Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Conference Report, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation

Issuance of Section 10(a)(1)(A) Permit 18928 for the Chief Joseph Hatchery Okanogan Spring Chinook Salmon Program

NMFS Consultation Number: WCR-2014-607

Action Agencies: National Marine Fisheries Service (NMFS)
U.S. Fish and Wildlife Service (USFWS)
U.S. Bureau of Reclamation (USBOR)
Bonneville Power Administration (BPA)

Program Operators: U.S. Fish and Wildlife Service (USFWS)
Confederated Tribes of the Colville Reservation (CTCR)

Affected Species and Determinations:

ESA-Listed Species	**Status**	**Is Action Likely to Adversely Affect Species or Critical Habitat?**	**Is Action Likely To Jeopardize the Species?**	**Is Action Likely To Destroy or Adversely Modify Critical Habitat?**
Upper Columbia River steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	No
Upper Columbia River spring Chinook salmon (*O. tshawytscha*)	Endangered	Yes	No	No
Okanogan spring Chinook salmon Non-essential Experimental Population (NEP)	Non-Essential Experimental[1]	N/A	No	N/A

[1] Section 10(j) of the Endangered Species Act requires that, for the purposes of section 7 (except 7(a)(1)), non-essential experimental populations shall be treated as species proposed for listing. There is no consultation obligation with respect to species proposed for listing; rather, action agencies need only confer with the Services. Section 7(a)(4). The informal discussions that comprise the conference are used to determine if the action is likely to jeopardize the continued existence of the proposed species and, when that is not the case, a conference report can provide any non-binding recommendations to minimize or avoid adverse impacts (USFWS and NMFS 1998, chapter 6). A conference report for Okanogan spring Chinook salmon NEP is set out in section 2.11.

Fishery Management Plan That Describes 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: The National Marine Fisheries Service, West Coast Region

Issued By:

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Date: 10/27/14

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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.

The Proposed Action is the approval of a Section 10(1)(a)(1)(A) permit for a hatchery program (including research, monitoring and evaluation) intended to create a nonessential experimental population (NEP) of Upper Columbia River spring Chinook salmon in an area where spring Chinook salmon have been extirpated. The designation of the experimental population was previously authorized under Section 10(j) of the Endangered Species Act ESA (NMFS 2014). Consistent with that designation, this permit will allow collection of ESA-listed adult spring Chinook salmon in the Methow Basin, rearing at hatchery facilities and acclimated release of the their progeny into the Okanogan Basin of Washington, where they may affect naturally produced listed steelhead. The program, as well as associated RM&E, is described in the application documents, which consist of two hatchery and genetic management plans (HGMPs) (USFWS 2012a; CTCR 2013).

A description of effects, benefits, and risks of the program is provided in Section 2.4.1 of this biological opinion (opinion). The program relies on an existing program at the Winthrop National Fish Hatchery (WNFH) developed as mitigation for Grand Coulee Dam. The permit will allow approximately one third of the production from that program to be acclimated and released in the Okanogan Basin. Thus analysis of the program relies on two HGMPs (Table 1).

Consistent with ESA Section 10(j), the NEP is defined by geographic boundaries, *viz* the mainstem Okanogan River and all its tributaries between the US-Canadian border and the confluence of the Okanogan with the Columbia River. The spring Chinook salmon have NEP status when they are within those boundaries, but not when they are outside those boundaries. Thus, prior to their release into the Okanogan River, members of the Upper Columbia River spring Chinook salmon ESU are treated as endangered and effects on them are examined in this opinion accordingly. Section 7 consultation requirements do not apply to the NEP, but there is a requirement to confer with NMFS (see footnote 1). Impacts of the proposed action on the NEP have been considered consistent with the conference requirements of the ESA and the resultant conference report is set out at Section 2.11.

Table 1. HGMPs evaluated in this opinion, and program operating and funding agencies

Hatchery and Genetics Management Plan	**Program Operator**	**Funding Agency**
Winthrop NFH Spring Chinook Salmon	USFWS	USBOR
Chief Joseph Hatchery Okanogan Spring Chinook Salmon	CTCR	BPA

1.1. Background

NMFS prepared the biological opinion and incidental take statement (ITS) portions of this document in accordance with Section 7(b) of the ESA of 1973, as amended (16 U.S.C. 1531, *et seq.*), and implementing regulations at 50 CFR 402. The opinion documents consultation by NMFS, as the Action Agency, on the actions proposed by the program operators and funders (Table 1).

With respect to designated critical habitat, the following analysis relied only on the statutory provisions of the ESA, and not on the regulatory definition of "destruction or adverse modification" at 50 CFR 402.02.

NMFS also completed an Essential Fish Habitat (EFH) consultation. It was prepared 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.

The opinion, ITS, and EFH conservation recommendations are in compliance with Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-5444) ("Data Quality Act") and underwent pre-dissemination review. The project files for both consultations are located at the Sustainable Fisheries Division (SFD) in Portland, Oregon.

1.2. Consultation History

The first hatchery consultations in the Columbia River Basin followed the first listings of Columbia River Basin salmon under the ESA. Snake River sockeye salmon were listed as an endangered species on November 20, 1991, Snake River spring/summer Chinook salmon and Snake River fall Chinook salmon were listed as threatened species on April 22, 1992, and the first hatchery consultation and opinion was completed on April 7, 1994 (NMFS 1994; 2008e). The 1994 opinion was superseded by "Endangered Species Act Section 7 Biological Opinion on 1995-1998 Hatchery Operations in the Columbia River Basin, Consultation Number 383" completed on April 5, 1995 (NMFS 1995b). This opinion determined that hatchery actions jeopardize listed Snake River salmon and required implementation of reasonable and prudent alternatives (RPAs) to avoid jeopardy.

A new opinion was completed on March 29, 1999, after UCR steelhead were listed under the ESA (62 FR 43937, August 18, 1997) and following the expiration of the previous opinion on December 31, 1998 (NMFS 1999). That opinion concluded that Federal and non-Federal hatchery programs jeopardize Lower Columbia River (LCR) steelhead and Snake River steelhead protected under the ESA and described RPAs necessary to avoid jeopardy. Those measures and conditions included restricting the use of non-endemic steelhead for hatchery broodstock and limiting stray rates of non-endemic salmon and steelhead to less than 5% of the annual natural population in the receiving stream. Soon after, NMFS reinitiated consultation when LCR Chinook salmon, UCR spring Chinook salmon, Upper Willamette Chinook salmon, Upper Willamette steelhead, Columbia River chum salmon, and Middle Columbia steelhead were added to the list of endangered and threatened species (Smith 1999).

Between 1991 and the summer of 1999, the number of distinct groups of Columbia River Basin salmon and steelhead listed under the ESA increased from 3 to 12, and this prompted NMFS to

reassess its approach to hatchery consultations. In July 1999, NMFS announced that it intended to conduct five consultations and issue five opinions "instead of writing one biological opinion on all hatchery programs in the Columbia River Basin." Opinions would be issued for hatchery programs in the, (1) Upper Willamette, (2) Middle Columbia River (MCR), (3) LCR, (4) Snake River, and (5) UCR, with the UCR NMFS' first priority (Smith 1999). Between August 2002 and October 2003, NMFS completed consultations under the ESA for approximately twenty hatchery programs in the UCR. For the MCR, NMFS completed a draft opinion and distributed it to hatchery operators and to funding agencies for review on January 4, 2001, but completion of consultation was put on hold pending several important basin-wide review and planning processes.

The increase in ESA listings during the mid to late 1990s triggered a period of investigation, planning, and reporting across multiple jurisdictions and this served to complicate, at least from a resources and scheduling standpoint, hatchery consultations. A review of Federal funded hatchery programs ordered by Congress was underway at about the same time that the 2000 Federal Columbia River Power System (FCRPS) opinion was issued by NMFS (NMFS 2000). The Northwest Power and Conservation Council (Council) was asked to develop a set of coordinated policies to guide the future use of artificial propagation, and Reasonable and Prudent Alternative (RPA) 169 of the FCRPS opinion called for the completion of NMFS-approved hatchery operating plans (i.e., HGMPs) by the end of 2003. The RPA required the Action Agencies to facilitate this process, first by assisting in the development of HGMPs, and then by helping to implement identified hatchery reforms (Brown 2001). Also at this time, a new *U.S. v. Oregon* Columbia River Fisheries Management Plan (CRFMP), which included goals for hatchery management, was under negotiation and new information and science on the status and recovery goals for salmon and steelhead was emerging from Technical Recovery Teams (TRTs). Work on HGMPs under the FCRPS opinion was undertaken in cooperation with the Council's Artificial Production Review and Evaluation process, with CRFMP negotiations, and with ESA recovery planning (Jones 2002; Foster 2004). HGMPs were submitted to NMFS under RPA 169; however, many were incomplete and, therefore, were not found to be sufficient[2] for ESA consultation.

