IDEQ has not established sediment quality guidelines for the protection of aquatic life. However, rule language prohibits IDEQ from authorizing mixing zones that unreasonably interfere with beneficial uses. The Guidance (IDEQ 2016) stipulates that IDEQ will consider the accumulation of a chemical into sediments as it evaluates whether a given effluent may cause harm to aquatic life. Furthermore, the IDEQ stated staff will use available scientific literature, such as that developed by MacDonald et al. (2000a) to evaluate sediment toxicity and attraction (Essig 2018). If IDEQ finds that the discharge has the potential to cause a hazardous accumulation of chemicals, then upstream and downstream monitoring of sediment quality would be required. Finally, the Guidance emphasizes the need for additional scrutiny when mixing zones are proposed to be authorized in areas where ESA-listed species or designated critical habitats occur (Sections 2.2.2 and 2.2.6). Together, the rule and Guidance language provide substantial flexibility in determining what constitutes unreasonable interference and restricting mixing zone sizes such that unreasonable interference does not occur.

2.5.2.3 Bioaccumulation

Bioaccumulation occurs when an organism takes up a contaminant and is not able to eliminate the contaminant, leading to an increase in body burdens relative to environmental concentrations. Sources of contaminant exposure can include water column, sediment, pore water, or biota (e.g., prey items). The IDEQ defines a bioaccumulative pollutant as one with bioaccumulation or bioconcentration factors greater than one thousand. Contaminants meeting this definition include organic compounds (e.g., polychlorinated biphenyls, polycyclic aromatic hydrocarbons, organochlorine pesticides), and methylmercury. Contaminants that do not meet this definition can still accumulate to toxic levels. Meador (2015) found tissue concentrations of copper and cadmium caused reduced growth or mortality in fish. NMFS (2014) reported that arsenic bioaccumulation through the dietary pathways was of concern because adverse effects (e.g., reduced growth, organ damage, and other physiological effects) could occur even when water column arsenic concentrations were below the chronic criterion. Selenium is another example where toxicity associated with bioaccumulation is of utmost importance (Hamilton et al. 1990; NMFS 2014), yet does not meet the IDEQ definition of "bioaccumulative pollutant." Farag et al. (1994) determined that continuous exposure to zinc at the chronic criterion concentration was associated with bioaccumulation of the metal by juvenile rainbow trout.

Very little is known about the exposure to and uptake of contaminants in juvenile salmon and steelhead that migrate and rear in Idaho waters. In addition, water quality and sediment data for much of the habitat in anadromous watersheds is incomplete. For example, there are only three U.S. Geological Survey National Water Quality Assessment monitoring sites within the migration corridor of Snake River sockeye salmon and no sites in spawning and rearing habitat. In general, toxics monitoring in the migratory corridor has largely occurred outside of the action area.

The mixing zone rule stipulates that "bioaccumulation of pollutants…resulting in tissue levels in aquatic organisms that exceed levels protective of human health or aquatic life" is considered unreasonable interference. The Guidance specifically addresses bioaccumulation and requires additional scrutiny when mixing zones are proposed for contaminants that are known to bioaccumulate. Although the rule and Guidance identifies particular contaminants as "bioaccumulative," the Guidance also recognizes other contaminants as having a moderate to high bioaccumulation potential, including selenium and arsenic. Because bioaccumulation varies with site-specific conditions, the IDEQ may require the discharger to provide additional information regarding the potential for particular pollutants to bioaccumulate or bioconcentrate in organisms residing in the receiving waters. Additional information may include contaminant concentration data for sediments or benthic macroinvertebrates (IDEQ 2016).

Although the rule specifically defines bioaccumulative pollutants, the Guidance offers flexibility to consider other contaminants that have a moderate to high propensity to bioaccumulate. In addition, unreasonable interference includes consideration of successful rearing and completion of life cycles. Bioaccumulation of contaminants to levels that reduce growth or cause other sublethal effects that reduce survival could therefore be considered unreasonable interference. Finally, the Guidance emphasizes the need for additional scrutiny when mixing zones are proposed to be authorized in areas where ESA-listed species or designated critical habitats occur (Sections 2.2.2 and 2.2.6). Together, the rule and Guidance language provide substantial flexibility in determining what constitutes unreasonable interference and restricting mixing zone sizes such that unreasonable interference does not occur.

2.5.2.4 Altered Thermal Regime

The temperature of effluent from permitted discharges varies significantly due to many factors including geographic location, seasonality, and facility type. One study noted temperatures from 13–25.5°C for a municipal wastewater treatment facility in Sacramento, California, compared to effluent temperatures ranging from 7 to 23°C for a municipal wastewater treatment facility in Mt. Angel, Oregon (WDOE 2010). The NMFS (2015b) Opinion for revisions to Oregon temperature criteria also noted variability of effluent temperatures (25 to 36°C) from different industrial and municipal facilities discharging to the Columbia River. Idaho wastewater permitted discharges would likely exhibit similar temperature ranges.

Salmonids are ectothermic and their survival is highly dependent upon water temperature, among other things. All life-stages of salmonids (i.e., spawning adults, egg incubation, fry emergence, juvenile rearing, migration [adult and juvenile], and pre-spawn holding) have optimal temperature thresholds. The magnitude of the species' zone of tolerance and upper and lower incipient lethal limits varies with temperature and duration of acclimation. When stream temperatures fall outside these ranges, fish may die or experience other sublethal impacts that reduce their likelihood of completing their life cycle.

Even small increases in temperatures (1–2°C) above biologically optimal ranges can have dire consequences such as reduced egg survival (McCullough et al. 2001). Crozier et al (2017) found that water temperature influenced adult Snake River spring/summer Chinook salmon survival migrating through the Columbia and Snake Rivers. Survival from Bonneville Dam to Lower Granite Dam varied from a low of 20 percent at temperatures over 20°C to a high of 80 percent at optimal temperatures (13–16°C). From 1999 to 2012, survival of passive integrated transponder (PIT) tagged adult sockeye salmon from Lower Granite Dam to the Sawtooth Valley was negatively correlated ($r^2 = 0.53$) to water temperature in the Snake River (Arthaud and Morrow 2013). River temperatures in the Frasier River were also strongly associated with adult mortality during their spawning migration (Macdonald et al. 2011). Sublethal effects that may occur as a result of exposure to elevated temperatures include reduced growth, increased susceptibility to disease, decreased ability to compete for food, decreased ability to evade predators, increased susceptibility to contaminant toxicity, slowed migration, and decreased gamete viability (EPA 2003). Stream temperature is a significant limiting factor for ESA-listed anadromous fish. In light of a changing climate, preserving and restoring cold water refugia throughout the migratory and rearing habitats is paramount.

The mixing zone rule allows for temperature-specific mixing zones. However, the rule provisions specifically identify heat in the discharge that causes thermal shock, lethality, or loss of cold water refugia as unreasonable interference. Furthermore, IDEQ is required to ensure mixing zones do not unreasonably interfere with successful spawning, egg incubation, rearing, or passage. We expect that when mixing zones for temperature are proposed in areas with anadromous fish, the IDEQ will provide adequate rationale for why the mixing zones will not cause unreasonable interference, especially when mixing zones utilize greater than 25 percent of the critical low flow volume.

2.5.2.5 Passage Barriers

Contaminants, alone or in combination, can create passage barriers in streams if concentrations exceed levels that are known to cause avoidance. Elevated stream temperatures can also create passage barriers. Avoidance response in fish has been studied for some metals including cadmium (Woodward et al. 1997; McNichol and Scherer 1991), copper (Hansen et al. 1999a, 1999b; Scherer and McNichol 1998, Woodward et al. 1997), lead (Woodward et al. 1997; Scherer and McNichol 1998), mercury (Atchison et al. 1987), and zinc (Hansen et al. 1999b; Woodward et al. 1997; Scherer and McNichol 1998). Most avoidance studies have been conducted in laboratories. Because the motivations of fish are much different in the laboratory than under natural conditions, laboratory experiments can only approximate the actual response (Atchison et al. 1987). In the natural environment, fish movements are not only influenced by chemical concentrations but also by prey availability, cover, shade, velocity, temperature and competition (Mebane 2006).

Except for copper and zinc, the literature on avoidance response of fish to metals concentrations is limited. In laboratory tests, copper and zinc mixtures have been shown to act together to cause a lower threshold of avoidance than would result from either metal alone (Giattina and Garton 1983). Hansen et al. (1999a) reported that rainbow trout and Chinook salmon exhibited behavioral avoidance to copper and cobalt individually, as well as in mixtures. Rainbow trout were found to avoid mixtures of metals (e.g., copper, cadmium, lead, and zinc) found in the Clark Fork River (Woodward et al. 1995; Hansen e al. 1999b). The avoidance responses of salmonids to contaminants is variable due to water chemistry (pH and hardness for example), the mixture of metals considered, and the species of salmonid. Generally, avoidance behavior is elicited at a higher concentration than the chronic criteria for individual metals (e.g. cadmium, chromium, and mercury).

Less research has been specifically performed on fish avoidance of thermal plumes. Adult salmon migration blockages are reported to occur consistently in the temperature range of 19 to 23°C (McCullough et al. 2001). The migration of spring/summer Chinook salmon in the Clearwater and Snake Rivers was blocked at 21°C (Stabler 1981; Stuehrenberg et al. 1978 as cited by Dauble and Mueller 1993). Detailed examination of PIT-tag records revealed increased incidence of sockeye salmon fallback events at dams (Bonneville, The Dalles, and Lower Granite) tended to be associated with water temperatures in excess of 22°C and may be related to temperature stress and the failure of homing behavior (NMFS 2019). MacDonald et al. (2011) also documented high sockeye salmon mortality events related to elevated instream temperatures.

While avoidance of a mixing zone could protect species from exposure to potentially harmful levels of pollutants, an avoidance response to a mixing zone could reduce the availability of, or restricting movement within, stream habitats. If an authorized mixing zone spans across the entire portion of a stream that is passable to fish, then it could potentially create a migratory barrier. According to the mixing zone rule, prohibiting successful passage of aquatic life constitutes unreasonable interference (IDAPA 58.01.02.060.01.d.i). As previously described, mixing zones can be conditioned or denied to limit adverse effects such as preventing access to, or restricting movement within, aquatic habitats. The Guidance specifically discusses avoidance and the need for restricting the extent of mixing zones to ensure sufficient stream area and volume of water provides for a zone of passage. The Guidance recognizes that more careful evaluation needs to be made when considering mixing zones on migratory routes of salmonids and monitoring of passage may be required in some circumstances.

While there is potential for mixing zone authorizations to adversely impact salmonid migration, there is sufficient basis in rule and sufficient guidance to effectively minimize this potential impact to ESA-listed species.

2.5.2.6 Application of Effects to VSP Parameters

As previously described, mixing zones have the potential to adversely impact individual fish through water column toxicity, sediment toxicity, bioaccumulation, altered thermal regimes, and passage barriers. Whether or not an individual experiences adverse effects depends upon a variety of factors, including the contaminant(s) to which the fish are exposed; the magnitude, duration, and frequency of exposure; the life stage and species exposed; the health of the individual; and other environmental factors that affect the toxicity of the contaminant(s) and susceptibility of the organism.

Our next step in this analysis is to evaluate the degree to which the VSP parameters could be affected by the proposed action and its subsequent implementation in CWA programs. The spatial structure and diversity VSP parameters are not expected to be impacted because the mixing zones are expected to be spatially limited throughout the action area and because mixing zones are not allowed to create passage barriers. Because the action could adversely affect individual fitness, the abundance and productivity attributes are of greatest concern. We assess the potential for the action to affect abundance and productivity separately for each species below. This is because each species has varying life history strategies and occupies different portions of the action area.

Snake River Sockeye Salmon. Within the action area, Snake River sockeye salmon utilize the Snake River from the Washington/Idaho border to the Salmon River, the Salmon River, and various creeks as migratory habitat. Spawning and rearing occurs in the Sawtooth Valley lakes and portions of Fishhook Creek and Redfish Lake Creek (NMFS 2015a). NMFS is not aware of any mixing zones currently authorized in spawning or rearing habitat for this species. There are at least four IDEQ-authorized mixing zones along the migratory corridor, including that of Clearwater Paper, City of Lewiston POTW, City of Riggins POTW, and City of Salmon POTW.

Currently, authorized mixing zones have the potential to affect adult and juvenile sockeye salmon only during their migration. Juvenile travel time from Redfish Lake Creek and Lower Granite Dam ranges from 5–20 days, with a median travel time generally being less than 11 days (Axel et al. 2017). Within the Lower Granite Reservoir, NMFS (2004) estimated the majority (90 percent) of sockeye smolts to pass through the reservoir within 15 days or less. Juveniles migrate between April and May, during the higher spring flows, when the physical extent of mixing zones are expected to be at their smallest. Conversely, adults migrate during periods of lower flows (i.e., from July through September), when the physical extent of mixing zones are expected to more closely mirror critical conditions. Median adult travel time from Lower Granite Dam to the Sawtooth weir from 2008–2013 ranged from 35 to 43 days (Crozier et al. 2014). Considering these relatively quick rates of travel, it is reasonable to assume that the majority of juvenile and adults are not likely to spend multiple days in one discrete area along their migration route in Idaho.

Given the existing federal protections (i.e., SNRA Act and Wilderness Act), it is highly unlikely that new point source discharges will be permitted in spawning/rearing habitat in the future. However, it is feasible that IDEQ will authorize new mixing zones for new point source discharges or authorize expanded mixing zones for existing dischargers along the migratory corridor in the future. The majority of the migratory corridor in Idaho lies within federally-managed lands. Any future discharges in these areas, and any future discharges in spawning/rearing areas (although improbable) will likely be associated with an action that requires federal authorization. Thus, NMFS will have an opportunity to review any proposed mixing zone authorizations in those areas as interrelated/interdependent to the larger federal action. For discharges in areas that are not federally-managed, NMFS will have an opportunity to review any proposed mixing zone authorizations and work with IDEQ and EPA as described in Section 1.3.3 to further minimize any potential impacts that are concern for this species.

In summary, there are few existing IDEQ-authorized mixing zones along the sockeye salmon migratory corridor in Idaho. Because these mixing zones are ongoing actions, their effects are already included in the baseline condition of the action area. However, because these mixing zones are anticipated to be reauthorized in the future, their effects are expected to continue and are considered as part of this consultation. Due to the antibacksliding provisions of the permitting program (CWA section 402(o)), it is unlikely that the quality of these discharges will degrade over time. In addition, it is possible that new mixing zones will be authorized for new discharges in the future. Rule provisions enable IDEQ to minimize negative effects resulting from mixing zone authorizations. In particular, NMFS believes the following rule provisions are especially important in minimizing adverse effects: (1) IDEQ’s authority to condition or deny mixing zones; (2) mixing zones cannot be larger than necessary; and (3) mixing zones cannot unreasonably interfere with beneficial uses. Furthermore, NMFS will review future mixing zone authorizations either through their association with a separate federal authorization for an activity on federally-managed lands or through the IDEQ public comment process. Through these processes, NMFS will identify concerns and provide suggestions (or requirements in the case of section 7 consultation) to minimize adverse impacts to Snake River sockeye salmon.

Existing mixing zones, when taken together are assumed to occupy a very small fraction of available habitat for juvenile and adult spawning. Information about the length and width of mixing zones is not available for the vast majority of discharges because CORMIX modeling is reserved for the facilities with the greatest potential to impact beneficial uses. The extent of mixing zones will vary depending on various factors such as the relative flows of the receiving water and effluents, temperature, configuration of the outfall, and channel and substrate characteristics. For the Grouse Creek Mine discharges, CORMIX modeling estimated the linear extent of mixing zones to range from as little as three feet to more than 2,000 feet. For purposes of this Opinion, we will assume that mixing zones for each facility encompass a total of 500 linear feet. This is likely a conservative assumption because we are applying it equally to all facilities with authorized mixing zones.