ESA consultations and an opinion were completed in 2007 for nine hatchery programs that produce a substantial proportion of the total number of salmon and steelhead released into the Columbia River annually. These programs are located in the LCR and MCR and are operated by the FWS and by the Washington Department of Fish and Wildlife (WDFW). NMFS' opinion (NMFS 2007a) determined that operation of the programs would not jeopardize salmon and steelhead protected under the ESA.

On May 5, 2008, NMFS published a Supplemental Comprehensive Analysis (SCA) (NMFS 2008e) and an opinion and RPAs for the FCRPS to avoid jeopardizing ESA-listed salmon and

[2] "Sufficient" means that an HGMP meets the criteria listed at 50 CFR 223.203(b)(5)(i), which include (1) the purpose of the hatchery program is described in meaningful and measureable terms, (2) available scientific and commercial information and data are included, (3) the Proposed Action, including any research, monitoring, and evaluation, is clearly described both spatially and temporally, (4) application materials provide an analysis of effects on ESA-listed species, and (5) preliminary review suggests that the program has addressed criteria for issuance of ESA authorization such that public review of the application materials would be meaningful.

steelhead in the Columbia River Basin (NMFS 2008b). The SCA environmental baseline included "the past effects of hatchery operations in the Columbia River Basin. Where hatchery consultations have expired or where hatchery operations have yet to undergo ESA Section 7consultation, the effects of future operations cannot be included in the baseline. In some instances, effects are ongoing (e.g., returning adults from past hatchery practices) and included in this analysis.

Because it was aware of the scope and complexity of ESA consultations facing the co-managers and hatchery operators, NMFS offered substantial advice and guidance to help with the consultations. In September 2008, NMFS announced its intent to conduct a series of ESA consultations and that "from a scientific perspective, it is advisable to review all hatchery programs (i.e., Federal and non-Federal) in the UCR affecting ESA-listed salmon and steelhead concurrently" (Walton 2008). In November 2008, NMFS expressed again, the need for re-evaluation of UCR hatchery programs and provided a "framework for ensuring that these hatchery programs are in compliance with the Federal Endangered Species Act" (Jones 2008). NMFS also "promised to share key considerations in analyzing HGMPs" and provided those materials to interested parties in February 2009 (Jones 2009).

The WNFH program operated under Section 10(1)(a)(1)(A) permit 1300 (NMFS 2002b), issued in 2002, and which expired in 2008. USFWS submitted a new HGMP to initiate consultation in 2009 (Gale 2009). Extensive discussion took place between NMFS and the fishery managers regarding spring Chinook management in the Methow Basin resulted in the submission (Gale 2012) of a revised HGMP and supplemental information for the WNFH program (USFWS 2012a; 2012b). NMFS declared application packages for both programs sufficient for consultation in March 2013 (Jones 2013b; 2013c).

The Okanogan program is new, made possible by development of a rule (NMFS 2014) allowing creation of a non-essential experimental spring Chinook population in the Okanogan Basin, which is outside the geographical boundaries of the Upper Columbia spring Chinook salmon ESU. Anticipating completion of the rule, an HGMP (CTCR 2013) for the Okanogan program was first submitted in 2012 (Friedlander 2012), and declared sufficient in July 2013 (Jones 2013a).

The pertinent HGMPs and supporting materials for were made available for public comment upon publication of a notice of availability in the Federal Register on December 10, 2013 (December 10, 2013 78 FR 74116). The public comment period expired on January 9, 2014. NMFS received no comments.

Originally, the full WNFH spring Chinook salmon program, the Methow spring Chinook salmon program (DPUD and WDFW 2010), and the Okanogan program were to be the subject of a single consultation. However, the Okanogan program can be reviewed separately because its effects in the Methow Basin are minimal; aside from broodstock collection and juvenile rearing that takes place in the Methow Basin, the program affects only the Okanogan Basin. Nor is the proposed action interrelated or interdependent with the operation of the Methow hatchery program. That program, which is ongoing, would continue irrespective of whether the proposed action were taking place, as it has for many years prior to this new action. Therefore, NMFS decided to do this program in a separate consultation.

1.3. Proposed Action

"Action" means all activities, of any kind, authorized, funded, or carried out, in whole or in part, by the action agency or action agencies. 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.

NMFS describes a hatchery program as a group of fish that have a separate purpose and that may have independent spawning, rearing, marking and release strategies (NMFS 2008b). The operation and management of every hatchery program is unique in time, and specific to an identifiable stock and its native habitat (Flagg et al. 2004). The proposed action is the issuance of a research/enhancement permits under Section 10(a)(1)(A) of the Endangered Species Act. The proposed permit authorizes the operation of a hatchery program to create a non-essential experimental population of Upper Columbia spring Chinook salmon in the Okanogan Basin, an area outside the geographical boundaries of the Upper Columbia Spring Chinook Salmon ESU, using returning hatchery fish in the Methow River. This program serves two primary purposes: 1) by establishing a new spring Chinook salmon population in the Okanogan, it increases the spatial structure of UCR spring Chinook salmon, thus reducing extinction risk and aiding recovery of the UCR spring Chinook salmon ESU; 2) it potentially reestablishes a traditional fishery resource for the Confederated Tribes of the Colville Reservation. In addition, by using fish from an existing hatchery program for these purposes, it reduces risk to UCR spring Chinook salmon without reducing overall hatchery production levels. All activities necessary for broodstock collection, spawning, incubation, rearing, transfer, acclimation, and RM&E at sites and facilities affiliated with this program will be authorized by the permit. Fisheries targeting the NEP are intended for the future, but not until the NEP reaches what is deemed a harvestable abundance level. This is not expected to occur during the 10-year term of the permit, so harvest is not part of the Proposed Action at this time. The effects of the issuance of the permit are fully described in the summary of the underlying activities presented below.

The hatchery production from this program is intended to be consistent with the Upper Columbia ESA Recovery Plan for the Upper Columbia (UCSRB 2007) and with the 2008-2017 *U.S. v. Oregon* Management Agreement as modified in January 2009 (*U.S. v. Oregon* 2009).

The program is described in detail below. Descriptions include the purpose and goals as stated by the operators, history, facilities involved, broodstock collection activities, egg/juvenile transfer, acclimation and release strategies, and marking protocols. The HGMPs contain a considerable amount of detail on fish cultural methods beyond that presented in this section. Research, monitoring, and evaluation activities are also described. Unless otherwise indicated, all information in Section 1.3 is from the Winthrop NFH spring Chinook salmon program (hereafter WNFH) HGMP (USFWS 2012a), or the Chief Joseph Hatchery Okanagan spring Chinook salmon non-essential 10(j) program (hereafter, Okanogan program).

It is important to note that with respect to the Methow Basin, this consultation covers none of the spring Chinook salmon released into the Methow Basin, only that which is released into the Okanogan Basin. The remainder of the Methow production, which includes up to 400,00 fish released by WNFH and 224,000 fish released by programs funded by three public utility

districts—Douglas County, Grant County, and Chelan County—will be dealt with in a separate consultation.

The Okanogan program is an effort by the CTCR to reintroduce spring Chinook salmon to the Okanogan Basin as a non-essential experimental population (NEP) under Section 10(j) of the ESA. The Bonneville Power Administration (BPA) is the primary funding entity with cost-share contributions from Grant, Douglas, and Chelan Public Utility Districts. This program will utilize the Methow Composite (MetComp) stock[3] from the Winthrop National Fish Hatchery (WNFH) to establish that population. All broodstock collection, spawning, mating and most early rearing will occur at WNFH, so additional details can be found in the WNFH HGMP (USFWS 2012a). Initially, fall parr will be transferred directly from WNFH to an acclimation pond in the Okanogan. Eventually, it is anticipated that eyed eggs will be transferred to CJH for early rearing before going to an acclimation pond in the Okanogan. Facilities associated with the program are shown in Figure 1.

Proposed hatchery broodstock collection

- **Broodstock origin and number:** Methow River composite stock spring Chinook salmon. The annual collection goal at WNFH is 400 hatchery origin adults. Approximately 1/3 of these would be used (but undifferentiated) for the Okanogan program. WNFH broodstock will consist primarily of returnees trapped at the hatchery ladder but also 20%-30% surplus returnees to the Methow Hatchery. The program will eventually begin collecting broodstock in the Okanogan, but this activity is not part of the current Proposed Action.

- **Duration of collection:** The hatchery operates the ladder and adult collection facilities from Mid-May into September to ensure collection from the full spectrum of the run.

- **Encounters, sorting, and handling, with ESA and non-ESA listed fish, adults, and juveniles:** Encounters with natural origin spring Chinook adults while operating the
- WNFH ladder and trap are rare. Occasionally listed natural origin spring Chinook adults are captured (< 1 / year on average). In these cases the individuals will either be transferred to WDFW for use as broodstock at Methow FH or immediately returned to the natural environment. All listed hatchery origin spring Chinook adults collected will be retained for broodstock and adult management (i.e. pHOS) purposes. In cases of low natural and hatchery origin return years hatchery adults collected at Winthrop may be transferred to Methow FH for use as broodstock (i.e. safety net purposes).

  Any non-target natural origin adults or juveniles that volunteer to the WNFH hatchery ladder will be returned unharmed to the natural environment, residual ESA listed

[3] This is the only stock of spring Chinook salmon produced at WNFH. In earlier planning the program was to have released Carson-stock fish, which are still produced at Leavenworth NFH, but not at WNFH. See Section (2.3.2) for further details.

hatchery origin juveniles (steelhead and spring Chinook salmon) captured in the adult pond will be retained to reduce ecological impacts to natural origin juveniles.

Proposed mating protocols and adult disease management

- Fish will be collected from the entire spectrum of the run and mated randomly in 1x1 individual matings.
- The inclusion of jacks is limited to < 10 % unless required to meet broodstock requirements (i.e. due to low return).
- Backup males will be used only in cases where a problem is noted with the milt (e.g. blood, water, etc.,).
- The spawning population will be tested for reportable viruses and bacteria according to the Fish Health Policy of the Co-Managers of Washington State and the USFWS Fish Health Policy. It will usually consist of testing 150 ovarian fluid samples for viruses and 60 male kidney/spleen tissues for viruses and culturable bacteria. In addition, kidneys will be tested from 100% of the spawned females for levels of *Renibacterium salmoninarum*, the causative agent of Bacterial Kidney Disease, to provide a risk assessment for disease development in the offspring from each female. Other samples may be taken to test for other pathogens of concern as deemed appropriate or necessary by the attending Fish Health Biologist at the time of sampling.

Proposed protocols for each release group (annually)

- **Life stage:** yearling smolt
- **Size:** 15-17 fpp
- **Acclimation and duration of acclimation:** overwinter, late October or Early November through mid-April.
- **Volitional Release:** Yes, approximately two weeks, non-migrants forced out in early May.
- **External mark(s):** 100% adipose fin clipped, initially, but this may change
- **Internal marks/tags:** 100% CWT, 5000 PIT-tags
- **Maximum number released:** 200,000 ($\pm$ 10%)
- **Release location:** Tonasket Acclimation Pond (Riverside or Omak Ponds are contingency sites)
- **Time of release:** Mid April through early May
- **Fish health certification:** Disease monitoring is accomplished by daily visual observations by hatchery staff and once monthly monitoring by fish health biologists/pathologists from the USFWS Olympia Fish Health Center (OFHC). At least three weeks before release, all smolt lots are tested for reportable pathogens at the 5% assumed pathogen prevalence level (APPL). All test records and results are on file at the OFHC.

Proposed adult management

- **Anticipated number or range in adult hatchery fish returns originating from this program:** No data on Okanogan releases are available. The HGMP assumes a survival rate of 0.3%, which would yield a return of 600 fish from a release of 200,000. Using the survival range presented above for the WNFH program, a range of 194 to 1376 would be expected.
- **Removal of hatchery-origin adults and the anticipated number of natural-origin fish encountered:** This is a reintroduction program. No natural-origin fish are expected initially, but if the program is successful, natural-origin adults can be expected starting 6 years from the first release in 2015 (jacks in 5 years). No adult management is expected during the 10-year course of the permit, as all fish will be needed to spawn naturally.
- **Appropriate uses for hatchery fish that are removed:** Not applicable.
- **Are hatchery fish intended to spawn naturally (Y/N):** Yes.
- **Performance standard for pHOS (proportion of naturally spawning fish that are of hatchery-origin):** None during the period of the permit.

Proposed Research, Monitoring, and Evaluation

- **Adult sampling, purpose, methodology, location, and the number of fish handled:** There are PIT interrogation sites on most tributaries but adult fish will not be handled. There is video monitoring on some tributaries and Zosel Dam fishway but this is also passive handling. There is a weir on Omak Creek and one proposed on Salmon Creek for steelhead management which are likely to encounter spring Chinook. These weirs are covered separately under permits 1395 and 1412 (NMFS 2003b; 2008d). Spring Chinook will be released upstream unharmed if captured at a weir.
- **Juvenile sampling, purpose, methodology, location and number of fish handled:** Two rotary screw traps will be operated near the town of Okanogan (Hwy 20 bridge) for the purpose of enumerating Chinook salmon smolt emigration. Yearling Chinook smolts captured in the screw trap will be enumerated, measured, scanned for PIT and CWT, and a tissue sample will be taken for genetics, then they will be released. Electrofishing and snorkeling will occur at base flow periods (after hatchery smolt outmigration) in select tributaries for the purpose of evaluating steelhead. This effort could encounter offspring of successful spawners from this hatchery program. This activity targets steelhead and is covered under NMFS permit # 16122 as part of the Okanogan Basin Monitoring and Evaluation Program (BPA Project # 2003-022-00)

Proposed operation and maintenance of hatchery facilities

- **Water source(s) and quantity for hatchery facilities:**
    - WNFH withdraws approximately 75% (up to 50 cubic feet per second [cfs]) of its water supply from the Methow River at Foghorn Dam and 25% from ground water supply. The total 25 cfs of surface water from the Methow River represents

about 3.1% of the mean annual discharge of the Methow River (1,592 cfs). In extreme low-flow years, flow at the mouth of the Methow River has been 505 cfs (1977) (USGS 2014), and the hatchery diversion would represent about 10% of the flow.

- Chief Joseph Hatchery will be supplied with 60 cfs of surface water from Rufus Woods Lake and 39 cfs of well water. The intake is above anadromous passage, and is returned (minus evaporation) to the Columbia River.
- Tonasket Pond will utilize up to 15 cfs of Okanogan River surface water. The removal of surface water from the Okanogan River represents about 1.2% of the median annual discharge of the Okanogan River (1,300 cfs). The ponds are used during winter and spring, and avoid extreme low-flow times. In the even that Tonasket pond cannot be used, either Riverside or Omak ponds may be used for acclimation as alternates.
    - Both Riverside Pond and Omak Pond use up to 15.3 cfs of Okanogan River surface water. Since only one pond will be used in place of Tonasket, the impact will be nearly identical (approximately 1.2% of the median annual discharge of the Okanogan River (1,300 cfs) will be removed)

- **Water diversions meet NMFS screen criteria:** Yes, all three ponds are screened.
- **Permanent or temporary barriers to juvenile or adult fish passage:** None
- **Instream structures:** None
- **Streambank armoring or alterations:** None
- **Pollutant discharge and location(s):** Effluent from all hatcheries and acclimation ponds will be monitored and kept within discharge thresholds. Acclimation ponds will be dewatered and cleaned before receiving fish each year. During fish rearing, the ponds will be vacuumed of propagation wastes as needed and solids properly disposed. WNFH complies with the current National Pollutant Discharge Elimination System (NPDES) permit standards (WAG-13-0000). Discharge occurs below the hatchery ladder into Spring Creek/outfall channel. All cleaning effluent is discharged to a settling facility before discharge into Spring Creek/outfall channel. At Chief Joseph Hatchery, a cleaning waste collection and treatment system will remove pollutants, primarily un-eaten feed and fish feces, from the rearing raceways and ponds. The collection system will be based on an eductor-type vacuuming system that discharges into a dual cell settling pond designed to comply with WDOE criteria.