The migratory corridor for sockeye salmon from the Idaho/Washington border to the Sawtooth Valley lakes is more than 400 miles long. Assuming each existing mixing zone encompassed 500 linear feet, less than 0.1 percent of the sockeye salmon migratory corridor is currently impacted by a mixing zone. In these areas, mixing zones do not expand the entire width of the channel, but instead are restricted to a small fraction of the width of the river, allowing for passage around.

There is potential for a few individual fish to linger within existing and any future authorized mixing zones for a period long enough to elicit sublethal effects or behavioral alterations. However, for the reasons outlined above, NMFS believes the vast majority of fish will not be affected by mixing zones. Because only a few fish are expected to be adversely affected each year, EPA’s approval of the proposed mixing zone rule and IDEQ’s subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River sockeye salmon.

Snake River Fall Chinook Salmon. Fall Chinook salmon inhabit the Snake River below Hells Canyon Dam, Salmon River up to French Creek, and the Clearwater River and some of its larger tributaries. Adults are most commonly present from September through November. Juveniles typically migrate downstream in spring, summer, and fall with some overwintering in the Lower Granite Reservoir.

Currently, all life stages of Snake River fall Chinook salmon have the potential to be exposed to mixing zones. There are at least eight permitted point source discharges with IDEQ-authorized mixing zones within habitat occupied by fall Chinook salmon. Those include the Clearwater Paper, Lewiston POTW, and a number of small wastewater treatment plants (WWTP). Because the Clearwater Paper and Lewiston POTW discharges are near the confluence of the Clearwater and Snake Rivers, we assume that all adult and juvenile fish in this ESU have the potential to be exposed to mixing zones associated with those discharges. A few of the smaller WWTP and drinking water treatment facilities discharge to reaches of the Clearwater River where relatively high densities of fall Chinook salmon redds were documented in 2015, which was a year of high adult returns (Arnsberg 2019). Barring any site-specific information, NMFS assumes that redds could be constructed near the facility outfalls.

Emergence timing and residence time of fall Chinook salmon varies among reaches and years (Keefer and Peery 2008). Emergence in the Snake River is earlier than what occurs in the Clearwater River. Juvenile fish may remain in the free-flowing portions of the Clearwater and Snake Rivers for weeks to months prior to beginning their emigration downstream. In addition, juvenile fish may spend a substantial amount of time in the upper reaches of the Lower Granite Reservoir (e.g., in the transitional zones between the free flowing rivers and the reservoir), and some may even overwinter in the reservoir. Considering these varying life history strategies and barring any site-specific information about habitat conditions within currently authorized mixing zones or mixing zones authorized in the future, we cannot rule out the potential for juvenile fall Chinook salmon to be exposed to mixing zones for extended periods of time.

Most adult fall Chinook salmon pass over Lower Granite Dam by early August (Columbia River DART 2019) and are present in the action area from August through November. From the Lower Granite Reservoir, adult fish need to travel between 18 and 95 miles to spawning habitat. Connor and Garcia (2006) documented prespawning movements by adult Chinook salmon in the Snake River upstream of Lower Granite Dam. The authors described a migratory phase, which included the upstream movement of adult fish to their natal or release sites, followed by a search phase where adults searched for suitable spawning habitat. On average, the time spent migrating and searching for spawning habitat was about 45 days. Although the sample size was small, the distance traveled coupled with the time it took to reach spawning sites suggest that adult fish are unlikely to spend a substantial amount of time in a given location prior to spawning. An exception to this could exist when adults remain in cold water refugia during periods when mainstem stream temperatures are high.

At least half of the Snake River that is occupied by fall Chinook salmon lies within federal lands. Considering the remoteness of this area coupled with the federal protections that are in place, it is highly unlikely that new discharges will be authorized along the Snake River upstream from areas already urbanized (i.e., near Lewiston, Idaho and Asotin, Washington). Conversely, the vast majority of habitat potentially occupied by fall Chinook salmon in the Clearwater River is under private ownership. It is possible that new mixing zone authorizations, including expansion of existing mixing zones, could occur in urban and rural areas of the Snake and Clearwater River overlapping Snake River fall Chinook salmon habitat.

There are a number of existing IDEQ-authorized mixing zones in fall Chinook salmon habitat. Because these mixing zones are ongoing actions, their effects are already included in the baseline condition of the action area. However, because these mixing zones are anticipated to be reauthorized in the future, their effects are expected to continue and are considered as part of this consultation. Rule provisions enable IDEQ to minimize negative effects resulting from mixing zone authorizations. In particular, NMFS believes the following rule provisions are especially important in minimizing adverse effects: (1) IDEQ’s authority to condition or deny mixing zones; (2) mixing zones cannot be larger than necessary; and (3) mixing zones cannot unreasonably interfere with beneficial uses. Furthermore, NMFS will review future mixing zone authorizations either through their association with a separate federal authorization for an activity on federally-managed lands or through the IDEQ public comment process. Through these processes, NMFS will identify concerns and provide suggestions (or requirements in the case of section 7 consultation) to minimize adverse impacts to Snake River fall Chinook salmon. Existing mixing zones, when taken together, occupy a very small fraction of available habitat for juvenile rearing and adult spawning. For example, fall Chinook currently occupy roughly 330 miles of river in Idaho. If we were to assume that each existing mixing zone encompassed 500 linear feet, then less than 0.2 percent of the habitat currently has a mixing zone associated with it. In these areas, mixing zones are restricted to a small fraction of the width of the river, allowing for passage around.

There is potential for a few individual fish to inhabit existing and any future authorized mixing zones for a period long enough to elicit sublethal effects or behavioral alterations. However, for the reasons outlined above, NMFS believes the vast majority of fish will not be affected by mixing zones. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River fall Chinook salmon.

Snake River spring/summer Chinook Salmon. Snake River spring/summer Chinook salmon inhabit streams and rivers in the Snake River (from Lower Granite Reservoir upstream to the Hells Canyon Dam and all accessible reaches in the Salmon River basins. Adults may be in the action area from May through September, when spawning activities are generally completed. Juveniles can spend one to two years rearing in freshwater. Due to their longer residence time and tendency to establish territorial areas, juveniles are at greatest risk of being exposed to mixing zones for longer periods of time.

Currently, all life stages of spring/summer Chinook salmon have potential to be exposed to mixing zones and exposure can occur during the critical time periods. There are at least seven permitted point source discharges with IDEQ-authorized mixing zones within habitat occupied by ESA-listed spring/summer Chinook salmon. Those include the Clearwater Paper, Thompson Creek Mine (which has three points of discharge with authorized mixing zones), Blackbird Mine, Grouse Creek Mine (which has two points of discharge with authorized mixing zones), City of Riggins POTW, and City of Salmon POTW[5]. All adult and juvenile fish in the four MPGs that enter Idaho have the potential to be exposed to mixing zones associated with the Clearwater Paper discharge. No individuals in any given population are exposed to more than an additional three mixing zones (two of which are the smaller POTWs). Individuals from the Yankee Fork population, Salmon River Lower Mainstem, and Panther Creek populations may be exposed to mine-related discharges with approved mixing zones.

There is potential for a few individual fish to reside within existing and any future authorized mixing zones for a period long enough to elicit sublethal effects described in Section 5.2. Existing mixing zones, when taken together occupy a very small fraction of available habitat for juvenile rearing and adult spawning. For example, there are about 1,575 miles of stream habitat characterized as having intrinsic potential for spring/summer Chinook salmon spawning and

[5] No mixing zone was authorized for discharges at Idaho Cobalt Mine. In addition, NMFS assumes that any mixing zone associated with discharges at Beartrack Mine would not overlap occupied habitat because the discharge point is located far upstream of designated critical habitat.

early rearing (Cooney and Holzer 2006). If we were to assume that each existing mixing zone encompassed 500 linear feet, then less than 0.1 percent of the habitat currently has a mixing zone associated with it. In these areas, mixing zones are restricted to a fraction of the receiving stream and allow for salmonid passage.

As described in Section 2.2, the vast majority of habitat occupied by Snake River spring/summer Chinook salmon is under federal ownership. It is plausible that mixing zones for new discharge or expanded mixing zones for existing discharges will be authorized in the future. The greatest potential for new discharges to rivers include mineral development and WWTP discharges from growing rural areas (e.g., Challis). At a minimum, existing IDEQ-authorized mixing zones in spring/summer Chinook salmon habitat are anticipated to be reauthorized in the future. Effects associated with these mixing zones are included in the baseline condition of the action area; however, because they are ongoing actions their effects are expected to continue and are considered as part of this consultation. Rule provisions enable IDEQ to minimize negative effects resulting from mixing zone authorizations. In particular, NMFS believes the following rule provisions are especially important in minimizing adverse effects: (1) IDEQ's authority to condition or deny mixing zones; (2) mixing zones cannot be larger than necessary; and (3) mixing zones cannot unreasonably interfere with beneficial uses. Furthermore, NMFS will review future mixing zone authorizations either through their association with a separate federal authorization for an activity on federally-managed lands or through the IDEQ public comment process. Through these processes, NMFS will identify concerns and provide suggestions (or requirements in the case of section 7 consultation) to minimize adverse impacts to Snake River spring/summer Chinook salmon.

There is potential for a few individual fish to inhabit existing and any future authorized mixing zones for a period long enough to elicit sublethal effects or behavioral alterations. However, for the reasons outlined above, NMFS believes the vast majority of fish will not be affected by mixing zones. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River spring/summer Chinook salmon.

Snake River Basin Steelhead. Steelhead inhabit streams and rivers in the Snake River (from Lower Granite Reservoir upstream to the Hells Canyon Dam and all accessible reaches in the Salmon and Clearwater River basins. Adults may be in the action area from October (Columbia River DART 2019) through May, when spawning activities are generally completed. Juveniles can spend multiple years rearing in freshwater. Due to their longer residence time and relative tendency to stay in territorial areas, juveniles have a greater likelihood of being exposed to mixing zones for longer periods of time.

Currently, all life stages of steelhead have potential to be exposed to mixing zones and exposure can occur during the critical time periods. There are at least fourteen permitted point source discharges with IDEQ-authorized mixing zones within habitat occupied by ESA-listed spring/summer Chinook salmon. Those include the Clearwater Paper; Thompson Creek Mine; Blackbird Mine; Grouse Creek Mine; and Riggins, Salmon, Kooskia, Culdesac, Juliaetta, Kamiah, Lewiston, Orofino, and Ahsahka city sewerage treatment systems[6]. Fish from the Grande Ronde, Imnaha, Clearwater, and Salmon River MPGs have the potential to be exposed to mixing zones associated with the Clearwater Paper and City of Lewiston mixing zones. Fish from the Clearwater MPG, more specifically, the Clearwater Lower Mainstem population, have the potential to be exposed to the greatest number of mixing zones. Individuals from the Panther and Upper Salmon River populations can be exposed to mine-related discharges with approved mixing zones.

Existing mixing zones, when taken together occupy a very small fraction of available habitat for juvenile rearing and adult spawning. For example, there are about 5,200 miles of stream habitat characterized as having intrinsic potential for Snake River Basin steelhead spawning and early rearing (Cooney and Holzer 2006). If we were to assume that each existing mixing zone encompassed 500 linear feet, then less than 0.05 percent of the habitat currently has a mixing zone associated with it. In these areas, mixing zones are restricted to a fraction of the receiving stream and allow for salmonid passage.

As described in Section 2.2, the vast majority of habitat occupied by Snake River Basin steelhead is under federal ownership. It is plausible that mixing zones for new discharge or expanded mixing zones for existing discharges will be authorized in the future. The greatest potential for new discharges to rivers include mineral development and WWTP discharges from growing rural areas (e.g., Challis). At a minimum, existing IDEQ-authorized mixing zones in are anticipated to be reauthorized in the future. Effects associated with these mixing zones are included in the baseline condition of the action area; however, because they are ongoing actions, their effects are expected to continue and are considered as part of this consultation. Rule provisions enable IDEQ to minimize negative effects resulting from mixing zone authorizations. In particular, NMFS believes the following rule provisions are especially important in minimizing adverse effects: (1) IDEQ’s authority to condition or deny mixing zones; (2) mixing zones cannot be larger than necessary; and (3) mixing zones cannot unreasonably interfere with beneficial uses. Furthermore, NMFS will review future mixing zone authorizations either through their association with a separate federal authorization for an activity on federally-managed lands or through the IDEQ public comment process. Through these processes, NMFS will identify concerns and provide suggestions (or requirements in the case of section 7 consultation) to minimize adverse impacts to Snake River Basin steelhead.

There is potential for a few individual fish to inhabit existing and any future authorized mixing zones for a period long enough to elicit sublethal effects described in Section 5.2. However, for the reasons outlined above, NMFS believes that exposures of the vast majority of steelhead will not be affected by mixing zones. Because only a few fish are expected to be adversely affected each year, EPA’s approval of the proposed mixing zone rule and IDEQ’s subsequent implementation of the rule is not expected to reduce the abundance or productivity of populations within the Snake River Basin steelhead DPS.

2.5.3 Effects to Designated Critical Habitat

[6] No mixing zone was authorized for discharges at Idaho Cobalt Mine. In addition, NMFS assumes that any mixing zone associated with discharges at Beartrack Mine would not overlap occupied habitat.

Designated critical habitat for Snake River sockeye salmon, Snake River fall Chinook salmon, Snake River spring/summer Chinook salmon, and Snake River Basin steelhead within the action area is described in Table 8 and illustrated in Figure 2. While the extent of designated critical habitat throughout the action area varies by species, all four species have similar freshwater habitat requirements. As such, the following designated critical habitat analysis is applicable to all four species.

Table 7 summarizes the PBFs necessary to support freshwater spawning, rearing, and migration. There is little to no relation between mixing zones and the condition of the following PBFs: water quantity, riparian vegetation, instream cover/shelter; water velocity; and floodplain connectivity. As such, these PBFs are not discussed further. The critical habitat PBFs that could potentially be affected by the proposed action include water quality, water temperature, spawning substrate, forage, and safe passage. These PBFs are discussed in the following subsections.

2.5.3.1 Water Quality

Mixing zones are areas where pollutant concentrations may exceed established criteria. The localized effects of mixing zones on water quality have been described above. Individual fish that spend extended periods of time in these areas are likely to experience sublethal effects. If redds are built within mixing zone areas, it is possible that embryos would either not survive or the alevins with either have deformities or other sublethal physiological changes that reduce their chances of survival. While water quality in mixing zones is not expected to interfere with migration (see Section 2.5.3.5 for further discussion), water quality in mixing zones is not expected to be suited for successful spawning or rearing. As such, the conservation value of the water quality PBF will be diminished in the localized areas of mixing zones.

2.5.3.2 Temperature

Mixing zones may be authorized for temperature, and in these localized areas, temperatures are not expected to be within the optimal ranges for salmon and steelhead. As described above, fish residing in areas with altered thermal regimes can experience slowed migration, reduced growth, increased susceptibility to disease, decreased ability to compete for forage and evade predators, increased susceptibility to contaminant toxicity, and decreased gamete viability. As such, the conservation value of the temperature PBF will be diminished in the localized areas of mixing zones.

2.5.3.3 Spawning Substrate

Elevated levels of TSS or other contaminants associated with mixing zone authorizations can readily deposit on substrates in localized areas of the stream. This, in turn, may result in the following effects to salmonid habitat: (1) Reduce the ability of fish to build suitable redds; (2) hinder water flow through redds (leading to decreased oxygen saturation and removal of metabolic waste); (3) fill interstitial spaces (reducing the habitat for alevins, and preventing the emergence of fry); and (4) reduce the quantity or quality of forage for alevins and juvenile fish. The mixing zone provisions state that the narrative criteria for deleterious materials and floating, suspended, or submerged matter apply within the mixing zone (IDAPA 58.01.02.060.01.b). These narrative criteria prohibit these types of materials being present in concentrations that impair beneficial uses. Because deposition of materials within the mixing zone is prohibited by these narrative criteria, we do not expect to see negative impacts to spawning substrates. As such, we do not expect the conservation value of the spawning substrate PBF to be diminished in localized areas of mixing zones.