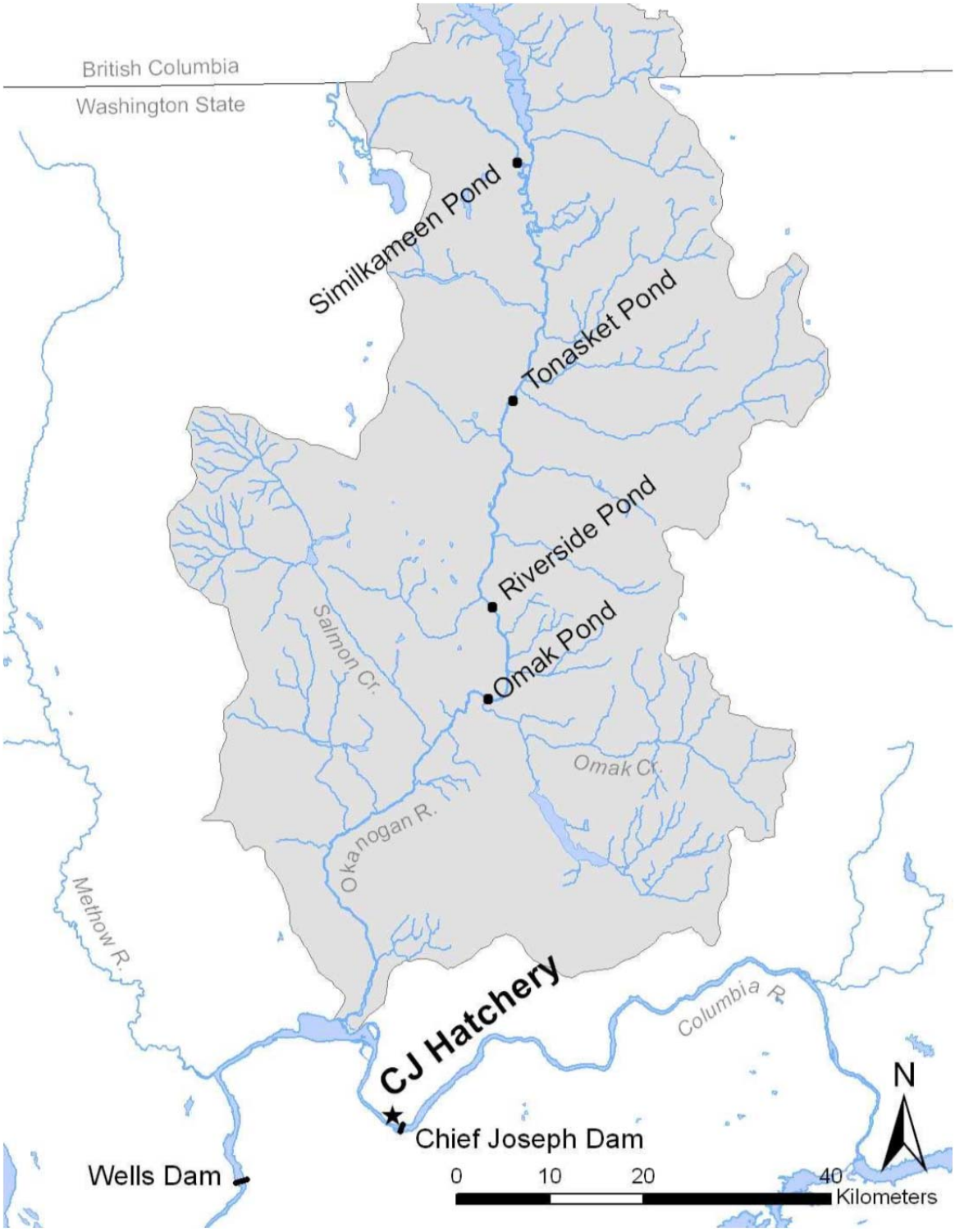

Figure 1. U.S. portion of the Okanogan River Basin, the Chief Joseph Hatchery, and Chinook salmon acclimation sites. Tonasket Pond is the primary intended acclimation site for Okanogan spring Chinook salmon (CTCR 2013).

1.4. Action Area

The "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 Proposed Action takes place in the Methow and Okanogan Basins. Action area in the Methow is limited to the adult migration corridor up to the Winthrop and Methow hatcheries (~RM 52). in the Okanogan Basin it includes all reaches of the Okanogan River and its tributaries within the United States, accessible to anadromous fish, downstream to the Columbia confluence. The action area also includes Wells Dam on the Columbia River, where some broodstock fish may be trapped for the Methow program and transferred to WNFH for use as broodstock. ESA-listed species in the Action Area that may be adversely affected include UCR Chinook salmon and UCR steelhead (Table 2). Table 3 provides more detailed description of stream reaches in the Action Area.

Table 2. ESA- listed species considered in this consultation, their listing status, critical habitation designation, and protective regulations.

Species	Listing Status	Critical Habitat	Protective Regulations
Chinook salmon (*Oncorhynchus tshawytscha*)			
Upper Columbia River spring-run	Endangered 70 FR 37160; June 28, 2005	70 FR 52630; Sept 2, 2005	70 FR 37160; June 28, 2005
Steelhead (*O.mykiss*)			
Upper Columbia	Threatened 74 FR 42605; August 24, 2009	70 FR 52630; Sept 2, 2005	70 FR 37160; June 28, 2005

Table 3. Stream reaches of the Methow and Okanogan (US only) Basins included in the Action Area. Stream reach information on use by anadromous fish is from RTT (2013a).

Watershed (sub-basin)	Assessment Unit (or primary sub-watershed)	River miles	Secondary and tertiary sub-watersheds	Fish Use
Methow	Middle Methow	26.8 - 51.6		MaSA for steelhead and summer Chinook.
	Lower Methow	0 - 26.8		MiSA for steelhead.
Okanogan	Inundated Okanogan	0 - 15.1		
	Okanogan River 01	15.1 - 25.75	Chiliwist and Loup Loup creeks	
	Okanogan River 02	25.75 - 31.5	Salmon Creek	
	Okanogan River 03	31.5 - 41.1	Wanacut, Johnson, and Omak Creeks	
	Okanogan River 04	41.1 - 52.6	Tunk Creek	
	Okanogan River 05	52.6 - 57.3	Aeneas and Bonaparte creeks	
	Okanogan River 06	57.3 - 74.3	Wildhorse spring, Whitestone,	

Watershed (sub-basin)	Assessment Unit (or primary sub-watershed)	River miles	Secondary and tertiary sub-watersheds	Fish Use
			Siwash, and Antonie creeks	
	Okanogan River 07	74.3 - 78.9	Ninemile, Tonasket creeks, Similkameen River	
	Lower Similkameen	0 - 3.7		
	Middle Similkameen	3.7 - 6.6		
	Upper Similkameen	6.6 - 8.9		
	Chiliwist Creek	0 -0.3		
	Loup Loup Creek	0 - 1.4		
	Lower Salmon Creek	0 - 4.5		
	Upper Salmon Creek	4.5 - 17.6		
	Lower Omak Creek	0 - 5.6		
	Upper Omak Creek	5.6 - 26.6	Stapaloop, Swimptkin, Trail creeks	
	Wanacut Creek	0 - 1.3		
	Johnson Creek	0 - 7.5		
	Tunk Creek	0 - 0.75		
	Aeneas Creek	0 - 0.75		
	Bonaparte Creek	0 - 0.99		
	Siwash Creek	0 - 1.8		
	Lower Antoine Creek	0 - 0.89		
	Upper Antoine Creek	0.89 - 11.9		
	Wild Horse Spring Creek	0 - 0.68		
	Tonasket Creek	0 - 2.17		
	Nine Mile Creek	0 - 5.22		

The operation of hatchery facilities has the potential to affect ESA-listed salmon and steelhead in streams adjacent to hatchery facilities through the diversion of surface water or the maintenance of instream structures (e.g., the water intake and discharge structures) and the release of effluent. Under the Proposed Action, a number of hatchery facilities will be used, depending on the program, to spawn, incubate, and rear salmon and steelhead for the Methow and Okanogan spring Chinook salmon programs.

- Winthrop National Fish Hatchery
- Chief Joseph Hatchery
    - Tonasket Acclimation Pond
    - Riverside Acclimation Pond
    - Omak Acclimation Pond

Wells Dam may also be used as a broodstock trapping site, but only to a very limited extent.

The action area includes these facilities and portions of the adjacent streams where water withdrawals are affecting ESA-listed fish.

NMFS considered whether the mainstem Columbia River, the estuary, and the ocean should be included in the action area but the effects analysis was unable to detect or measure effects of the

proposed action beyond the area described above, based on best available scientific information (NMFS 2009a). Available knowledge and techniques are insufficient to discern the role and contribution of the proposed action to density dependent interactions affecting salmon and steelhead growth and survival in the mainstem Columbia River, the Columbia River estuary, and in the Pacific Ocean. From the scientific literature, the general conclusion is that the influence of density dependent interactions on growth and survival is likely immeasurably small. While there is evidence that hatchery production, on a scale many times larger than the proposed action, can impact salmon survival at sea, the degree of impact or level of influence is not yet understood or predictable. NMFS will monitor emerging science and information and will reinitiate Section 7 consultation in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

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. Section 7(a)(2) of the ESA requires Federal agencies to consult with the U.S. Fish and Wildlife Service (USFWS), NMFS, or both, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Section 7(b)(3) requires that at the conclusion of consultation, NMFS provide an opinion stating how the agencies' actions will affect listed species or their critical habitat. If incidental take is expected, Section 7(b)(4) requires the provision of an incidental take statement specifying the impact of any incidental taking, and including reasonable and prudent measures to minimize such impacts.

2.1. Introduction to the Biological Opinion

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. The jeopardy analysis considers both survival and recovery of the species. The adverse modification analysis considers the impacts on the conservation value of the designated critical habitat.

"To jeopardize the continued existence of a listed species" means to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing the reproduction, numbers, or distribution of that species or reduce the value of designated or proposed critical habitat (50 CFR 402.02).

This opinion uses the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[4] It does not rely on the regulatory definition of 'destruction or adverse modification' of critical habitat at 50 CFR. 402.02. NMFS will use the following approach to assess the effects of the Proposed Action described in Section 1.3.

[4] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

Range-wide status of the species and critical habitat

This section describes the status of species and critical habitat that are the subject of this opinion. The status review starts with a description of the general life history characteristics and the population structure of the ESU/DPS, including the strata or major population groups (MPG) where they occur. NMFS has developed specific guidance for analyzing the status of salmon and steelhead populations in a "viable salmonid populations" (VSP) paper (McElhany et al. 2000b). The VSP approach considers four attributes, the abundance, productivity, spatial structure, and diversity of each population (natural-origin fish only), as part of the overall review of a species' status. For salmon and steelhead protected under the ESA, the VSP criteria therefore encompass the species' "reproduction, numbers, or distribution" (50 CFR 402.02). In describing the range-wide status of listed species, NMFS reviews available information on the VSP parameters including abundance, productivity trends (information on trends, supplements the assessment of abundance and productivity parameters), spatial structure and diversity. We also summarize available estimates of extinction risk that are used to characterize the viability of the populations and ESU/DPS, and the limiting factors and threats. To source this information, NMFS relies on viability assessments and criteria in technical recovery team documents, ESA Status Review updates, and recovery plans. We determine the status of critical habitat by examining its physical and biological features (also called "primary constituent elements" or PCEs). Status of the species and critical habitat are discussed in Section 2.2.

Describing the environmental baseline

The environmental baseline includes the past and present impacts of Federal, state, or private actions and other human activities *in the action area* [5] on ESA-listed species. It includes the anticipated impacts of proposed Federal projects that have already undergone formal or early Section 7 consultation and the impacts of state or private actions that are contemporaneous with the consultation in process. The environmental baseline is discussed in Section 2.3 of this opinion.

Cumulative effects

Cumulative effects, as defined in NMFS' implementing regulations (50 CFR 402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area[6]. Future Federal actions that are unrelated to the proposed action are not considered because they require separate Section 7 consultation. Cumulative effects are considered in Section 2.5 of this opinion.

Integration and synthesis

Integration and synthesis occurs in Section 2.6 of this opinion. In this step, NMFS adds the effects of the Proposed Action (Section 2.4) to the status of ESA protected populations in the Action Area under the environmental baseline (Section 2.3) and to cumulative effects (Section

[5] 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 ESA section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

[6] 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).

2.5). Impacts to individuals within the affected populations are analyzed to determine their effects on the VSP parameters for the affected populations, and these are combined with the overall status of the strata/MGP to determine the effects on the ESA-listed species (ESU/DPS) which will be used to formulate the agency's opinion as to whether the hatchery action is likely to: (1) result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat.

Jeopardy and adverse modification

Based on the Integration and Synthesis analysis in Section 2.6, the opinion determines whether the proposed action is likely to jeopardize ESA protected species or destroy or adversely modify designated critical habitat in Section 2.7.

Reasonable and prudent alternative(s) to the proposed action

If NMFS determines that the action under consultation is likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat, NMFS must identify a RPA or RPAs to the proposed action.

2.2. Range-wide Status of the Species and Critical Habitat

This opinion examines the status of each species (as defined below) that would be affected by the Proposed Action. The status is the level of risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. The species status section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

"Species" Definition: The ESA of 1973, as amended, 16 U.S.C. 1531 et seq. defines "species" to include any "distinct population segment (DPS) of any species of vertebrate fish or wildlife which interbreeds when mature." To identify DPSs of salmon species, NMFS follows the "Policy on Applying the Definition of Species under the ESA to Pacific Salmon" (56 FR 58612). Under this policy, a group of Pacific salmon is considered a distinct population, and hence a "species" under the ESA if it represents an evolutionarily significant unit (ESU) of the biological species. The group must satisfy two criteria to be considered an ESU: (1) It must be substantially reproductively isolated from other con-specific population units; and (2) It must represent an important component in the evolutionary legacy of the species. To identify DPSs of steelhead, NMFS applies the joint FWS-NMFS DPS policy (61 FR 4722). Under this policy, a DPS of steelhead must be discrete from other populations, and it must be significant to its taxon. For example, the UCR steelhead constitute a DPS of the taxonomic species *Oncorhynchus mykiss*, and UCR Chinook salmon, constitute an ESU (salmon DPS) of the taxonomic species *Oncorhynchus tshawytscha*, and as such each are considered a "species" under the ESA.

2.2.1. Status of Listed Species

For Pacific salmon and steelhead NMFS commonly uses four parameters to assess the viability of the populations that, together, constitute the species: spatial structure, diversity, abundance, and productivity (McElhany et al. 2000b). These VSP parameters therefore encompass the species' "reproduction, numbers, or distribution" as described in 50 CFR 402.02. When these parameters are collectively at appropriate levels, they maintain a population's capacity to adapt to various environmental conditions and allow it to sustain itself in the natural environment. These attributes are influenced by survival, behavior, and experiences throughout a species' entire life cycle, and these characteristics, in turn, are influenced by habitat and other environmental conditions.

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

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

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

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

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

2.2.1.1. Life History and Status of UCR Chinook Salmon

Chinook salmon (*Oncorhynchus tshawytscha)* have a wide variety of life history patterns that include: variation in age at seaward migration; length of freshwater, estuarine, and oceanic residence; ocean distribution; ocean migratory patterns; and age and season of spawning migration. Two distinct races of Chinook salmon are generally recognized: "stream-type" and "ocean-type" (Healey 1991; Myers et al. 1998). ESA-listed UCR spring Chinook salmon are stream-type. Stream-type Chinook salmon spend 2 to 3 years in coastal ocean waters, whereas

ocean-type Chinook salmon spend 3 to 4 years at sea and exhibit extensive offshore ocean migrations. Ocean-type Chinook salmon also enter freshwater later, upon returning to spawn, than the stream type, May and June compared to February through April. Ocean-type Chinook salmon use different areas – they spawn and rear in lower elevation mainstem rivers and they typically reside in fresh water for no more than 3 months compared to spring Chinook salmon that spawn and rear high in the watershed and reside in freshwater for a year.

Three major population groups (MPGs) and eight populations comprise the historical UCR spring Chinook salmon ESU, however the ESU is currently limited to one MPG and three extant populations. Approximately half of the area that originally produced spring Chinook salmon in this ESU is blocked by dams. What remains of the ESU includes all naturally spawned fish upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington State, excluding the Okanogan River (64 FR 14208, March 24, 1999) (Figure 2). Six artificial propagation programs were originally included in the ESU including the Twisp, Chewuch, Methow Composite, Winthrop NFH, Chiwawa, and White River hatchery programs (70 FR 37204, June 28, 2005). Currently the three Methow Basin programs (Twisp, Chewuch, Methow Composite) are considered a single program, with two components: Twisp and Methow (the previous Chewuch and Methow programs combined). Furthermore, a Nason Creek program is beginning in the Wenatchee Basin(GPUD and WDFW 2009a), and the White River releases will be discontinued after 2016 (GPUD and WDFW 2009b).