2.5.3.4 Forage

Juvenile salmon and steelhead are opportunistic feeders and typically eat larval and adult insects, zooplankton, and other macroinvertebrates. While salmonids may eat a variety of insects, mayflies and chironomid midges appeared to be disproportionately important (Davis 2015; Healy 1991). Many invertebrates are sensitive to toxic substances; therefore, mixing zones are expected to have a localized, negative effect on aquatic macroinvertebrate communities. Although there may be community-level changes and possibly some reduction of the conservation value of the forage PBF in localized areas as a result of mixing zone authorizations, this reduction is not anticipated to impact the overall ability of the stream to provide forage for juvenile fish. This is because mixing zones are limited in size and invertebrates will drift downstream from areas outside of the mixing zone. Furthermore, salmonids will shift their feeding to whatever is abundant, accessible, and palatable (NMFS 2014).

2.5.3.5 Safe Passage/Space

Mixing zones have the potential to create areas that fish avoid, and can effectively impede or block upstream or downstream fish passage if not properly sized. As described in Section 2.5, behavioral avoidance of metals has been demonstrated both in the laboratory and field at very low concentrations for a variety of metals and metal mixtures. However, avoidance responses are highly variable depending on water chemistry, species exposed, the metal or mixture of metals encountered, and temperature, cover, shade, prey availability, presence of predators, and competition with other fish. This makes it very difficult to predict whether and to what extent an avoidance response may occur, especially when site-specific details are not available.

Mixing zones utilizing less than 25 percent of the critical stream flow are generally presumed to support safe passage. Authorization of mixing zones larger than this will require site-specific justification that passage will not be impeded. Furthermore, the extent to with the mixing zone and the zone of passage (based on water velocity and depth) overlap will be considered when mixing zones are authorized for constituents that are known to elicit an avoidance response (IDEQ 2016). Because impeding passage is not authorized, implementation of the mixing zone provisions is not expected to measurably affect safe passage. However, mixing zones are expected to cause localized areas of degraded habitat quality. As such, the conservation value of the space PBF will be reduced to some degree.

2.5.3.6 Summary of Effects to Designated Critical Habitat

Mixing zones are expected to adversely affect the water quality, temperature, space, and forage PBFs in localized areas of the stream. As described in Section 2.5.2.6, existing mixing zone authorizations are distributed throughout the action area. Mixing authorizations exist in sockeye salmon migratory habitat, but do not exist in sockeye salmon spawning or rearing habitat. Mixing zones exist in migratory, spawning, and rearing habitat for the remaining three species.

The proposed rule provisions, coupled with the authorization process provide sufficient mechanisms to minimize negative effects to designated critical habitat. In particular, NMFS believes the following rule provisions are especially important in minimizing adverse effects: (1) IDEQ's authority to condition or deny mixing zones; (2) mixing zones cannot be larger than necessary; and (3) mixing zones cannot unreasonably interfere with beneficial uses. The authorization process requires IDEQ to seek public comment on proposed mixing zones. This enables NMFS to review site-specific mixing zone authorizations, identify concerns regarding the potential impact of mixing zones on ESA-listed species or their designated critical habitat, and provide suggestions for minimizing adverse impacts. Finally, a substantial amount of designated critical habitat falls within federally-managed lands. As previously described, mixing zones in these areas will likely be associated with an activity that requires a federal authorization, which will in turn undergo a separate consultation.

At most, existing mixing zones encompass less than 0.2 percent of the designated critical habitat within Idaho for these species. It is likely that additional mixing zones will be authorized in the future; however, we are not able to predict when or where those mixing zones will be. Based on the number of new discharges authorized since 2009, the vast majority of land being under federal ownership, and the relatively low population growth rates in urban and rural areas, we do not anticipate there will be a substantial number of new discharges in the future. For purposes of this Opinion, we have assumed that mixing zone authorizations could double in the future. Considering the rule provisions and mixing zone authorization processes, coupled with the relatively small amount of available designated critical habitat that could be impacted by mixing zones (even when considering a doubling of mixing zone authorizations) above information, NMFS concludes that the function and conservation role of the water quality, temperature, space, and forage PBFs within the action area will not be appreciably diminished. By extension, the function and conservation role of the PBFs at the critical habitat designation scale will not be appreciably diminished.

2.5.4 Effects of Climate Change

As previously described, the mixing zone rules will remain in place and will be applied to CWA programs until the rules are repealed and replaced. Thus, our analysis of effects for species and their designated critical habitat extends from the date of this Opinion for as long as the mixing zone rule remains effective.

The hydraulic regimes of streams in Idaho are expected to be impacted by climate change. Those impacts will result in lower summer baseflows, higher winter flows, early spring runoffs, and elevated stream temperatures. As described in Section 2.5, mixing zone authorizations consider critical conditions in the streams and are only applicable for the duration of the permit. The CWA stipulates permit terms of five years; however, permit extensions are authorized under specific circumstances. As part of the permit renewal process, current information on stream temperatures, hydrology, and chemical contaminants is obtained and critical conditions are reevaluated. Any realized impacts resulting from climate change are expected to be reflected in the updated baseline information.

In the past, permits have been administratively extended for up to a total of 10 years, which means that it is reasonably foreseeable that mixing zone authorizations could be in place for an extended period of time. However, even in these situations, climate change is not expected to amplify the effects of the proposed action. The potential localized effects of the proposed action on water quality are not expected to be exacerbated by climate change effects to a degree that reduces the ability of the water quality PBF to meet the conservation needs of the species. Any potential effects of climate change on stream flows, instream temperature, or water quality will be captured in the ongoing monitoring and incorporated into the next permit development cycle when mixing zone authorizations are reevaluated.

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). 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 environmental baseline (Section 2.3).

Non-federal actions, which are summarized in the baseline section, are likely to continue affecting ESA-listed fish species. The cumulative effects of non-federal actions are difficult to analyze due to the action area's size, broad geographic landscape, and land use diversity. Whether those effects will increase or decrease in the future is not known; however, generally speaking, counties within the action area experienced population growth between 0.3 and 12 percent from 2010 and 2018 (U.S. Census Bureau 2019b). The one exception to this was Custer County, which experienced a two percent reduction in population during this same time period. Based on patterns of percent change in populations, it is reasonable to conclude effects of non-federal actions are likely to increase in some areas and may decrease in others. Examination of Idaho's IPDES Permit Issuance Plan: 2019–2020 (IDEQ 2019), indicates that there are no new facilities seeking a discharge permit in the action area at this time[7].

In general, we expect trends in habitat quality in the action area to remain relatively flat with gradual declines or improvements in some areas depending on spatial scale (e.g., site, reach, watershed, basin), level of development (i.e., forest, rural, urban), and variation in levels of economic activity in different geographic regions. At best, these trends will increase population

[7] As previously stated, NMFS is aware of a potential future discharge in the East Fork South Fork Salmon River; however, because that facility (Stibnite Gold) is involved in a federal activity, it is not considered part of the cumulative effects.

abundance and productivity for the species affected by this consultation. In most instances, we expect cumulative effects will have a minor, negative effect on population abundance trends. Similarly, we expect the quality and function of critical habitat PBFs generally to express a minor negative trend over time as a result of the cumulative effects, with the possibility of a gradual positive or negative trend depending on the balance between economic activity and habitat protection and restoration.

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 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 diminishes the value of designated or proposed critical habitat for the conservation of the species. Components of this analysis that are common to all species are described below and are not repeated in Sections 2.7.1 through 2.7.4.

Anadromous salmonids migrate long distances as juveniles and adults. During migration, salmon and steelhead are exposed to many environmental stressors, one of which is pollution from point and nonpoint sources. Contaminants in municipal, agricultural, and industrial point and nonpoint sources are known to be toxic to fish. Warm stream temperatures can impede migration and reduce fitness of adults traveling to spawning grounds. Water quality criteria have been developed for some, but not all, toxic contaminants as well as for water temperature. While criteria are geared toward establishing levels that protect aquatic communities, mixing zones allow areas of the streams to exceed those standards.

The existing environmental baseline for all species varies from excellent condition in wilderness portions of the action area to severely degraded in areas with agricultural (e.g., Upper Salmon basin) or urban (e.g., Lower Clearwater basin) impacts. The effect of degraded baseline conditions is a general and systemic reduction in carrying capacity for each of the anadromous species considered in this Opinion. Temperature is a significant limiting factor for the vast majority of salmon and steelhead populations. Additionally, toxic contaminants from both point and nonpoint sources are a threat to all four anadromous species that reside in Idaho. Exposure to toxic chemicals during all life stages may contribute to low survival and impede recovery of the species.

The environmental baseline includes effects of existing, authorized mixing zones throughout the action area. Because these mixing zones are expected to be reauthorized, their effects on ESA-listed species and designated critical habitat are expected to continue. Due to the antibacksliding provisions of Section 402 of the CWA, it is reasonable to conclude that these discharges will not worsen over time and authorized mixing zones are likely to remain the same or diminish in size. Additional mixing zones are anticipated to be authorized in the future; however, it is not possible to predict when, where, or how many will be authorized with any reasonable certainty.

Climate change will likely alter the hydraulic regimes of Idaho streams, resulting in lower summer baseflows, higher winter flows, early spring runoffs, and elevated stream temperatures. Discharge permits and their associated mixing zone authorizations are issued for 5-year terms; however, we recognize they may be administratively extended for a number of years. As part of the permit renewal process, current information on stream temperatures, hydrology, and contaminant concentrations are expected to be gathered. As such, any habitat changes caused by climate change will be reflected in the updated baseline information. Because climate change impacts will be incorporated into the mixing zone analysis, and because permits are good for a short period of time (relative to climate change), any effects of the proposed action on ESA-listed species and designated critical habitat are not expected to be further exacerbated by climate change.

The environmental baseline also reflects impacts from existing federal and non-federal land use activities on ESA-listed species are reflected in the environmental baseline section of this document. Current levels of these uses are likely to continue into the future and are unlikely to be substantially more severe than they currently are. In general, we expect trends in habitat quality in the action area to remain relatively flat with gradual declines or improvements in some areas depending on spatial scale, level of development, recovery actions undertaken, and variation in levels of economic activity in different geographic regions.

The actual mixing of a particular effluent and river will vary over time, and the instream area where criteria are exceeded is expected to fluctuate in response to varying effluent and receiving water conditions (i.e., flows and chemical concentrations). By designing mixing zones under critical conditions, the impacted instream area represents the worst-case extent that would be expected to occur (assuming the discharge complies with its effluent limits and the receiving stream flows are no lower than the critical conditions). Our analysis in Sections 2.5.2 and 2.5.3 has shown that mixing zone authorizations can adversely affect ESA-listed species and designated critical habitat. Furthermore, our analysis recognized that new discharge facilities were likely to be permitted in the future, but that it is not feasible to predict when, where, and what type of mixing zones will be authorized in the future. Considering the low number of new discharge facilities that have been permitted over the past the past 10 years, federal ownership of the vast majority of land in the action area, and relatively little urbanization, we have assumed that doubling the number of existing mixing zone authorizations would be a relatively conservative assumption to include in our analysis of effects.

Many of the potential adverse effects can be mitigated through careful determinations of the size, configuration and location of mixing zones based on the specific needs of the water body and aquatic community. Techniques to promote faster mixing, and thus smaller mixing zones include use of diffusers that are submerged and located off the bank and/or to increase treatment requirements. In addition, the mixing zone rule provisions provide substantial flexibility for minimizing the potential of mixing zones to cause lethal and sublethal effects to ESA-listed species and to diminish the quality of designated critical habitat. Notable provisions that provide this flexibility include: (1) IDEQ may condition or deny mixing zones; (2) mixing zones may be no larger than is necessary; and (3) mixing zones may not cause unreasonable interference to beneficial uses.

The Guidance states that new discharges or expanded mixing zone authorizations in areas that support anadromous fish will be reviewed with a "higher degree of scrutiny." Specifically, the Guidance recognized that additional restrictions or additional monitoring may be required depending on the potential impact on the species. NMFS believes it is reasonable to conclude that any mixing zone interfering with one or more populations of spring/summer Chinook salmon, fall Chinook salmon, sockeye salmon, or steelhead, such that recovery is impeded constitutes an impairment to the integrity of the aquatic community. Thus, in such situations, the IDEQ would be required to deny or limit the size of the mixing zone. Overall, the rule language, coupled with direction provided by the Guidance leave substantial latitude in defining what constitutes unreasonable interference for ESA-listed anadromous fish and subsequently restricting the size of mixing zones.

Additional measures that can result in reducing the potential for adverse effects include the interagency coordination that is described in the BE (EPA 2019) and summarized in Section 1.3.3 of this Opinion. As part of this interagency coordination, the IDEQ committed to providing NMFS with annual permit implementation plan as well as draft permits (EPA 2019). Through review of these documents, NMFS can identify permits or issues of particular concern. NMFS anticipates that fact sheets accompanying draft permits will provide adequate justification that any authorize mixing zone will not unreasonably interfere with beneficial uses. If after review of this material, NMFS has concerns about whether adverse effects have been adequately minimized, NMFS can submit comments to IDEQ. In the event that IDEQ does not adequately address NMFS' concerns, EPA has oversight authority and can object to the permit issuance. In extreme cases, the EPA has authority to federalize the permit where appropriate with the CWA. While these commitments are important mechanisms by which adverse effects can be minimized, there remains substantial uncertainty about whether concerns NMFS may have relative to proposed mixing zone authorizations in the future will be adequately addressed. As such, our effects analysis primarily relies on our interpretation of the rule language, as informed by the Guidance and BE (EPA 2019), and less weight is given to implementation of the proposed conservation measures.

Finally, the fact that a vast majority of occupied habitat lies within federal land ownership provides another avenue by which adverse effects can be minimized. Activities on federal land will require federal authorization, which in turn requires consultation. In these situations, NMFS will be able to evaluate the interrelated/interdependent effects of discharges and authorized mixing zones on ESA-listed species. Together, those activities are not allowed to result in jeopardy to the species, or destruction or adverse modification of designated critical habitat.

2.7.1 Snake River spring/summer Chinook Salmon

The Snake River spring/summer Chinook salmon ESU is currently threatened. In order to be a candidate for delisting, the abundance and productivity of many populations will need to increase. Numerous limiting factors will need to be addressed to recover the species, including elevated stream temperatures and toxic contaminants.

As described above, mixing zone authorizations have the potential to adversely impact individual spring/summer Chinook salmon. Currently, spring/summer Chinook salmon are exposed to at least seven IDEQ-authorized mixing zones. These mixing zones are spread throughout their designated critical habitat, and encompass a very small proportion of the stream. While it is possible that spring/summer Chinook salmon will be exposed to additional mixing zones in the future, we do not expect there to be many more mixing zones authorized in the action area. For these reasons, the vast majority of spring/summer Chinook salmon are not expected to reside in mixing zones long enough to experience adverse effects. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River spring/summer Chinook salmon. Therefore, it is NMFS's opinion that the proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

2.7.2 Snake River Fall Chinook Salmon

Substantial improvements in the abundance and productivity of the ESU through 2015 lead NMFS to reduce the ESU's risk of extinction from moderate to low (NMFS 2016a). Even in light extinction risk reduction, the species remains listed as threatened. In order to recover the species under a single population scenario, one or more major spawning areas must produce a significant level of natural-origin spawners with low hatchery influence (NWFSC 2015). Numerous limiting factors, including elevated stream temperatures and toxic contaminants, will need to be addressed to recover the species.

As described above, mixing zones authorizations have the potential to adversely impact individual fall Chinook salmon. Currently, fall Chinook salmon are exposed to at least eight IDEQ-authorized mixing zones. These mixing zones are spread throughout their designated critical habitat, and encompass a very small proportion of the stream. While it is possible that fall Chinook salmon will be exposed to additional mixing zones in the future, we do not expect many more mixing zones to be authorized in the future. For these reasons, the vast majority of fall Chinook are not expected to reside in mixing zones long enough to experience adverse effects. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River fall Chinook salmon. Furthermore, recent increases in abundance and productivity suggest that existing mixing zones are not likely impacting recovery. Therefore, it is NMFS's opinion that the proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

2.7.3 Snake River Sockeye Salmon

The Snake River sockeye salmon ESU is currently endangered. In order to be a candidate for delisting, at least two of the three historical lake populations need to be restored to a highly viable status and a third needs to obtain viable status. In order to achieve this, substantial increases in survival rates across all life history stages must occur (NWFSC 2015). In particular, juvenile and adult losses during travel through the Salmon, Snake, and Columbia River migration corridor continue to present a significant threat to species recovery (NMFS 2015a).

As described above, mixing zones authorizations have the potential to adversely impact individual sockeye salmon. Currently, sockeye salmon are exposed to at least four IDEQ-authorized mixing zones along their migratory corridor. These mixing zones are spread throughout their designated critical habitat and encompass a very small proportion of the stream. While it is possible that sockeye salmon will be exposed to additional mixing zones in the future, we do not expect many more mixing zones to be authorized in the future. For these reasons, the vast majority of sockeye salmon are not expected to reside in mixing zones long enough to experience adverse effects. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River sockeye salmon. Therefore, it is NMFS's opinion that the proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

2.7.4 Snake River Basin Steelhead

The Snake River Basin steelhead DPS is currently listed as threatened. None of the MPGs residing in Idaho are meeting viability criteria. In order to be a candidate for delisting, the abundance and productivity of many populations will need to increase. The factors and threats limiting the recovery of Snake River Basin steelhead are substantially similar to those limiting the recovery of Snake River spring/summer Chinook salmon, and include elevated stream temperatures and toxic contaminants.

As described above, mixing zones authorizations have the potential to adversely impact individual steelhead. Currently, there are at least fourteen authorized mixing zones within habitat occupied by steelhead. These mixing zones are spread throughout their designated critical habitat and encompass a very small proportion of the stream. While it is possible that steelhead will be exposed to additional mixing zones in the future, we do not expect many more mixing zones to be authorized in the future. For these reasons, the vast majority of steelhead are not expected to reside in mixing zones long enough to experience adverse effects. Because only a few fish are expected to be adversely affected each year, EPA's approval of the proposed mixing zone rule and IDEQ's subsequent implementation of the rule is not expected to reduce the abundance or productivity of the Snake River Basin steelhead. Therefore, it is NMFS's opinion that the proposed action is not likely to appreciably diminish the survival and recovery of the ESU.

2.7.5 Designated Critical Habitat for All Species

The quality of aquatic habitat for salmon and steelhead in Idaho varies from excellent in wilderness and roadless areas to poor in areas subject to intensive human land uses. Past and current land uses that have degraded or continue to degrade habitat conditions include dam construction and operation, agriculture, forestry, mining, livestock grazing, water diversions, urbanization, wetland draining and conversion, and road construction (many with impassable culverts) and maintenance. In many watersheds, land management and development activities have reduced connectivity between streams, riparian areas, floodplains, and uplands; elevated fine sediment yields; reduced large woody material; reduced riparian shading; altered channel complexity; altered the quantity and timing of stream flows; and reduced water quality. Both point and nonpoint sources of pollution have contributed to elevated contaminants in some areas of critical habitat. These activities will likely continue to influence water quality, temperature, and habitat conditions for anadromous fish in the action area.

As described in Section 2.5.3, mixing zones are expected to adversely affect the water quality, temperature, and forage PBFs in localized areas of streams. Currently, mixing zones are estimated to impact less than 0.1 to 0.5 percent of the designated critical habitats within Idaho, depending on the species. Currently, there are at least fourteen authorized mixing zones within designated critical habitats. These mixing zones are spread throughout the action area and encompass a very small proportion of the stream. Additional mixing zones are expected to be authorized in the future, and although we are not able to predict when or where these mixing zones may be authorized, we don't expect many more to be authorized and those that are authorized are expected to be similar in size and distribution to current mixing zones. Due to their limited size and distribution across the action area, the vast majority of fish are not expected to reside in mixing zones long enough to experience adverse effects. Therefore, it is NMFS's opinion that the anticipated localized effects of current and future authorized mixing zones to these PBFs will not appreciably diminish the value of designated critical habitat for conservation of Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Snake River sockeye salmon, or Snake River Basin steelhead.

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, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of Snake River sockeye salmon, Snake River fall Chinook salmon, Snake River spring/summer Chinook salmon, Snake River Basin steelhead, and is not likely to destroy or adversely modify their designated critical habitats.

2.9 Incidental Take Statement

Section 9 of the ESA and federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). On an interim basis, NMFS interprets "harass" to mean "Create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

While the proposed action itself will not result in incidental take, implementation of the mixing zone provisions by the applicant is reasonably certain to result in incidental take of ESA-listed species. As described in this Opinion, implementation of the mixing zone provisions is interrelated/interdependent to the proposed action. NMFS is reasonably certain the incidental take described here will occur because: (1) Mixing zones may be authorized for discharges to waters that support ESA-listed species; (2) contaminant concentrations, individually or collectively, within mixing zones may be allowed to exceed levels deemed protective of anadromous salmonids; and (3) other water quality parameters (e.g., temperature) may be allowed at levels that do not support optimal growth and survival. Because we do not have certainty regarding when, where, and for what parameters mixing zones may be authorized, we have concluded that all life stages of Snake River spring/summer Chinook salmon, Snake River fall Chinook salmon, Snake River sockeye salmon, and Snake River Basin steelhead could be adversely affected through implementation of the proposed rule. NMFS is unable to quantify the amount of take that is associated with mixing zone authorizations for the reasons listed below.

1. The proposed action enables future authorization of mixing zones and it is not possible to predict how many, when, where, and for what parameters mixing zones will be authorized.

2. The number of ESA-listed fish that occupy mixing zones is unknown and is expected to vary annually as well as seasonally in response to a myriad of factors beyond the quality of discharge. Furthermore, it is not possible to count the number of fish that may be adversely affected within each mixing zone as the majority of effects are anticipated to be sublethal or behavioral in nature.

3. The actual exposure of ESA-listed fish to harmful concentrations of pollutants and pollutant mixtures, and the duration of such exposures, is unpredictable.

4. There is a large degree of variability in effects that could occur if fish were exposed to pollutant concentrations of sufficient magnitude and for a sufficient period of time.

Because it is not practicable to quantify an amount of take, we will use a surrogate for take that is directly related to the area of potentially occupied habitat where ESA-listed species may be exposed to elevated contaminant concentrations or other degraded physiochemical conditions within the mixing zone. Because these areas of potentially adverse impacts will vary over time and are dependent upon the quality and flow of both the effluent and receiving streams, the surrogate will be defined based on the number and linear extent of mixing zone authorizations within habitat occupied by anadromous species.

Currently, there are fourteen dischargers with authorized mixing zones in the action area. Two of these facilities, Grouse Creek and Thompson Creek mines, have multiple authorized mixing zones. The extent of these mixing zones vary; however, as described in Section 2.7, we have assumed a total of 17 mixing zones, each of which is up to 500 feet long. We will assume that the number of authorized mixing zones will double over time. This means that up to 14 new facilities could be authorized with mixing zones in watersheds that support anadromous species. Most of these are not anticipated to be major facilities, and similar to the current suite of existing discharges, most are anticipated to have only one outfall. For the sake of this ITS, we will assume that two of the new facilities will each have three outfalls with authorized mixing zones. Thus, we estimate the total number of new mixing zone authorizations to be 18. As such, our estimate of the extent of take for mixing zone authorizations (which includes new, existing, or reauthorized mixing zones) as linear stream habitat is 35 mixing zones encompassing 17,500 feet in waters occupied by ESA-listed anadromous species.

These surrogates are not coextensive with the proposed action, because the proposed action does not identify an upper limit of mixing zones that may be authorized. Mixing zone authorizations will be considered whenever a new permit is issued and whenever an existing permit is reissued. For this reason, use of the number of authorized mixing zones in anadromous watersheds and/or the modeled extent of the mixing zones as surrogates function as effective reinitiation triggers.

2.9.2 Effect of the Take

In the Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). "Terms and conditions" implement the reasonable and prudent measures (50 CFR 402.14). These must be carried out for the exemption in section 7(o)(2) to apply.

NMFS believes the RPMs described below and their associated terms and conditions described in Section 2.9.4, are necessary and appropriate to minimize the likelihood of incidental take of ESA-listed species due to implementation of the proposed action.

The EPA and IDEQ, whichever agency is the permitting authority, shall:

1. Minimize the potential for adverse effects associated with mixing zone authorizations; and

2. Ensure completion of a monitoring and reporting program to confirm that the terms and conditions in the ITS are effective in avoiding and minimizing incidental take from mixing zone authorizations and ensuring the amount of incidental take is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the EPA and IDEQ must comply with them in order to implement the RPMs (50 CFR 402.14). The EPA and IDEQ have 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 EPA and IDEQ to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement RPM 1:

    a. The permitting authority shall provide NMFS with copies of draft permits and fact sheets for facilities discharging within the HUCs listed in Table 9. Electronic copies of these documents shall be sent to the email address listed in 2.b below on the same day they are posted to the IDEQ website. This requirement may be waived in the event IDEQ develops and implements an automatic electronic notification system with the following capabilities:

        1. User can subscribe to public comment opportunities specific to IPDES discharge permits; and

        2. User can specify specific HUCs for receipt of notice.

    b. The permitting authority shall ensure WET testing is required for:

        1. The POTW facilities (a publicly or privately owned treatment works) with a design flow equal to or greater than 1-million gallons per day, or serving a population of ten thousand or more, or which have the potential to cause significant water quality impacts.

        2. Non-POTW facilities that have the potential to cause significant water quality impacts, including but not limited to mining and other operations expected to discharge pollutants toxic to aquatic life.

    c. WET testing shall comply with the following:

        1. Toxicity trigger concentrations for WET tests shall be established using dilution series based upon no more than 25 percent of the applicable critical flow volume. The dilution series for WET testing shall be designed such that one treatment consists of 100 percent effluent, and at least one treatment is more dilute than the targeted flow condition.

        2. Receiving waters upstream of the effluent discharge should be used as the dilution water whenever possible.

        3. When routine WET testing results indicate toxicity above either the WET permit limit or toxicity trigger concentration, then the permittee will perform accelerated monitoring consisting of six WET tests conducted at approximately 2-week intervals over a 12-week period[8].

[8] This is consistent with procedures described in the *EPA Region 8, 9, and 10 Toxicity Training Tool* (Denton et al. 2007).

4. During the accelerated WET testing if more than one sample demonstrates an unacceptable level of toxicity then a toxicity reduction evaluation (TRE) must be undertaken to identify and remedy the causes of toxicity, which may include reducing the size of the authorized mixing zone. If necessary, a toxicity identification evaluation (TIE) should be undertaken to identify the specific pollutant causing toxicity. When intermittent toxicity is found (i.e., when toxicity is not detected in every test event with each subsequent sampling event) then the sampling procedures should be altered to obtain and store adequate sample volume such that WET testing and subsequent TIE procedures can be conducted on the same sample (if the WET testing indicates toxicity). Because considerable judgment may be involved in designing and carrying out a TRE and/or TIE, and because the results are performance-based, more specific guidance is inappropriate to provide here.

d. When mixing zones greater than 25 percent of the receiving stream flow are proposed to be authorized and NMFS demonstrates that impacts associated with the larger mixing zone could substantially impact one or more populations of ESA-listed anadromous fish, the IDEQ will consider whether to deny or restrict the size of the mixing zone. If the IDEQ does not concur with NMFS and does not modify nor restrict the size of the mixing zone, then IDEQ will provide a written rationale for the decision and if requested, will meet with NMFS.

3. The following terms and conditions implement RPM 2:

a. The permitting authority shall maintain a record of mixing zones authorized for point source facilities discharging to streams within HUCs listed in Table 9. The permitting authority shall provide NMFS with a report summarizing these mixing zones. For purposes of this consultation, an authorized mixing zone includes any mixing considered in the reasonable potential to exceed analysis, regardless of whether an effluent limit is required. At a minimum, the report shall contain the following information:

i. Facility details (i.e., facility name, major/minor classification, type of facility);

ii. Permit number;

iii. Name of the receiving waterbody;

iv. Name and number of the 5^{th} field HUC;

v. Type of outfall (side bank, diffuser, etc.);

vi. Location of outfall (latitude, longitude, and datum); and

vii. Mixing zone authorizations, including:

a) Parameter(s) for which mixing is authorized;

b) Critical receiving stream flow statistic;

c) Percent of critical flow authorized for mixing; and

d) Downstream extent of the mixing zone, if known.

b. The report described above shall be emailed to NMFS (nmfswcr.srbo@noaa.gov) by December 31 each year a new or reissued discharge permit is finalized for a facility discharging to a surface water within the HUCs listed in Table 9 of the Opinion.

2.10 Conservation Recommendations

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

1. To improve the potential or recovery of ESA-listed anadromous species in Idaho, the EPA should carry out management actions (e.g., update technology-based treatment requirements as appropriate) that ensure point source discharges are employing the most effective treatment technologies available.

2. The EPA should develop an approach to assess the risk to ESA-listed fish at sites currently contaminated or at risk of becoming contaminated due to new mineral or industrial development, which addresses exposure to multiple contaminants via both water and dietary routes, and which defines samples (e.g., invertebrates, sediment, water), contaminants, and analyses (e.g., total versus speciation) necessary to appropriately quantify risks.

3. The EPA should revise its 1985 *Guidelines for Deriving Numerical National Water Quality Criteria for the Protection of Aquatic Organisms and The Uses* to reflect more recent scientific advancements in the fields of ecotoxicology and salmon biology. As part of this effort, the EPA should collaborate with NMFS scientists to ensure the most sensitive and relevant toxicological endpoints (e.g., behavioral effects, olfaction, etc.), assessment methodologies, and effects thresholds are incorporated into the criteria development procedures.

Please notify NMFS if the EPA, IDEQ, or another entity, carries out these recommendations so that we will be kept informed of actions that minimize or avoid adverse effects and those that benefit listed species or their designated critical habitats.

2.11 Reinitiation of Consultation

This concludes formal consultation for EPA's proposed approval of the Idaho mixing zone water quality standards. As 50 CFR 402.16 states, reinitiation of formal consultation is required 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 agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this Opinion; (4) a new species is listed or critical habitat designated that may be affected by the action; or (5) the IDEQ does not authorize mixing zones in a manner that is consistent with the Guidance document.

2.12 "Not Likely to Adversely Affect" Determinations

The proposed action is described in Section 1.3 of this Opinion. While the proposed action will not have any direct effects on SRKW, it may indirectly affect the species by reducing the quantity and quality of available prey. On November 18, 2005, NMFS listed the SRKW DPS as endangered under the ESA (70 FR 69903). The SRKW DPS is composed of a single population that ranges as far south as central California and as far north as Southeast Alaska. Although the entire DPS has the potential to occur along the outer coast at any time during the year, occurrence along the outer coast is more likely from late autumn to early spring. The SRKWs have been repeatedly observed feeding off the Columbia River plume in March and April during peak spring Chinook salmon runs (Krahn et al. 2004; Zamon et al. 2007; Hanson et al. 2008; and Hanson et al. 2010). For this reason, the action area includes the eastern Pacific Ocean, where SRKW overlap with Chinook salmon from the Snake River basin.