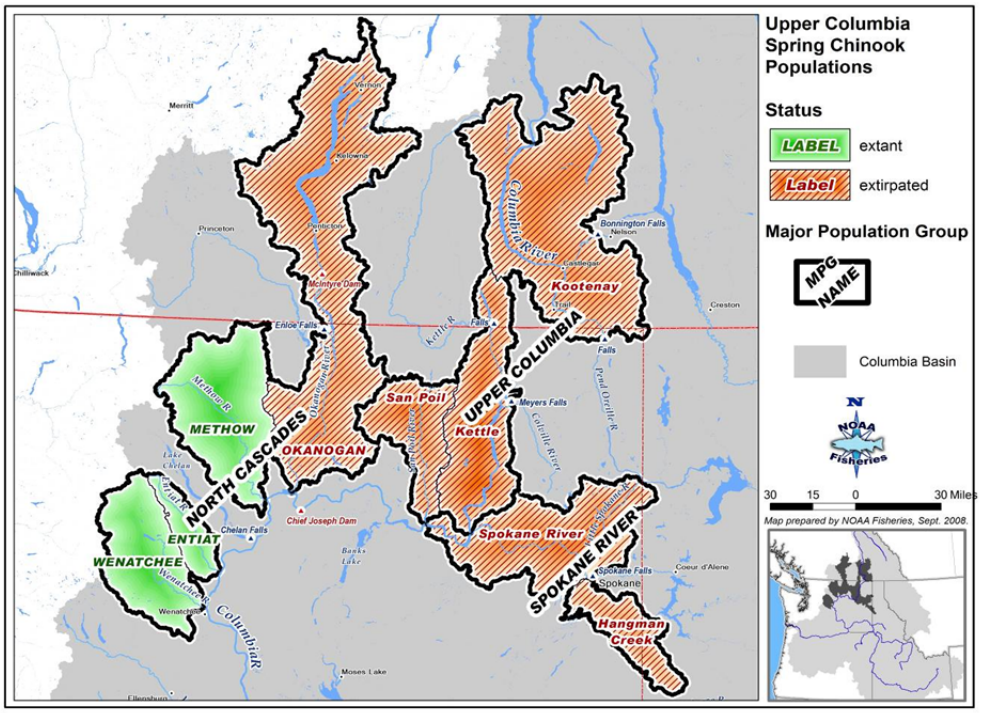

Figure 2. Upper Columbia River spring Chinook salmon ESU (ICTRT 2008).

Abundance, Productivity, Spatial Structure, and Diversity

Status of the species is determined based on the abundance, productivity, spatial structure, and diversity of its constituent natural populations. Best available information indicates that the species, in this case the UCR spring Chinook salmon ESU, is at high risk and remains at endangered status. The ESA Recovery Plan (UCSRB 2007) calls for improvement in each of the three extant spring Chinook salmon populations (no more than a 5% risk of extinction in 100 years) and for a level of spatial structure and diversity that restores the distribution of natural populations to previously occupied areas and allows natural patterns of genetic and phenotypic diversity to be expressed. This corresponds to a threshold of at least "viable" status for each of the three natural populations.

Risk Rating for Abundance / Productivity	Risk Rating for Spatial Structure / Diversity: Very Low	Low	Moderate	High
Very Low (<1%)	**Highly Viable**	**Highly Viable**	**Viable**	**Maintained**
Low (1-5%)	**Viable**	**Viable**	**Viable**	**Maintained**
Moderate (6-25%)	**Maintained**	**Maintained**	**Maintained**	**High Risk**
High (>25%)	**High Risk**	**High Risk**	**High Risk**	**High Risk** **Wenatchee R.** **Entiat R.** **Methow R.** **Okanogan R. (extinct)**

Figure 3. Matrix used to assess population status across VSP parameters or attributes for UCR spring Chinook salmon. Percentages for abundance and productivity scores represent the probability of extinction in a 100-year time period (ICTRT 2007; Ford 2011).

For the most recent period (1987–2009), abundance has increased, but productivity, for two of the three populations, remains below replacement and has actually declined substantially. For spatial structure and diversity, there is a consistent and substantial decline in the proportion of natural-origin fish on the spawning grounds for all three populations. Natural-origin fish now make up fewer than fifty percent of the spawners for all three populations (Table 5).

Although increases in natural-origin abundance relative to the extremely low levels observed during the mid-1990s are encouraging, overall productivity has decreased to extremely low levels for the two largest populations (Wenatchee and Methow populations) and the predominance of hatchery fish on the spawning grounds, particularly for the Wenatchee and Methow populations, is an increasing risk. Populations that rely on hatchery spawners are not viable (McElhany et al. 2000b). Based on the combined ratings for abundance/productivity and spatial structure/diversity, all three extant populations and the ESU remain at high risk of extinction.

Table 4. Risk levels and viability ratings for UCR spring Chinook salmon populations (Ford 2011).

Population	Abundance Criteria for ESA De-listing, Abundance, and Productivity Measures and Integrated Abundance and Productivity (A/P) Risk				Risk Levels for Spatial Structure and Diversity and Integrated Spatial Structure and Diversity (SS/D) Risk			Overall Risk Rating for A/P and SS/D
	Minimum Natural-Origin Fish Abundance Criteria for ESA Delisting	***Natural-Origin Fish Spawning Abundance***	***Productivity***	***A/P Risk***	***Natural Processes Risk***	***Diversity Risk***	***SS/D Risk***	
Wenatchee River 1987-2009	2000	449 (119-1,050)	0.61 (0.40-0.95)	High	Low	High	High	High Risk
1981-2003		*222* *(18-1,050)*	*0.93* *(0.57-1.53)*	*High*				
Entiat River 1999-2009	500	105 (27-291)	1.08 (0.75-1.55)	High	Moderate	High	High	High Risk
1981-2003		*59* *(10-291)*	*0.72* *(0.59-0.93)*	*High*				
Methow River 1999-2009	2000	307 (79-1,979)	0.45 (0.26-0.8)	High	Low	High	High	High Risk
1981-2003		*180* *(20-1,979)*	*0.80* *(0.52-1.24)*	*High*				

Table 5. Estimates of natural-origin spawning escapement for UCR spring Chinook salmon populations (Ford 2011).

Population	% Natural-Origin (5-year average)		
	1991 to 1996	1997 to 2001	2003 to 2008
Wenatchee River	*69%*	*58%*	31%
Entiat River	*82%*	*58%*	46%
Methow River	*78%*	*41%*	29%

Many factors affect the abundance, productivity, spatial structure, and diversity of the UCR Spring Chinook Salmon ESU. Factors limiting the ESU's survival and recovery include:

- survival through the FCRPS
- degradation and loss of estuarine areas that help the fish survive the transition between fresh and marine waters
- spawning and rearing areas that have lost deep pools, cover, side-channel refuge areas, and high quality spawning gravels
- interbreeding and competition with hatchery fish that far outnumber fish from natural populations

An increase in spatial structure and abundance of the ESU will be attempted through recolonization of the Okanogan Basin by establishment of a non-essential experimental population (NEP) under Section 10(j) of the ESA (NMFS 2014). Recolonization will begin in 2015 with the acclimated release into the Okanogan Basin of 200,000 Methow-Composite stock spring Chinook salmon transferred from Winthrop National Fish Hatchery (WNFH). Releases of fish originating from WNFH will continue until the numbers of returning spring Chinook salmon to the Okanogan are large enough to allow within-basin collection of broodstock.

2.2.1.2. Life History and Status of UCR Steelhead

Steelhead (*O. mykiss*) occur as two basic anadromous run types based on the level of sexual maturity at the time of river entry and the duration of the spawning migration (Burgner et al. 1992). The stream-maturing type (inland), or summer steelhead, enters freshwater in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type (coastal), or winter steelhead, enters freshwater with well-developed gonads and spawns shortly after river entry (Barnhart 1986).

UCR steelhead are summer steelhead, returning to freshwater between May and October, and require up to 1 year in freshwater to mature before spawning (Chapman et al. 1994). Spawning occurs between January and June. In general, they prefer smaller higher gradient streams

relative to other Pacific salmon and they spawn farther upstream than winter steelhead (Withler 1966; Behnke 1992). Progeny typically reside in freshwater for two years before migrating to the ocean, but freshwater residence can vary from 1-7 years (Peven et al. 1994). For UCR steelhead, marine residence is typically one year, although the proportion of two-year ocean fish can be substantial in some years. They migrate directly offshore during their first summer rather than migrating nearer to the coast as do salmon. During fall and winter, juveniles move southward and eastward (Hartt and Dell 1986).

The UCR Steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River Basin upstream of the Yakima River, Washington to the U.S. – Canada border. The UCR Steelhead DPS also includes six artificial propagation programs: the Wenatchee River, Wells Hatchery (in the Methow and Okanogan rivers), Winthrop NFH, Omak Creek, and the Ringold steelhead hatchery programs.