The final listing rule identified several potential factors that may have resulted in the decline of the SRKW or that may be limiting recovery of the species. These factors include: the quantity and quality of prey, toxic chemicals which accumulate in top predators, and disturbance from sound and vessel traffic. The rule also identified oil spills as a potential risk factor for the small population of SRKW. More information about these potential threats to the SRKW is included in the final recovery plan (NMFS 2008).

Although SRKWs consume a variety of fish species (22 species) and one species of squid (Ford et al. 1998; Ford 2000; Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016), salmon are their primary prey. Scale and tissue sampling of prey remains from May to September indicate that the SRKW diet consists of a high percentage of Chinook salmon (monthly proportions as high as >90 percent) (Hanson et al. 2010; Ford et al. 2016). The diet data also indicate that the whales are consuming mostly larger (i.e., older) Chinook salmon. Ford et al. (2016) confirmed the importance of Chinook salmon to the SRKWs in the summer months using deoxyribonucleic acid (DNA) sequencing from whale feces. Salmon and steelhead made up to 98 percent of the inferred diet, of which almost 80 percent were Chinook salmon. Coho salmon (*O. kisutch*) and steelhead are also found in the diet in spring and fall months when Chinook salmon are less abundant. Specifically, coho salmon contribute to over 40 percent of the diet in late summer, which is evidence of prey shifting at the end of summer towards coho salmon (Ford et al. 1998;

Ford and Ellis 2006; Hanson et al. 2010; Ford et al. 2016). Less than 3 percent each of chum salmon (*O. keta*), sockeye salmon (*O. nerka*), and steelhead were observed in fecal DNA samples collected in the summer months (May through September). Prey remains and fecal samples collected in inland waters during October through December indicate that Chinook and chum salmon are primarily contributors to the whales' diet (NWFSC unpubl. data).

Observations of whales overlapping with salmon runs (Wiles 2004; Zamon et al. 2007; Krahn et al. 2009), and collections of prey and fecal samples have also occurred in the winter months. Preliminary analysis of prey remains and fecal samples collected during the winter and spring in coastal waters indicated that the majority of prey samples were Chinook salmon (80 percent of prey remains and 67 percent of fecal samples were Chinook salmon), with a smaller number of steelhead, chum salmon, and halibut (NWFSC unpubl. data).

The occurrence of K and L pods off the Columbia River in March suggests the importance of Columbia River spring-run stocks of Chinook salmon in their diet (Hanson et al. 2013) at that time of year. Chinook salmon genetic stock identification from samples collected in winter and spring in coastal waters included 12 U.S. west coast stocks, and over half of the Chinook salmon consumed originated in the Columbia River (NWFSC unpubl. data) for the K and L pods (primarily fall-run stocks). Based on genetic analysis of feces and scale samples, Chinook salmon from Fraser River stocks dominate the diet of Southern Residents in the summer (Hanson et al. 2010).

As described in the above Opinion and ITS, depending on the authorized mixing zone, there could potentially be small periodic loss of Chinook salmon juveniles from each brood year. This, in turn, could reduce the SRKW's available prey base when the affected broods would otherwise have been present in the Pacific Ocean. Because mixing zones comprise an exceedingly small proportion of the overall habitat available to Chinook salmon and because mechanisms are in place to minimize adverse effects to ESA-listed species, only a small number of juveniles are expected to be adversely affected annually. Coupling this small number of fish with both the downstream migration survival rate and the probability of SRKW intercepting these fish as prey items, NMFS concludes the reduction in prey due to the proposed action will be extremely small.

Depending on the authorized mixing zone and the type of pollutants in the discharge, there is also the potential for alteration of the quality of prey because some contaminants can bioaccumulate. The mixing zone provisions specifically address bioaccumulation under the unreasonable interference restrictions (IDAPA 58.01.02.050.01.d.iii). The IDEQ Guidance states that mixing zones for bioaccumulative pollutants should be evaluated more rigorously to ensure bioaccumulation of pollutant(s) does not unreasonably interfere with beneficial uses. In addition, the Guidance recognizes additional pollutants as bioaccumulative, beyond those that meet the Idaho WQS definition of bioaccumulative pollutants. Finally, given the short duration in which prey items are exposed to bioaccumulative pollutants in mixing zones relative to their residence time in the ocean, the body burden of adult salmon is likely more representative of its estuarine and ocean life than of life in Idaho. Therefore, Idaho's contribution to a Chinook's tissue pollutant concentrations and its contribution to a killer whale's exposure is expected to be minimal.

NMFS finds that the proposed action will not have anything more than minimal effects on the abundance or productivity of ESA-listed Chinook salmon, and therefore the effects to the quantity of prey available to the whales in the their vast range is expected to be very small. For these reasons, NMFS concurs that the proposed action may affect, but is not likely to adversely affect SRKW.

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. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 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) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the EPA (2019) and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fishery Management Council (PFMC) and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

The proposed action and action area for this consultation are described in Sections 1.3 and 2.3 of the preceding ESA consultation, respectively. The action area includes areas designated as EFH for spawning, rearing, and migratory life-history stages of Chinook and coho salmon. Chinook salmon EFH occurs in all of the HUCs listed in Table 9. Coho salmon EFH occurs within the Lower Snake-Asotin, Clearwater, Lower North Fork Clearwater, South Fork Clearwater, Middle Fork Clearwater, Upper Selway, and Lower Selway subbasins. Authorization of mixing zones has the potential to adversely affect stream reaches that are used by these life-history stages.

The PFMC (2014) identified five habitat areas of particular concern (HAPC), which warrant additional focus for conservation efforts due to their high ecological importance. Three of the five HAPC are applicable to freshwater and include: (1) Complex channels and floodplain habitats; (2) thermal refugia; and (3) spawning habitat. All three of these HAPCs are present in the action area; however, the proposed action may only affect the thermal refugia and spawning habitat HAPCs.

3.2 Adverse Effects on Essential Fish Habitat

As described in Sections 2.5.3 of the preceding Opinion, the primary adverse effects to EFH are related to changes in water quality as a result of authorizing areas of mixing where water quality criteria may be exceeded. Mixing zones will adversely affect water conditions necessary to support spawning and rearing; therefore the spawning habitat HAPC is likely to be adversely affected. As previously described, these adverse effects are expected to be localized and will vary spatially and temporally over time in response to changes in the quantity and quality of effluent in the discharges and water in the receiving streams. Implementation of the proposed action is not anticipated to affect the thermal refugia HAPCs because the mixing zone provisions prohibit the loss of thermal refugia.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS believes that the following seven Conservation Recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH. These Conservation Recommendations are a non-identical set of the ESA Terms and Conditions.

1. To improve the potential or recovery of ESA-listed anadromous species in Idaho, the EPA should carry out management actions (e.g., update technology-based treatment requirements as appropriate) that ensure point source discharges are employing the most effective treatment technologies available.

2. Adequate monitoring should be required in discharge permits to assure that mixture toxicity and bioaccumulation is not occurring in either the habitat or species.

3. The EPA should replace the fixed duration LC_{50} acute toxicity tests used for criteria development with acute toxicity tests based on exposure-response curves to describe the relationship between exposure and toxicological effects, and EPA should replace the current chronic tests, *i.e.*, hypothesis testing, used for criteria development with chronic toxicity tests based on exposure-response curves to describe the relationship between exposure and toxicological effects. In addition, the procedures should allow for consideration of more sensitive toxicological endpoints.

4. The permitting authority should provide NMFS with copies of draft permits and fact sheets for facilities discharging within the HUCs listed in Table 9. Electronic copies of these documents should be sent to the email address listed in 2.b below on the same day they are posted to the IDEQ website. This requirement may be waived in the event IDEQ develops and implements an automatic electronic notification system with the following capabilities:

    a. User can subscribe to public comment opportunities specific to IPDES discharge permits; and

    b. User can specify specific HUCs for receipt of notice.

5. The permitting authority should ensure WET testing is required for:

    a. The POTW facilities (a publicly or privately owned treatment works) with a design flow equal to or greater than 1-million gallons per day, or serving a population of ten thousand or more, or which have the potential to cause significant water quality impacts.

    b. Non-POTW facilities that have the potential to cause significant water quality impacts, including but not limited to mining and other operations expected to discharge pollutants toxic to aquatic life.

6. WET testing should comply with the following:

    a. Toxicity trigger concentrations for WET tests should be established using dilution series based upon no more than 25 percent of the applicable critical flow volume. The dilution series for WET testing should be designed such that one treatment consists of 100 percent effluent, and at least one treatment is more dilute than the targeted flow condition.

    b. Receiving waters upstream of the effluent discharge should be used as the dilution water whenever possible.

    c. When routine WET testing results indicate toxicity above either the WET permit limit or toxicity trigger concentration, then the permittee should perform accelerated monitoring consisting of six WET tests conducted at approximately 2-week intervals over a 12-week period[9].

    d. During the accelerated WET testing if more than one sample demonstrates an unacceptable level of toxicity then a TRE should be undertaken to identify and remedy the causes of toxicity, which may include reducing the size of the authorized mixing zone. If necessary, a TIE should be undertaken to identify the specific pollutant causing toxicity. When intermittent toxicity is found (i.e., when toxicity is not detected in every test event with each subsequent sampling event) then the sampling procedures should be altered to obtain and store adequate sample volume such that WET testing and subsequent TIE procedures can be conducted on the same sample (if the WET testing indicates toxicity). Because considerable judgment may be involved in designing and carrying out a TRE and/or TIE, and because the results are performance-based, more specific guidance is inappropriate to provide here.

7. When mixing zones greater than 25 percent of the receiving stream flow are proposed to be authorized and NMFS demonstrates that impacts associated with the larger mixing zone could substantially impact one or more populations of ESA-listed anadromous fish, the IDEQ should consider whether to deny or restrict the size of the mixing zone. If the IDEQ does not concur with NMFS and does not modify nor restrict the size of the mixing

[9] This is consistent with procedures described in the *EPA Region 8, 9, and 10 Toxicity Training Tool* (Denton et al. 2007).

zone, then IDEQ should provide a written rationale for the decision and if requested, should meet with NMFS.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, designated EFH, specifically the spawning habitat HAPC, for Pacific Coast salmon in Idaho.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the EPA must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the federal agency have agreed to use alternative time frames for the federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

The 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 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 and IDEQ. Other interested users could include point source dischargers. Individual copies of this Opinion were provided to the EPA and IDEQ. 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 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.

5. REFERENCES

Arthaud, D. and J. Morrow. 2013. Improving migration survival estimates of Snake River sockeye salmon. National Marine Fisheries Service, Idaho Habitat Office, Boise, Idaho, 8/23/2013.

Arnsberg, B. Project Leader, Department of Fisheries Resources Management, Nez Perce Tribe. June 20, 2019. Personal communication, email to Johnna Sandow, NMFS Fish Biologist, regarding fall Chinook redd shapefiles.

Asch, R. 2015. Climate change and decadal shifts in the phenology of larval fishes in the California Current ecosystem. PNAS:E4065-E4074.

Atchison, G. J., M. G. Henry, and M. B. Sandheinrich. 1987. Effects of metals on fish behavior: a review. Environmental Biology of Fishes. 18:11-25.

Axel, G. A., C. C. Kozfkay, B. P. Sandford, M. Peterson, M. G. Nesbit, B. J. Burkey, K. E. Frick, and J. Lamb. 2017. Characterizing migration and survival between the Upper Salmon River Basin and Lower Granite Dam for juvenile Snake River sockeye salmon 2011-2014. Report for Bonneville Power Administration, Project 2010-076-00. 54 p.

Bakun, A., B. A. Black, S. J. Bograd, M. García-Reyes, A. J. Miller, R. R. Rykaczewski, and J. Sydeman. 2015. Anticipated Effects of Climate Change on Coastal Upwelling Ecosystems. Current Climate Change Reports. 1:85-93.

Battin, J., M. W. Wiley, M. H. Ruckelshaus, R. N. Palmer, E. Korb, K. K. Bartz, and H. Imaki. 2007. Projected impacts of climate change on salmon habitat restoration. Proceedings of the National Academy of Sciences of the United States of America 104(16):6720-6725.

Beckman, B. 2018. Estuarine growth of yearling Snake River Chinook salmon smolts. Progress report. Northwest Fisheries Science Center, Seattle, Washington.

Beechie, T., H. Imaki, J. Greene, A. Wade, H. Wu, G. Pess, P. Roni, J. Kimball, J. Stanford, P. Kiffney, and N. Mantua. 2013. Restoring Salmon Habitat for a Changing Climate. River Research and Applications. 29:939-960.

Bian, B., Y. Zhou, and B. B. Fang. 2016. Distribution of heavy metals and benthic macroinvertebrates: impacts from typical infow river sediments in the Taihu Basin, China. Ecol Ind 69:348–359

Bjornn, T. C. and D. W. Reiser. 1991. Habitat requirements of salmonids in streams. Pages 83–138 *in* W.R. Meehan, editor. Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society, Special Publication 19. Bethesda, Maryland.

Bjornn, T. C., D. R. Craddock, and D. R. Corley. 1968. Migration and survival of Redfish Lake, Idaho, sockeye salmon, *Oncorhynchus nerka*. Transactions of the American Fisheries Society. 97:360-373.

Black, B., J. Dunham, B. Blundon, J. Brim Box, and A. Tepley. 2015. Long-term growth-increment chronologies reveal diverse influences of climate forcing on freshwater and forest biota in the Pacific Northwest. Global Change Biology. 21:594-604.

Bond, N. A., M. F. Cronin, H. Freeland, and N. Mantua. 2015. Causes and impacts of the 2014 warm anomaly in the NE Pacific. Geophysical Research Letters 42:3414–3420.

Bograd, S., I. Schroeder, N. Sarkar, X. Qiu, W. J. Sydeman, and F. B. Schwing. 2009. Phenology of coastal upwelling in the California Current. Geophysical Research Letters. 36:L01602.

Bonneville Power Administration (BPA), U.S. Bureau of Reclamation (BOR), and U.S. Army Corps of Engineers (COE). 2013. Endangered Species Act Federal Columbia River Power System 2013 Comprehensive Evaluation (Sections 1, 2, & 3, appendices and references).

BPA, BOR, and COE. 2016. Endangered Species Act Federal Columbia River Power System 2016 Comprehensive Evaluation (Sections 1 & 2).

Burnell, B. Water Quality Division Administrator, Idaho Department of Environmental Quality. October 26, 2016. Letter to Dan Opalski, Director of Office of Water and Watersheds, Environmental Protection Agency Region 10.

Chapman, D., W. Platts, D. Park and M. Hill. 1990. Status of Snake River sockeye salmon. Final Report to PNUCC, June 26. Don Chapman Consultants Inc.: Boise, Idaho. 96 p.

Cheung, W., N. Pascal, J. Bell, L. Brander, N. Cyr, L. Hansson, W. Watson-Wright, and D. Allemand. 2015. North and Central Pacific Ocean region. Pages 97-111 *in* Hilmi N., Allemand D., Kavanagh C., et al, editors. Bridging the Gap Between Ocean Acidification Impacts and Economic Valuation: Regional Impacts of Ocean Acidification on Fisheries and Aquaculture.

Climate Change Science Program (CCSP). 2014. Climate Change Impacts in the United States. Third National Climate Assessment. U.S. Global Change Research Program. DOI:10.7930/J0Z31WJ2.

Climate Impacts Group. 2004. Overview of Climate Change Impacts in the U.S. Pacific Northwest. Background paper prepared for the West Coast Governors' Climate Change Initiative. 13 pp.

Collier, T. K., J. P. Meadow, and L. L. Johnson. 2002. Fish tissue and sediment effects thresholds for polychlorinated biphynyls, polycyclic aromatic hydrocarbons, and tributyltin. *Aquatic conservation: Marine and Freshwater Ecosystems.* 12:489-492.

Columbia River Data Access in Real time (DART), Columbia Basin Research, University of Washington. 2019. Columbia Basin ESU/DPS historical Run Timing. Available: http://www.cbr.washington.edu/dart/query/esu_hrt. June 2019.

Connor, W. P., H. L. Burge, R. Waitt, and T. C. Bjornn. 2002. Juvenile life history of wild fall Chinook salmon in the Snake and Clearwater Rivers. North American Journal of Fisheries Management 22:703-712.

Connor, W. P. and H. L. Burge. 2003. Growth of wild subyearling fall Chinook salmon in the Snake River. North American Journal of Fisheries Management 23:594-599.

Connor, W. P. and A. P. Garcia. 2006. Prespawning movement of wild and hatchery fall Chinook salmon adults in the Snake River. Transactions of the American Fisheries Society. 135(2):297-305.

Connor, W. P., J. G. Sneva, K. F. Tiffan, R. K. Steinhorst, and D. Ross. 2005. Two alternative juvenile life history types for fall Chinook salmon in the Snake River Basin. Transactions of the American Fisheries Society 134:291-304.

Cooney, T. and D. Holzer. 2006. Appendix C: Interior Columbia Basin stream type Chinook salmon and steelhead populations: Habitat intrinsic potential analysis. Northwest Fisheries Science Center. 21 pp.

Coutant, C. C., and R. R. Whitney. 2006. Hydroelectric system development: effects on juvenile and adult migration. Pages 249-324 *in* R. N. Williams, editor. Return to the River - Restoring Salmon to the Columbia River. Elsevier Academic Press, Amsterdam.

Crozier, L. and R. W. Zabel. 2006. Climate impacts at multiple scales: evidence for differential population responses in juvenile Chinook salmon. Ecology. 75:1100-1109.

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

Crozier, L. G., A. P. Hendry, P. W. Lawson, T. P. Quinn, et al. 2008b. Potential responses to climate change for organisms with complex life histories: evolution and plasticity in Pacific salmon. Evolutionary Applications 1:252-270.

Crozier, L. G., B. J. Burke, B. P. Sandford, G. A. Axel, and B. L. Sanderson. 2014. Passage and survival of adult Snake River sockeye salmon within and upstream from the Federal Columbia River Power System. Report to U.S. Army Corps of Engineers, Walla Walla District. 78 p.

Crozier, L. G., L. Wiesebron, E. Dorfmeier, B. J. Burke. 2017. River conditions, fisheries and fish history drive variation in upstream survival and fallback for Upper Columbia River spring and Snake River spring/summer Chinook salmon. Fish Ecology Division, Northwest Fisheries Science Center, Seattle, WA. 47 pp.

Dalton, M., P. W. Mote, and A. K. Stover. 2013. Climate change in the Northwest: implications for our landscapes, waters and communities. Island Press, Washington, D.C.

Daly, E. A., R. D. Brodeur, and L. A. Weitkamp. 2009. Ontogenetic Shifts in Diets of Juvenile and Subadult Coho and Chinook Salmon in Coastal Marine Waters: Important for Marine Survival? Transactions of the American Fisheries Society. 138(6):1420-1438.

Daly, E. A., J. A. Scheurer, R. D. Brodeur, L. A. Weitkamp, B. R. Beckman, and J. A. Miller. 2014. Juvenile Steelhead Distribution, Migration, Feeding, and Growth in the Columbia River Estuary, Plume, and Coastal Waters. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 6(1):62-80.

Dauble, D. D., and D. R. Geist. 2000. Comparisons of mainstem spawning and habitats for two populations of fall Chinook salmon in the Columbia River Basin. Regulated Rivers: Research and Management 16:345-361.

Dauble, D. D., R. L. Johnson, and A. Garcia. 1999. Fall chinook spawning in tailraces of lower Snake River hydroelectric projects. Transactions of the American Fisheries Society. 128:672-697.

Dauble, D. D., and R. P. Mueller. 1993. Factors affecting the survival of upstream migrant adult salmonids in the Columbia River basin. Recovery issues for threatened and endangered Snake River salmon. Technical Report 9 of 11. Prepared for U.S. Department of Energy, Bonneville Power Administration, Division of Fish and Wildlife. Project No. 98-026. June.

Davis, S. R. 2015. Diet preferences of juvenile steelhead (*Oncorhynchus mykiss*): A comparison between three Hood Canal rivers. Masters Thesis, Evergreen State College, Olympia, WA. 102 pp.

Denton D. L., J. M. Miller, and R. A. Stuber. 2007. EPA Regions 8, 9 and 10 toxicity training tool (TTT). January 2010. San Francisco, CA.

Di Lorenzo, E. and N. Mantua. 2016. Multi-year persistence of the 2014/15 North Pacific marine heatwave. Nature Climate Change. 6:1042-1047.

Dorchin, A. and U. Shanas. 2013. Daphnia magna indicate severe toxicity of highway runoff. Journal of Environmental Quality. 42(5):1395-1401.

Eaton, D. L. and S. G. Gilbert. 2008. Principles of toxicology. Pages 11-44 in Klaasen, C.D., editor. 2008. Casarette and Doull's toxicology: The basic science of poisons. McGraw Hill Education.

Ecovista, Nez Perce Tribe Wildlife Division, and Washington State University Center for Environmental Education. 2003. Draft Clearwater Subbasin Assessment, Prepared for Nez Perce Tribe Watersheds Division and Idaho Soil Conservation Commission. 463 p. http://www.nwcouncil.org/fw/subbasinplanning/clearwater/plan/Default.htm

Edmundson, E., F. E. Everest, and D. W. Chapman. 1968. Permanence of station in juvenile Chinook salmon and steelhead trout. *Journal of Fisheries Research.* 25(7):1453-1464.

Environmental Protection Agency (EPA). 1991. Technical support document for water quality-based toxics control. Office of Water, EPA 505/2-90-001. Washington, D.C. 143 p.

EPA. 2003. EPA Region 10 Guidance for Pacific Northwest State and Tribal Temperature Water Quality Standards. EPA 910-B-03-002. Region 10 Office of Water, Seattle, WA. 57 p.

EPA. 2019. Biological evaluation for revisions to the mixing zone regulations of Idaho State water quality standards. EPA Region 10, Seattle, WA. 132 p.

Essig, D. Surface Water Program Manager, Idaho Department of Environmental Quality. August 13, 2018. Memorandum to All Surface Water Staff, Idaho Department of Environmental Quality.

Everest, F. H. and D. W. Chapman. 1972. Habitat selection and spatial interaction by juvenile Chinook salmon and steelhead trout in two Idaho streams. Journal of the Fisheries Research Board of Canada 29(1):91-100.

Evermann, B. W. 1895. A preliminary report upon salmon investigations in Idaho in 1984. *In* Chapman, D., W. Platts, D. Park and M. Hill. 1990. Status of Snake River sockeye salmon. Final Report to PNUCC, June 26. Don Chapman Consultants Inc.: Boise, Idaho. 96 p.

Farag, A. M., C. J. Boese, D. F. Woodward, and H. L. Bergman. 1994. Physiological changes and tissue metal accumulation in rainbow trout exposed to foodborne and water-borne metals. Environmental Toxicology and Chemistry. 13:2021-2029.

Finlayson, B. J., and K. M. Verrue. 1982. Toxicities of copper, zinc, and cadmium mixtures to juvenile chinook salmon. Transactions of the American Fisheries Society. 111:645-650.

Fish Passage Center. June 24, 2016. Memorandum to Dave Statler, Nez Perce Tribe and Erick VanDyke, Oregon Department of Fish and Wildlife.

Fisher, J., W. Peterson, and R. Rykaczewski. 2015. The impact of El Niño events on the pelagic food chain in the northern California Current. Global Change Biology. 21:4401-4414.

Ford, J. K. B., G. M. Ellis, L. G. Barrett-Lennard, A. B. Morton, R. S. Palm, and K. C. Balcomb III. 1998. Dietary specialization in two sympatric populations of killer whales (*Orcinus orca*) in coastal British Columbia and adjacent waters. Canadian Journal of Zoology 76:1456-1471.

Ford, J. K. B. 2000. Killer whales: the natural history and genealogy of *Orcinus orca* in British Columbia and Washington State. Vancouver, British Columbia, UBC Press, 2nd Edition.

Ford, J. K. B. and G. M. Ellis. 2006. Selective foraging by fish-eating killer whales *Orcinus orca* in British Columbia. Marine Ecology Progress Series 316:185-199.

Ford, M.J. (ed.). 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-113, 281 p. http://www.westcoast.fisheries.noaa.gov/publications/status_reviews/salmon_steelhead/multiple_species/5-yr-sr.pdf

Ford, M. J., J. Hempelmann, M. B. Hanson, K. L. Ayres, R. W. Baird, C. K. Emmons, J. I. Lundin, G. S. Schorr, S. K. Wasser, and L. K. Park. 2016. Estimation of a killer whale (*Orcinus orca*) population's diet using sequencing analysis of DNA from feces. PLoS ONE. 11(1):e0144956. Doi:10.1371/journal.pone.0144956.

Foreman, M., W. Callendar, D. Masson, J. Morrison, and I. Fine. 2014. A Model Simulation of Future Oceanic Conditions along the British Columbia Continental Shelf. Part II: Results and Analyses. Atmosphere-Ocean. 52(1):20-38.

Gargett, A. 1997. Physics to Fish: Interactions Between Physics and Biology on a Variety of Scales. Oceanography. 10(3):128-131.

Giattina J. D. and R. R. Garton. 1983. A review of the preference -avoidance responses of fishes to aquatic contaminants. Residue Reviews 87: 43-90.

Good, T. P., R. S. Waples, and P. Adams (editors). 2005. Updated status of federally listed ESUs of West Coast salmon and steelhead. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-66, 598 p.

Haigh, R., D. Ianson, C. A. Holt, H. E. Neate, and A. M. Edwards. 2015. Effects of Ocean Acidification on Temperate Coastal Marine Ecosystems and Fisheries in the Northeast Pacific. PLoS ONE 10(2):e0117533.

Hamilton, S. J., K. J. Buhl, N. L. Faerber, R. H. Wiedmeyer, and F. A. Bullard. 1990. Toxicity of organic selenium in the diet to chinook salmon. Environmental Toxicology and Chemistry. 9(3): 347–358

Hansen, J. A., J. C. A. Marr, J. Lipton, and H. L. Bergman. 1999a. Differences in neurobehavioral responses of chinook salmon (*Oncorhynchus tshawytscha*) and rainbow trout (Oncorhynchus mykiss) exposed to copper and cobalt: behavioral avoidance. Environmental Toxicology and Chemistry. 18(9): 1972-1978

Hansen, J. A., D. F. Woodward, E. E. Little, A. J. DeLonay and H. L. Bergman. 1999b. Behavioral avoidance: possible mechanism for explaining abundance and distribution of trout species in a metal impacted river. Environmental Toxicology and Chemistry. 18:313-317.

Hansen, J. A., P. G. Welsh, J. Lipton, D. Cacela, and A. D. Dailey. 2002. Relative sensitivity of bull trout *(Salvelinus confluentus)* and rainbow trout *(Oncorhynchus mykiss)* to acute exposures of cadmium and zinc. Environmental Toxicology and Chemistry. 21(1):67–75.

Hanson, M. B., R. W. Baird, J. K. B. Ford, J. Hempelmann-Halos, D. M. Van Doornik, J. R. Candy, C. K. Emmons, G. S. Schorr, B. Gisborne, K. L. Ayres, S. K. Wasser, K. C. Balcomb, K. Balcomb-Bartok, J. G. Sneva, and M. J. Ford. 2010. Species and stock identification of prey consumed by endangered southern resident killer whales in their summer range. Endang.Spec. Res. 11: 69-82.

Hanson, M. B., C. K. Emmons, and E. J. Ward. 2013. Assessing the coastal occurrence of endangered killer whales using autonomous passive acoustic recorders. The Journal of the Acoustical Society of America. 134(5): 3486–3495.

Hanson, M. B., D. P. Noren, T. F. Norris, C. A. Emmons, M. M. Holt, T. Guy, and J. Zamon. 2008. Pacific Ocean killer whale and other cetaceans distribution survey, May 2007 (PODs 2007) conducted abord the NOAA ship McArthur II. NWFSC, Seattle, WA. 26 pp.

Harvey, C., T. Garfield, G. Williams, and N. Tolimieri, editors. 2019. California Current Integrated Ecosystem Assessment (CCIEA), California Current ecosystem status report, 2019. Report to the Pacific Fishery Management Council, 3/7/2019.

Healey, M. C. 1991. Life history of chinook salmon (*Oncorhynchus tshawytscha*). Pages 311-393 *in* C. Groot, and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, Canada.

Hegg, J., B. Kennedy, P. Chittaro, and R. Zabel. 2013. Spatial structuring of an evolving life-history strategy under altered environmental conditions. Oecologia:1-13.

Hillman, T. W., J. S. Griffith, W. S. Platts. 1987. Summer and winter habitat selection by juvenile Chinook salmon in a highly sedimented Idaho stream. *Transactions of the American Fisheries Society.* 116:185-195.

Hollowed, A. B., N. A. Bond, T. K. Wilderbuer, W. T. Stockhausen, Z. T. A'mar, R. J. Beamish, J. E. Overland, and M. J. Schirripa. 2009. A framework for modelling fish and shellfish responses to future climate change. ICES Journal of Marine Science. 66:1584-1594.

Interior Columbia Technical Recovery Team (ICTRT). 2003. Working draft. Independent populations of Chinook, steelhead, and sockeye for listed evolutionarily significant units within the Interior Columbia River domain. NOAA Fisheries. July.

ICTRT. 2007. Viability Criteria for Application to Interior Columbia Basin Salmonid ESUs, Review Draft March 2007. Interior Columbia Basin Technical Recovery Team: Portland, Oregon. 261 pp. https://www.nwfsc.noaa.gov/research/divisions/cb/genetics/trt/trt_documents/ictrt_viability_criteria_reviewdraft_2007_complete.pdf

ICTRT. 2010. Status Summary – Snake River Spring/Summer Chinook Salmon ESU. Interior Columbia Technical Recovery Team: Portland, Oregon.

Idaho Department of Environmental Quality (IDEQ). 2001. Middle Salmon River-Panther Creek Subbasin Assessment and TMDL. IDEQ: Boise, Idaho. 114 p.

IDEQ. 2004. South Fork Clearwater River Subbasin Assessment and TMDL.

IDEQ. 2016. Idaho Mixing Zone Implementation Guidance: Final. IDEQ: Boise, Idaho. 79 p.

IDEQ. 2017a. Idaho Pollutant Discharge Elimination System: Effluent limit development guidance. IDEQ: Boise, Idaho. 185 p.

IDEQ. 2017b. Idaho Pollutant Discharge Elimination System: User's Guide to Permitting and Compliance, Volume 2 – Publically owned treatment works. IDEQ: Boise, Idaho. 40 p.

IDEQ. 2017c. Idaho's 2014 Integrated Report, Final. IDEQ: Boise, Idaho. 625 p.

IDEQ. 2018a. Idaho's 2016 Integrated Report, Final. IDEQ: Boise, Idaho. 563 p.

IDEQ. 2018b. Idaho Pollutant Discharge Elimination System: User's Guide to Permitting and Compliance, Volume 3 – Non-POTW. IDEQ: Boise, Idaho. 28 p.

IDEQ and U.S. Environmental Protection Agency (EPA). 2003. South Fork Clearwater River Subbasin Assessment and Total Maximum Daily Loads. IDEQ: Boise, Idaho. 680 p.