The UCR steelhead DPS consisted of three MPGs before the construction of Grand Coulee Dam, but it is currently limited to one MPG with four extant populations: Wenatchee, Methow, Okanogan, and Entiat. A fifth population in the Crab Creek drainage is believed to be functionally extinct. What remains of the DPS includes all naturally spawned populations in all tributaries accessible to steelhead upstream from the Yakima River in Washington State, to the U.S. – Canada border (Figure 4). The Proposed Action affects the Wenatchee and Methow steelhead populations.

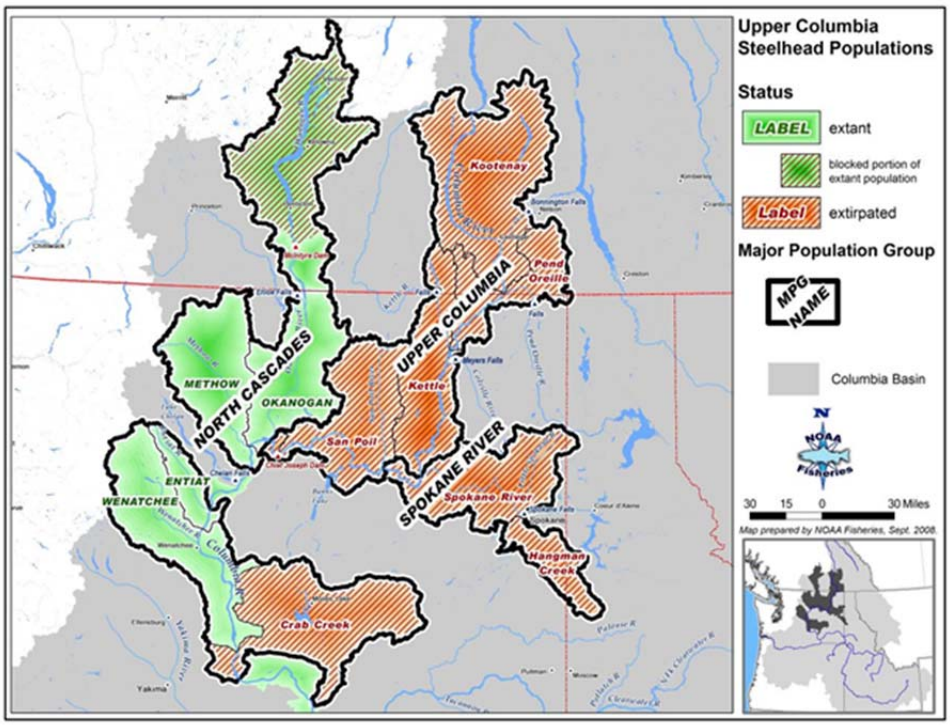

Figure 4. Upper Columbia River steelhead DPS (ICTRT 2008).

Abundance, Productivity, Spatial Structure, and Diversity

Status of the species is determined based on the abundance, productivity, spatial structure, and diversity of its constituent natural populations. Best available information indicates that the species, in this case the UCR steelhead DPS, is at high risk and remains at threatened status. The ESA Recovery Plan (UCSRB 2007) calls for improvement in each of the four extant steelhead populations (no more than a 5% risk of extinction in 100 years) and for a level of spatial structure and diversity that restores the distribution of natural populations to previously occupied areas and allows natural patterns of genetic and phenotypic diversity to be expressed. This corresponds to a threshold of at least "viable" status for each of the three natural populations, which falls into the category of "high risk" (Figure 5).

Risk Rating for Abundance / Productivity	Risk Rating for Spatial Structure / Diversity: Very Low	Low	Moderate	High
Very Low (<1%)	Highly Viable	Highly Viable	Viable	Maintained
Low (1-5%)	Viable	Viable	Viable	Maintained
Moderate (6-25%)	Maintained	Maintained	Maintained	High Risk
High (>25%)	High Risk	High Risk	High Risk	**High Risk** Wenatchee R. Entiat R. Methow R. Okanogan R.

Figure 5. Matrix used to assess population status across VSP parameters or attributes for UCR steelhead. Percentages for abundance and productivity scores represent the probability of extinction in a 100-year time period (ICTRT 2007; Ford 2011).

For the 2005-2009 period, abundance (5-year geometric mean) has increased for the aggregate return of UCR steelhead (combined hatchery and natural-origin returns measured at Priest Rapids Dam) and for natural-origin spawners in each of the four extant populations (Table 6). Annual returns (ESA-listed hatchery and natural-origin fish combined) were all above the population specific ranges in returns for the 5-year period reported in the 2005 BRT review (Good 2005; Good et al. 2005); however, natural-origin returns remain well below target levels. For spatial structure and diversity, hatchery origin returns continue to constitute a high fraction of total spawners in natural spawning areas for the Wenatchee population and for the DPS as a whole.

Although increases in natural-origin abundance relative to the extremely low levels observed during the mid-1990s are encouraging, overall productivity has decreased to extremely low levels for the two largest populations (Wenatchee and Methow populations) and the predominance of hatchery fish on the spawning grounds, particularly for the Wenatchee,

Methow, and Okanogan River populations, is an increasing risk. Populations that rely solely on hatchery spawners are not viable over the long-term (McElhany et al. 2000b). Based on the combined ratings for abundance/productivity and spatial structure/diversity, all four extant populations and the ESU remain at high risk of extinction, including the Wenatchee population.

Table 6. Recent abundance and proportion natural-origin in natural spawning areas compared to estimates at the time of listing and in the previous BRT review (Ford 2011).

Population North Cascades MPG	**Total Spawners (5-year geometric mean, range)**			**Natural-origin (5-year geometric mean)**			**Percent natural-origin (5-year average)**		
	Listing (1991-1995)	**Prior (1997-2001)**	**Current (2005-2009)**	**Listing (1991-1995)**	**Prior (1997-2001)**	**Current (2005-2009)**	**Listing (1991-1995)**	**Prior (1997-2001)**	**Current (2005-2009)**
Wenatchee River	1,880	696 (343–1,655)	1,891 (931–3,608)	458	326 (241–696)	819 (701–962)	24	48	47
Entiat River	121	265 (132–427)	530 (300–892)	59	46 (31–97)	116 (99–137)	48	19	23
Methow River	1,184	1,935 (1,417–3,325)	3,504 (2,982–4,394)	251	162 (68–332)	505 (361–703)	21	9	15
Okanogan River	723	1,124 (770–1,956)	1,832 (1,483–2,260)	84	53 (22–109)	152 (104–197)	12	5	9
Aggregate count at Priest Rapids Dam	8,420	14,592	16,989	1,147	3,007	3,604	14	19	19

Any factors affect the abundance, productivity, spatial structure, and diversity of the UCR Steelhead DPS. Factors limiting the DPS's survival and recovery include:

- past management practices such as the Grand Coulee Fish Maintenance Project,
- survival through the FCRPS,
- degradation and loss of estuarine areas that help the fish survive the transition between fresh and marine waters,
- spawning and rearing areas that have lost deep pools, cover, side-channel refuge areas, high quality spawning gravels,
- predation by native and non-native species,
- harvest,
- interbreeding and competition with hatchery fish that far outnumber fish from natural populations.

2.2.2. Status of Critical Habitat

In this section, we examine the range-wide status of designated critical habitat for the affected salmonid species. For UCR spring Chinook salmon and UCR steelhead, critical habitat was designated in 70 FR 52630 (September 2, 2005) (NMFS 2005a). UCR spring Chinook salmon critical habitat includes all Columbia River estuarine areas and river reaches proceeding upstream to Chief Joseph Dam, as well as specific stream reaches in the following subbasins: Chief Joseph, Methow, Upper Columbia/Entiat and Wenatchee. UCR steelhead critical habitat includes river reaches proceeding upstream to Chief Joseph Dam, as well as specific stream reaches in the following subbasins: Columbia River/Lynch Coulee, Chief Joseph, Okanogan, Salmon, Methow, Similkameen, Chewuch, Twisp, Entiat, Wenatchee, Chiwawa, Nason, and Icicle. UCR steelhead and spring Chinook salmon have overlapping ranges, similar life history characteristics.