IDEQ and EPA. 2018. National Pollutant Discharge Elimination System (NPDES) Memorandum of Agreement (MOA) Between the State of Idaho Department of Environmental Quality and U.S. Environmental Protection Agency, Region 10. 40 p. plus appendices

IDEQ. 2019. IPDES permit issuance plan: 2019-2020. Available at: https://www.deq.idaho.gov/media/60181756/sop-establishing-annual-permit-issuance-plan.pdf. Accessed September 23, 2019.

Idaho Department of Fish and Game (IDFG). 2007. Annual returns to Lower Granite Dam, Idaho Department of Fish and Game data provided to NMFS by Peter Hassemer, December 2007. IDFG: Boise, Idaho.

IDFG. 2016. "Hatchery and Wild Chinook Salmon Return to Lower Granite Dam." Follow Idaho Salmon Home (F.I.S.H) website, http://216.206.157.62/idaho/web/apps/MAIN_LGRchinadultreturn_spsu_wild.php, accessed 6-3-16.

IDFG, Nez Perce Tribe, and Shoshone-Bannock Tribes. 1990. Salmon River subbasin salmon and steelhead production plan. 390 p.

Independent Scientific Advisory Board (ISAB). 2007. Climate change impacts on Columbia River Basin fish and wildlife. ISAB Climate Change Report, ISAB 2007-2, Northwest Power and Conservation Council, Portland, Oregon.

Ipeaiyeda, A. R. and P. C. Onianwa. 2018. Monitoring and assessment of sediment contamination with toxic heavy metals: case study of industrial effluent dispersion in Alaro River, Nigeria. Applied Water Science. 8:161.

Johnson, E., K. Plaster, S. Simmonds, K. Kruse, and C. Koszfkay. 2017. Snake River sockeye salmon captive broodstock program: Annual progress report 2016. Idaho Department of Fish and Game, Report Number 17-11, July. 69 pp.

Jones, K. K., T. J. Cornwell, D. L. Bottom, L. A. Campbell, and S. Stein. 2014. The contribution of estuary-resident life histories to the return of adult *Oncorhynchus kisutch*. Journal of Fish Biology 85:52–80.

Keefer, M. L. and C. Peery. 2008. A literature review relevant to juvenile fall Chinook salmon habitat use, migration behavior, and survival in the lower Snake River. Technical Report 2008-11. Department of Fish and Wildlife Resources, College of Natural Resources, University of Idaho, Moscow, ID. 52 pp.

Kennedy, V. S. 1990. Anticipated Effects of Climate Change on Estuarine and Coastal Fisheries. Fisheries. 15(6):16-24.

Kirwan, M. L., G. R. Guntenspergen, A. D'Alpaos, J. T. Morris, S. M. Mudd, and S. Temmerman. 2010. Limits on the adaptability of coastal marshes to rising sea level. Geophysical Research Letters. 37:L23401.

Klos, P. Z., J. T. Abatzoglou, A. Bean, J. Blades, M. A. Clark, M. Dodd, T. E. Hall, A. Haruch, P. E. Higuera, J. D. Holbrook, V. S. Jansen, K. Kemp, A. Lankford, T. E. Link, T. Magney, A. J. H. Meddens, L. Mitchell, B. Moore, P. Morgan, B. A. Newingham, R. J. Niemeyer, B. Soderquist, A. A. Suazo, K. T. Vierling, V. Walden, and C. Walsh. 2015. Indicators of Climate Change in Idaho: An Assessment Framework for Coupling Biophysical Change and Social Perception. Weather Climate and Society 7(3):238-254.

Krahn, M. M., M. J. Ford, W. F. Perrin, P. R. Wade, R. P. Angliss, M. B. Hanson, B. L. Taylor, G. M. Ylitalo, M. E. Dahlheim, J. E. Stein, and R. S. Waples. 2004. 2004 status review of southern resident killer whales (*Orcinus orca*) under the Endangered Species Act. NOAA Technical Memorandum NMFS-NWFSC-62, U.S. Department of Commerce, Seattle, Washington.

Krahn, M. M., M. B. Hanson, G. S. Schorr, C. K. Emmons, D. G. Burrows, J. L. Bolton, R. W. Baird, and G. Ylitalo. 2009. Effects of age, sex and reproductive status on persistent organic pollutant concentrations in "Southern Resident" killer whales. Marine Pollution Bulletin 58:1522-1529.

Laetz, C. A., D. H. Baldwin, T. K. Collier, V. Hebert, J. D. Stark, and N. L. Scholz. 2009. The synergistic toxicity of pesticide mixtures: implications for risk assessment and the conservation of endangered Pacific salmon. Environmental Health Perspectives. 117(3): 348-353.

Lee, D. C., J. R. Sedell, B. E. Rieman, R. F. Thurow, and J. E. Williams. 1997. Broadscale Assessment of Squatic Species and Habitats. Volume III, Chapter 4. U.S. Forest Service, General Technical Report. PNW-GTR-405. Portland, Oregon.

Lemmen, D. S., F. J. Warren, T. S. James, and C. S. L. Mercer Clarke (Eds.). 2016. Canada's Marine Coasts in a Changing Climate. Ottawa, ON: Government of Canada.

Limburg, K., R. Brown, R. Johnson, B. Pine, R. Rulifson, D. Secor, K. Timchak, B. Walther, and K. Wilson. 2016. Round-the-Coast: Snapshots of Estuarine Climate Change Effects. Fisheries. 41(7):392-394.

Litz, M. N., A. J. Phillips, R. D. Brodeur, and R. L. Emmett. 2011. Seasonal occurences of Humbolt Squid in the Northern California Current System. California Cooperative Oceanic Fisheries Investigations Report. 52:97-108.

Lucey, S. and J. Nye. 2010. Shifting species assemblages in the Northeast US Continental Shelf Large Marine Ecosystem. Marine Ecology Progress Series, Marine Ecology Progress Series 415:23-33.

Lynch, A. J., B. J. E. Myers, C. Chu, L. A. Eby, J. A. Falke, R. P. Kovach, T. J. Krabbenhoft, T. J. Kwak, J. Lyons, C. P. Paukert, and J. E. Whitney. 2016. Climate Change Effects on North American Inland Fish Populations and Assemblages. Fisheries. 41(7):346-361.

MacDonald, D. D., C. G. Ingersoll, and T. A. Berger. 2000a. Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems. Archives of Environmental Contamination and Toxicology. 39(1): 20-31.

MacDonald, D. D., L. M. Dipinto, J. Field, C. G. Ingersoll, E. R. Long, and R. C. Swartz. 2000b. Development and evaluation of consensus-based sediment effect concentrations for polychlorinated biphenyls. Environmental Toxicology and Chemistry. 19:1403-1413.

Macdonald, J. S., D. A. Patterson, M. J. Hague, and I. C. Guthrie. 2011. Modeling the influence of environmental factors on spawning migration mortality for sockeye salmon fisheries management in the Fraser River, British Columbia. Transactions of the American Fisheries Society. 139:768-782.

Mallet, J. 1974. Long range planning for salmon and steelhead in Idaho: Inventory of salmon and steelhead resources, habitats, use and demands. Job performance report. Project F-58-R-1. Idaho Department of Fish and Game, Boise. 217 pp.

Mantua, N. J., S. Hare, Y. Zhang, et al. 1997. A Pacific interdecadal climate oscillation with impacts on salmon production. Bulletin of the American Meteorological Society 78:1069-1079, 1/6/1997.

Mantua, N., I. Tohver, and A. Hamlet. 2009. Impacts of climate change on key aspects of freshwater salmon habitat in Washington State. Climate Impacts Group, University of Washington, Seattle, Washington.

Martins, E. G., S. G. Hinch, D. A. Patterson, M. J. Hague, S. J. Cooke, K. M. Miller, M. F. Lapointe, K. K. English, and A. P. Farrell. 2011. Effects of river temperature and climate warming on stock-specific survival of adult migrating Fraser River sockeye salmon (*Oncorhynchus nerka*). Global Change Biology. 17(1):99–114.

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

Mathis, J. T., S. R. Cooley, N. Lucey, S. Colt, J. Ekstrom, T. Hurst, C. Hauri, W. Evans, J. N. Cross, and R. A. Feely. 2015. Ocean acidification risk assessment for Alaska's fishery sector. Progress in Oceanography. 136:71-91.

Matthews, G. M., R. S. Waples. 1991. Status Review for Snake River Spring and Summer Chinook Salmon. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-F/NWC-200. https://www.nwfsc.noaa.gov/publications/scipubs/techmemos/tm201/

McClure, M., T. Cooney, and ICTRT. 2005. Updated population delineation in the interior Columbia Basin. May 11, 2005 Memorandum to NMFS NW Regional Office, Co-managers, and other interested parties. NMFS: Seattle, Washington. 14 p.

McCullough, D., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Issue Paper 5: Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids. Prepared as part of EPA Region 10 Temperature Water Quality Criteria Guidance Development Project. EPA-910-D-01-005. 118 p.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-42, Seattle, Washington, 156 p.

McNichol, R. E. and E. Scherer. 1991. Behavioral responses of lake whitefish (*Conegonus clupeaformis*) to cadmium during preference-avoidance testing. Environmental Chemistry and Toxicology 10:225-234.

Meador, J. P. 2015. Tissue concentrations as the dose metric to assess potential toxic effects of metals in field-collected fish: copper and cadmium. Environmental Toxicology and Chemistry. 34(6):1309-1319.

Mebane, C. A. 2006. Cadmium risks to freshwater life: derivation and validation of low-effect criteria values using laboratory and field studies. U.S. Geological Survey Scientific Investigation Report 2006-5245 (2010 rev.). 130 pp. *http://pubs.water.usgs.gov/sir20065245/*.

Mebane, C. A., F. S. Dillon, and D. P. Hennessy. 2012. Acute toxicity of cadmium, lead, zinc, and their mixtures to stream-resident fish and invertebrates. Environmental Toxicology and Chemistry. 31(6):1334–1348.

Moberly, J. G., T. Borch, R.K. Sani, N. F. Spycher, S. S. Sengor, T. R. Ginn, and B. M. Peyton. 2008. Heavy metal-mineral associations in Coeur d'Alene River sediments: A synchrotron-based analysis. Water, Air, and Soil Pollution. 201:195-208.

Morris, J. F. T., M. Trudel, J. Fisher, S. A. Hinton, E. A. Fergusson, J. A. Orsi, and J. Edward V. Farley. 2007. Stock-Specific Migrations of Juvenile Coho Salmon Derived from Coded-Wire Tag Recoveries on the Continental Shelf of Western North America. American Fisheries Society Symposium. 57:81-104.

Mote, P. W., E. A. Parson, A. F. Hamlet, et al. 2003. Preparing for Climatic Change: The Water, Salmon, and Forests of the Pacific Northwest. Climatic Change 61:45-88.

Naiman, R. J., J. R. Alldredge, D. A. Beauchamp, P. A. Bisson, J. Congleton, C. J. Henny, N. Huntly, R. Lamberson, C. Levings, E. N. Merrill, W. G. Pearcy, B. E. Rieman, G. T. Ruggerone, D. Scarnecchia, P. E. Smouse, and C. C. Wood. 2012. Developing a broader scientific foundation for river restoration: Columbia River food webs. Proceedings of the National Academy of Sciences of the United States of America 109(52):21201-21207.

National Marine Fisheries Service (NMFS). 1992. Federal Register Notice: Threatened status for Snake River spring–summer Chinook salmon, threatened status for Snake River fall Chinook salmon. Federal Register 57:78(22 April 1992):14653–14663.

NMFS. 2003. Proposed Blackbird Mine Comprehensive Environmental Response, Compensation, and Liability Act actions for ESA section 7 consultation (3 projects).

NMFS. 2004. Endangered Species Act Section 7 Formal Consultation and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for Potlatch Pulp and Paper Mill, Lewiston, Idaho National Pollutant Discharge Elimination System Permit No.: ID-000116-3 for the discharge of effluents into the Snake River, Nez Perce County, Idaho and Asotin County, WA (1 Project). NMFS Tracking No. 2000/01449.

NMFS. 2006. National Marine Fisheries Service's comments and preliminary recommended terms and conditions for an application for a major new license for the Hells Canyon hydroelectric project (FERC No. 1971). National Marine Fisheries Service, Seattle, Washington. January 24, 2006.

NMFS. 2008. Recovery Plan for Southern Resident Killer Whales (*Orcinus orca*). NMFS, Northwest Region, Seattle, WA. 251 pp.

NMFS. 2014. Final Endangered Species Act Section 7 formal consultation and Magnuson-Stevens Fishery Conservation and Management Act essential fish habitat consultation for the water quality toxics standards for Idaho. NMFS Tracking No. WCR-2000-1484.

NMFS. 2015a. ESA Recovery Plan for Snake River Sockeye Salmon (*Oncorhynchus nerka*), June 8, 2015. NOAA Fisheries, West Coast Region. 431 p. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/snake_river_sockeye_recovery_plan_june_2015.pdf

NMFS. 2015b. Endangered Species Act biological opinion on the Environmental Protection Agency's proposed approval of certain Oregon water quality standards including temperature and intergravel dissolved oxygen. WCR-013-76. NMFS, Portland, OR.

NMFS. 2016a. 2016. 5-Year review: Summary & evaluation of Snake River sockeye, Snake River spring-summer Chinook, Snake River fall-run Chinook, and Snake River Basin steelhead.

NMFS. 2016b. Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Authorization of Operation and Maintenance of Existing Water Diversions on the Middle Salmon River Watershed of the Salmon-Challis National Forest, HUCs 1706020301, 1706020302, 1706020303, 1706020304, and 1706020305, Lemhi County, Idaho. NMFS Tracking No. WCR-2016-4505.

NMFS. 2017a. ESA Recovery Plan for Snake River Spring/Summer Chinook & Snake River Basin Steelhead. November 2017. NOAA Fisheries, West Coast Region. 1,125 p. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/Final%20Snake%20Recovery%20Plan%20Docs/final_snake_river_spring-summer_chinook_salmon_and_snake_river_basin_steelhead_recovery_plan.pdf

NMFS. 2017b. ESA Recovery Plan for Snake River Fall Chinook Salmon (*Oncorhynchus tshawytscha*). November 2017. NOAA Fisheries, West Coast Region. 366 p. http://www.westcoast.fisheries.noaa.gov/publications/recovery_planning/salmon_steelhead/domains/interior_columbia/snake/Final%20Snake%20Recovery%20Plan%20Docs/final_snake_river_fall_chinook_salmon_recovery_plan.pdf

NMFS. 2018. Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Hecla Grouse Creek Mine National Pollutant Discharge Elimination System Permit, Yankee Fork Watershed, HUC 1706020105, Custer County, Idaho (One Project). NMFS Tracking No. WCR-2016-4509.

NMFS. 2019. Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Continued Operation and Maintenance of the Columbia River System. NMFS Tracking No. WCRO-2018-00152.

National Research Council (NRC). 1996. Upstream: Salmon and Society in the Pacific Northwest. National Academy Press. Washington D.C. 452 p.

Nez Perce Tribe (NPT) and Ecovista. 2004. Snake Hells Canyon Subbasin Assessment. Prepared for the Northwest Power and Conservation Council.

Northwest Fisheries Science Center (NWFSC). 2015. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Pacific Northwest. 356 p.

NWFSC. 2017. Unpublished data used in the 2019 FCRPS Biological Opinion regarding Southern Resident Killer Whales. *in* NMFS. 2019. Endangered Species Act Section 7(a)(2) Biological Opinion, Concurrence letter, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation for the Continued Operation and Maintenance of the Columbia River System. NMFS Tracking No. WCRO-2018-00152.

Norwood, W. P., U. Borgmann, D. G. Dixon, and A. Wallace. 2003. Effects of metal mixtures on aquatic biota: a review of observations and methods. Human and Ecological Risk Assessment. 9(4):795-811.

Oregon Department of Environmental Quality. 2019. Regulatory Mixing Zones in NPDES Permits. Internet Page at https://www.oregon.gov/deq/wq/wqpermits/Pages/NPDES-Mixing-Zones.aspx. Web site accessed October 1, 2019.

Pearcy, W. G. 2002. Marine nekton off Oregon and the 1997–98 El Niño. Progress in Oceanography. 54:399-403.

Pearcy, W. G. and S. M. McKinnell. 2007. The Ocean Ecology of Salmon in the Northeast Pacific Ocean-An Abridged History. American Fisheries Society. 57:7-30.

Peterson, W., J. Fisher, J. Peterson, C. Morgan, B. Burke, and K. Fresh. 2014. Applied Fisheries Oceanography Ecosystem Indicators of Ocean Condition Inform Fisheries Management in the California Current. Oceanography. 27(4):80-89.

Pacific Fisheries Management Council (PFMC). 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Poesch, M. S., L. Chavarie, C. Chu, S. N. Pandit, and W. Tonn. 2016. Climate Change Impacts on Freshwater Fishes: A Canadian Perspective. Fisheries. 41:385-391.

Quinn, T. P. 2005. The behavior and ecology of Pacific salmon and trout. University of Washington Press, Seattle, WA.

Rehage J. S. and J. R. Blanchard. 2016. What can we expect from climate change for species invasions? Fisheries 41(7):405-407.

Rhodes, J. J., D. A. McCullough, and F. A. Jr. Espinosa. 1994. A Course Screening Process for Evaluation of the Effects of Land Management Activities on Salmon Spawning and Rearing Habitat in ESA Consultations. Columbia River Inter-Tribal Fish Commission Technical Report 94-4. Portland, OR. 127 pp

Rieman, B. E. and D. J. Isaak. 2010. Climate change, aquatic ecosystems, and fishes in the Rocky Mountain west: Implications and alternatives for management. GTR RMRS-GTR-250. USFS, Rocky Mountain Research Station. 53 p.

Rykaczewski, R., J. P. Dunne, W. J. Sydeman, M. Garcia-Reyes, B. A. Black, S. J. Bograd. 2015. Poleward displacement of coastal upwelling-favorable winds in the ocean's eastern boundary currents through the 21st century. Geophysical Research Letters. 42:6424-6431.

Scherer, E. and R. E. McNichol. 1998. Preference-avoidance responses of lake whitefish (*Coregonus clupeaformis*) to competing gradients of light and copper, lead, and zinc. Water Research. 32:924-929.

Scheuerell, M. D. and J. G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (*Oncorhynchus tshawytscha*). Fisheries Oceanography. 14(6):448-457.

Spehar, R. L. and J. T. Fiandt. 1986. Acute and chronic effects of water quality criteria-based metal mixtures on three aquatic species. Environmental Toxicology and Chemistry. 5(10): 917-931

Spence, B., G. Lomnicky, R. Hughes, and R. P. Novitski. 1996. An ecosystem approach to salmonid conservation. TR-4501-96-6057. ManTech Environmental Research Services Corp.: Corvallis, Oregon.

Stabler, D. F. 1981. Effects of altered flow regimes, temperatures, and river impoundment on adult steelhead trout and chinook salmon. MS thesis, University of Idaho, Moscow, ID. 84 pp.

Stuehrenberg, L. C., G. E. Monan, and K. L. Liscome. 1978. A study of apparent losses of Chinook salmon and steelhead based on count discrepancies between dams on the Columbia and Snake Rivers. 1967-1968. U.S. Army Corps of Engineers, Portland, OR.

Sykes, G. E., C. J. Johnson, and J. M. Shrimpton. 2009. Temperature and Flow Effects on Migration Timing of Chinook Salmon Smolts. Transactions of the American Fisheries Society. 138:1252-1265.

Tiffan, K. F. and W. P. Connor. 2012. Seasonal Use of Shallow Water Habitat in the Lower Snake River Reservoirs by Juvenile Fall Chinook Salmon. 2010–2011 Final Report of Research to U.S. Army Corps of Engineers Walla Walla District.

U.S. Census Bureau. 2019a. American Fact Finder for the United States (V2018). Accessed May 2019. Available: https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

U.S. Census Bureau. 2019b. Quickfacts for the United States (V2018). Accessed May 2019. Available: https://www.census.gov/quickfacts/fact/table/US/PST045218.

U.S. Forest Service (USFS). 2014. Nez Perce-Clearwater National Forests: Forest Plan Assessment. Available at www.fs.usda.gov/detail/nezperceclearwater/landmanagement/planning/?cid=stelprdb5396919. Accessed October 1, 2019.

Verdonck, D. 2006. Contemporary vertical crustal deformation in Cascadia. Tectonophysics. 417(3):221-230.

Vijver, M. G., E .G. Elliott, W. J. G. M. Peijnenburg, and G .R. de Snoo. 2011. Response predictions for organisms water-exposed to metal mixtures: A meta-analysis. Environmental Toxicology and Chemistry. 30(7):1482–1487.

Vose, R. S., D. R. Easterling, K. E. Kunkel, A. N. LeGrande, and M. F. Wehner. 2017: Temperature changes in the United States. *In:* D. J. Wuebbles, D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock (editors). Climate Science Special Report: Fourth National Climate Assessment, Volume I. U. S. Global Change Research Program, Washington D.C. pp. 185-206.

Wainwright, T. C. and L. A. Weitkamp. 2013. Effects of Climate Change on Oregon Coast Coho Salmon: Habitat and Life-Cycle Interactions. Northwest Science 87(3):219-242.

Ward, E. J., J. H. Anderson, T. J. Beechie, G. R. Pess, and M. J. Ford. 2015. I ncreasing hydrologic variability threatens depleted anadromous fish populations. Global Change Biology. 21(7):2500-2509.

Washington Department of Ecology (WDOE). 2010. Water quality program guidance manual - procedures to implement the state's temperature standards through NPDES permits. Revised October 2010. Publication Number 06-10-100. Washington Department of Ecology, Temperature Work Team, Water Quality Program, Olympia, WA. 57pp. http://www.ecy.wa.gov/biblio/0610100.html

Washington Department of Fish and Wildlife (WDFW) and Oregon Department of Fish and Wildlife (ODFW). 2014. 2014 Joint Staff Report: Stock Status and Fisheries for Fall Chinook, Coho Salmon, Chum Salmon, Summer Steelhead, and White Sturgeon, January 14, 2014. Oregon Department of Fish & Wildlife, Washington Department of Fish and Wildlife. 88 p.

Werner, K., R. Zabel, D. Huff, and B. Burke. 2017. Ocean Conditions and Salmon Returns for 2017-2018. Memorandum to M. Tehan, NMFS West Coast Region. Northwest Fisheries Science Center, Seattle, Washington.

Whitney, J. E., R. Al-Chokhachy, D. B. Bunnell, C. A. Caldwell, et al. 2016. Physiological Basis of Climate Change Impacts on North American Inland Fishes. Fisheries. 41(7):332-345.

Wiles, G. J. 2004. Washington State Status Report for the Killer Whale. March 2004. WDFW, Olympia, Washington. 120p.

Woodward, D. F., J. A. Hansen, H. L. Bergman, E. E. Little, and A. J. DeLonay. 1995. Brown trout avoidance of metals in water characteristic of the Clark Fork River, Montana. Can. J. of Fish. Aquatic Sci. 52:2031-2037.

Woodward, D. F., J. N. Goldstein, and A. M. Garag. 1997. Cutthroat trout avoidance of metals and conditions characteristic of a mining waste site: Coeur d'Alene River, Idaho. Transactions of the American Fisheries Society. 126:699-706.

Wuebbles, D. J., D. W. Fahey, K. A. Hibbard, B. DeAngelo, S. Doherty, K. Hayhoe, R. Horton, J. P. Kossin, P. C. Taylor, A. M. Waple, and C. P. Weaver. 2017. Executive Summary. *In:* D. J. Wuebbles, D. W. Fahey, K. A. Hibbard, D. J. Dokken, B. C. Stewart, and T. K. Maycock (editors). Climate Science Special Report: Fourth National Climate Assessment, Volume I. U. S. Global Change Research Program, Washington D.C. pp. 12-34.

Yamada, S., W. T. Peterson, and P. M. Kosro. 2015. Biological and physical ocean indicators predict the success of an invasive crab, *Carcinus maenas*, in the northern California Current. Marine Ecology Progress Series. 537:175-189.

Yi, Y., Z. Yank, and S. Zhang. 2011. Ecological risk assessment of heavy metals in sediment and human health risk assessment of heavy metals in fishes in the middle and lower reaches of the Yangtze River basin. Environmental Pollution. 159(10):2575-2585.

Zabel, R. W., M. D. Scheuerell, M. M. McClure, and J. G. Williams. 2006. The Interplay Between Climate Variability and Density Dependence in the Population Viability of Chinook Salmon. Conservation Biology 20(1):190-200, 2/1/2006.

Zamon, J. E., T. J. Guy, K. Balcomb, and D. Ellifrit. 2007. Winter observations of Southern Resident killer whales (*Orcinus orca*) near the Columbia River Plume during the 2005 Spring Chinook Salmon (*Oncorhynchus tshawytscha*) spawning migration. Northwest Naturalist 88:193-198.

APPENDIX A

Idaho Mixing Zone Rules (IDAPA 58.01.02)

010. DEFINITIONS.

11. Bioaccumulative Pollutants. A compound with a bioaccumulation factor of greater than one thousand (1,000) or a bioconcentration factor of greater than one thousand (1,000). (4-11-15)

98. Thermal Shock. A rapid temperature change that causes aquatic life to become disoriented or more susceptible to predation or disease. (4-11-15)

117. Zone of Initial Dilution (ZID). An area within a Department authorized mixing zone where acute criteria may be exceeded. This area shall be no larger than necessary and shall be sized to prevent lethality to swimming or drifting organisms by ensuring that organisms are not exposed to concentrations exceeding acute criteria for more than one (1) hour more than once in three (3) years. The actual size of the ZID will be determined by the Department for a discharge on a case-by-case basis, taking into consideration mixing zone modeling and associated size recommendations and any other pertinent chemical, physical, and biological data available. (4-11-15)

060. MIXING ZONE POLICY.

01. Mixing Zones for Point Source Discharges. Whether a mixing zone is authorized, and its size, configuration and location, is determined by the Department on a case-by-case basis. This determination is made in accordance with the provisions of Section 060 at the time a permit is issued, renewed, or materially modified and is in effect as long as the permit remains in effect. Such an authorization is required before a mixing zone can be used to determine the need for, or level of, effluent limits for a particular pollutant. (4-11-15)

a. Mixing zones shall not be authorized for a given pollutant when the receiving water does not meet water quality criteria for that pollutant; provided, however, the Department may authorize a mixing zone when the permitted discharge is consistent with an approved TMDL allocation or other applicable plans or analyses (such as 4b implementation plans, watershed loading analyses, or facility-specific water quality pollutant management plans) that demonstrate that there is available assimilative capacity and authorizing a mixing zone is consistent with achieving compliance with water quality standards in the receiving water. (4-11-15)

b. Water quality within an authorized mixing zone is allowed to exceed chronic water quality criteria for those parameters approved by the Department. If approved by the Department, acute water quality criteria for one (1) or more parameters may be exceeded within the zone of initial dilution inside the mixing zone. Narrative criteria in Subsections 200.03 and 200.05 apply within the mixing zone. All water quality criteria must be met at the boundary of any mixing zone under its design conditions. (4-11-15)

c. The size of mixing zone(s) and the concentration of pollutant(s) present shall be evaluated based on the permitted design flow. The Department shall not authorize a mixing zone that is determined to be larger than is necessary considering siting, technological, and managerial options available to the discharger. (4-11-15)

d. Mixing zones, individually or in combination with other mixing zones, shall not cause unreasonable interference with, or danger to, beneficial uses. Unreasonable interference with, or danger to, beneficial uses includes, but is not limited to, the following: (4-11-15)

i. Impairment to the integrity of the aquatic community, including interfering with successful spawning, egg incubation, rearing, or passage of aquatic life. (4-11-15)

ii. Heat in the discharge that causes thermal shock, lethality, or loss of cold water refugia. (4-11-15)

iii. Bioaccumulation of pollutants (as defined in Section 010) resulting in tissue levels in aquatic organisms that exceed levels protective of human health or aquatic life. (4-11-15)

iv. Lethality to aquatic life passing through the mixing zone. (4-11-15)

v. Concentrations of pollutants that exceed Maximum Contaminant Levels at drinking water intake structures. (4-11-15)

vi. Conditions which impede or prohibit recreation in or on the water body. Mixing zones shall not be authorized for *E. coli*. (4-11-15)

e. Multiple nested mixing zones may be established for a single point of discharge, each being specific for one (1) or more pollutants contained within the discharge. (4-11-15)

f. Multiple mixing zones may be established for a single activity with multiple points of discharge. When these individual mixing zones overlap or merge, their combined area and volume shall not exceed that which would be allowed if there was a single point of discharge. When these individual mixing zones do not overlap or merge, they may be authorized as individual mixing zones. (4-11-15)

g. Adjacent mixing zones of independent activities shall not overlap. (4-11-15)

h. Mixing zones shall meet the following restrictions; provided, however, that the Department may authorize mixing zones that vary from the restrictions under the circumstances set forth in Subsection 060.01.i. below: (4-11-15)

i. For flowing waters: (4-11-15)

(1) The width of a mixing zone is not to exceed twenty-five percent (25%) of the stream width; and (4-11-15)

(2) The mixing zone shall not include more than twenty-five percent (25%) of the low flow design discharge conditions as set forth in Subsection 210.03.b. of these rules. (4-11-15)

ii. For all new discharges to nonflowing waters authorized after July 1, 2015: (4-11-15)

(1) The size of the mixing zone is not to exceed five percent (5%) of the total open surface area of the water body or one hundred (100) meters from the point of discharge, whichever is smaller; (4-11-15)

(2) Shore-hugging plumes are not allowed; and (4-11-15) (3) Diffusers shall be used. (4-11-15)

iii. For all existing discharges to nonflowing waters authorized prior to July 1, 2015, the total horizontal area allocated to the mixing zone is not to exceed ten percent (10%) of the surface area of the lake. (4-11-15)

iv. Lakes and reservoirs with a mean detention time of fifteen (15) days or greater shall be considered nonflowing waters for this purpose. Detention time will be calculated as the mean annual storage volume divided by the mean annual flow rate out of the reservoir for the same time period. (4-11-15)

i. The Department may authorize a mixing zone that varies from the limits in Subsection 060.01.h. if it is established that: (4-11-15)

i. A smaller mixing zone is needed to avoid an unreasonable interference with, or danger to, beneficial uses as described in Subsection 060.01.d., and the mixing zone meets the other requirements set forth in Section 060; or (4-11-15)

ii. A larger mixing zone is needed by the discharger and does not cause an unreasonable interference with, or danger to, beneficial uses as described in Subsection 060.01.d., and the mixing zone meets the other requirements set forth in Section 060. The discharger shall provide to the Department an analysis that demonstrates a larger mixing zone is needed given siting, technological, and managerial options. (4-11-15)

j. The following elements shall be considered when designing an outfall: (4-11-15)

i. Encourage rapid mixing to the extent possible. This may be done through careful location and design of the outfall; and (4-11-15)

ii. Avoid shore-hugging plumes in those water bodies where the littoral zone is a major supply of food and cover for migrating fish and other aquatic life or where recreational activities are impacted by the plume. (4-11-15)

02. Points of Compliance as Alternatives to Mixing Zones. Specification of mixing zones for some 404 dredge and fill activities, stormwater, and nonpoint source discharges may not be practicable due to the generally intermittent and diffuse nature of these discharges. Rather, the Department may allow limited dilution of the discharge by establishing points for monitoring compliance with ambient water quality criteria. These alternatives to a mixing zone are still subject to requirements outlined in Subsections 060.01.a., 060.01.d., 200.03, and 200.05. (4-11-15)