Both species considered in this opinion have designated critical habitat. Except for reaches in the uppermost areas of their geographical range and the Okanogan River Basin, most areas of critical habitat for these species are co-extensive. Each species has a number of watersheds identified as comprising its designated critical habitat. The status of critical habitat is based primarily on a watershed-level analysis of conservation value that focused on the presence of ESA-listed species and physical features that are essential to their conservation. The NMFS organized information at the 5th field hydrologic unit code (HUC) watershed scale because it corresponds to the spatial distribution and site fidelity scales of salmon and steelhead populations (McElhany et al. 2000a). The analysis for the 2005 designations of salmon and steelhead species was completed by Critical Habitat Analytical Review Teams (CHARTs) that focused on large geographical areas corresponding approximately to recovery domains (NMFS 2005b). Each watershed was ranked using a conservation value attributed to the quantity of stream habitat with "primary constituent elements" (PCE), the present condition of those PCEs, the likelihood of achieving PCE potential (either naturally or through active restoration), support for rare or important genetic or life history characteristics, support for abundant populations, and support for spawning and rearing populations. In some cases, our understanding of these interim conservation values has been further refined by the work of TRTs and other recovery planning

efforts that have better explained the habitat attributes, ecological interactions, and population characteristics important to each species.

The NMFS reviews the status of designated critical habitat affected by the Proposed Action by examining the condition and trends of PCEs throughout the designated area. These PCEs vary slightly for some species, due to biological and administrative reasons, but all consist of site types and site attributes associated with life history events (Table 7).

Table 7. PCEs of critical habitat designated for ESA-listed salmon and steelhead considered in this opinion.

Primary Constituent Elements		**Species Life History Event**
Site Type	**Site Attribute**	
Freshwater spawning	Substrate Water quality Water quantity	Adult spawning Embryo incubation Alevin growth and development
Freshwater rearing	Floodplain connectivity Forage Natural cover Water quality Water quantity	Fry emergence from gravel Fry/parr/smolt growth and development
Freshwater migration	Free of artificial obstruction Natural cover Water quality Water quantity	Adult sexual maturation Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Estuarine areas	Forage Free of artificial obstruction Natural cover Salinity Water quality Water quantity	Adult sexual maturation and "reverse smoltification" Adult upstream migration and holding Kelt (steelhead) seaward migration Fry/parr/smolt growth, development, and seaward migration
Nearshore marine areas	Forage Free of artificial obstruction Natural cover Water quantity Water quality	Adult growth and sexual maturation Adult spawning migration Nearshore juvenile rearing
Offshore marine areas	Forage Water quality	Adult growth and sexual maturation Adult spawning migration Subadult rearing

Habitat quality in tributary streams in the Interior Columbia Recovery Domain range from excellent in wilderness and roadless areas to poor in areas subject to heavy agricultural and urban development (Wissmar et al. 1994; NMFS 2009b). Critical habitat throughout much of the Interior Columbia Recovery Domain has been degraded by intense agriculture, alteration of stream morphology (i.e., channel modifications and diking), riparian vegetation disturbance, wetland draining and conversion, livestock grazing, dredging, road construction and

maintenance, logging, mining, and urbanization. Reduced summer stream flows, impaired water quality, and reduction of habitat complexity are common problems for critical habitat in developed areas.

Many stream reaches designated as critical habitat in the Interior Columbia Recovery Domain are over-allocated under state water law, with more allocated water rights than existing stream-flow conditions can support. Withdrawal of water, particularly during low-flow periods that commonly overlap with agricultural withdrawals, often increase summer stream temperatures, block fish migration, strand fish, and alter sediment transport (Spence et al. 1996). Reduced tributary stream flow has been identified as a major limiting factor for all listed salmon and steelhead species in this area (NMFS 2007b; 2011b).

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

2.2.2.1. Critical Habitat for Upper Columbia River Spring Chinook salmon

The UCR spring Chinook salmon ESU's range consists of 31 watersheds. The CHART assigned five watersheds a medium rating and 26 received a high rating of conservation value to the ESU (NMFS 2005b).

Many factors, both human-caused and natural, have contributed to the decline of UCR spring Chinook salmon critical habitat. Upper Columbia River spring Chinook salmon habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture, resulting in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. The following are the major factors limiting the conservation value of UCR spring Chinook salmon critical habitat:

1. Columbia River hydropower system mortality (freshwater migration corridors without obstructions)

2. Degraded tributary riparian condition and loss of in-channel large wood (freshwater rearing sites with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams to form and maintain physical conditions that support juvenile growth and development)

3. Altered tributary floodplain and channel morphology (freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; freshwater rearing sites with floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and development)

4. Reduced tributary stream flow and altered passage (freshwater spawning sites with water quantity conditions supporting spawning, incubation and larval development; freshwater rearing sites with water quantity to form and maintain physical habitat conditions that support juvenile growth and development)

5. Nearly all historically suitable habitats in the Okanogan Basin are no longer accessible.

6. Climate change is expected to alter critical habitat as described in Section 2.2 by generally increasing temperature and peak flows and decreasing base flows. Although changes will not be spatially homogenous, effects of climate change will generally decrease the capacity of critical habitat to support successful spawning, rearing, and migration.

2.2.2.2. Critical Habitat for Upper Columbia River Steelhead

The UCR steelhead DPS's range includes 42 watersheds. The CHART assigned low, medium, and high conservation value ratings to three, eight, and 31watersheds, respectively (NMFS 2005b).

Many factors, both human-caused and natural, have contributed to the decline of UCR steelhead over the past century, as well as the conservation value of essential features and PCEs of designated critical habitat. Steelhead habitat has been altered through activities such as urban development, logging, grazing, power generation, and agriculture. These habitat alterations have resulted in the loss of important spawning and rearing habitat and the loss or degradation of migration corridors. The following are the major factors limiting the conservation value of critical habitat for UCR steelhead:

1. Columbia River hydropower system mortality (freshwater migration corridors without obstructions)

2. Reduced tributary stream flow (freshwater spawning sites with water quantity conditions supporting spawning, incubation and larval development; freshwater rearing sites with water quantity to form and maintain physical habitat conditions that support juvenile growth and development)

3. Degraded tributary riparian condition and loss of in-channel large wood (freshwater rearing sites with natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams to form and maintain physical conditions that support juvenile growth and development)

4. Altered tributary floodplain and channel morphology (freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development; freshwater rearing sites with floodplain connectivity to form and maintain physical habitat conditions that support juvenile growth and development)

5. Excessive sediment in tributaries (spawning sites with substrate to support egg incubation and larval growth and development; juvenile migration corridors and rearing sites with forage to support juvenile growth and development)

6. Degraded tributary water quality (spawning sites with water quality to support egg incubation and larval growth and development; juvenile rearing sites and migration corridors with water quality supporting juvenile growth and development)

7. Substantial truncation of their range in the Okanogan Basin

8. Climate change is expected to alter critical habitat as described in Section 2.2 by generally increasing temperature and peak flows and decreasing base flows. Although changes will not be spatially homogenous, effects of climate change will generally decrease the capacity of critical habitat to support successful spawning, rearing, and migration.

2.2.3. Climate Change

Climate change has negative implications for designated critical habitats in the Pacific Northwest (Climate Impacts Group 2004; Scheuerell and Williams 2005; Zabel et al. 2006; ISAB 2007). Average annual Northwest air temperatures have increased by approximately 1ºC since 1900, or about 50% more than the global average over the same period (ISAB 2007). The latest climate models project a warming of 0.1 ºC to 0.6 ºC per decade over the next century. According to the Independent Scientific Advisory Board (ISAB), these effects pose the following impacts over the next 40 years:

- Warmer air temperatures 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.
- With a smaller snowpack, these watersheds will see their runoff diminished earlier in the season, resulting in lower streamflow in the June through September period. River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.
- Water temperatures are expected to rise, especially during the summer months when lower streamflow co-occur with warmer air temperatures.

These changes will not be spatially homogeneous across the entire Pacific Northwest. Low-lying areas are likely to be more affected. Climate change may have long-term effects that include, but are not limited to, depletion of 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 (ISAB 2007).

To mitigate for the effects of climate change on listed salmonids, the ISAB (2007) recommends planning now for future climate conditions by implementing protective tributary, mainstem, and estuarine habitat measures, as well as protective hydropower mitigation measures. In particular, the ISAB (2007) suggests: increased summer flow augmentation from cool/cold storage reservoirs to reduce water temperatures or to create cool water refugia in mainstem reservoirs and the estuary; and the protection and restoration of riparian buffers, wetlands, and floodplains.

2.3. Environmental Baseline

Under the Environmental Baseline, NMFS describes what is affecting ESA-listed species and designated critical habitat in the Action Area before including any effects resulting from the proposed action. The 'environmental baseline' includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area and the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation (50 CFR 402.02). The effects of future actions over which the Federal agency has discretionary involvement or control will be analyzed as 'effects of the action.'

In order to understand what is affecting a species, it is first necessary to understand the biological requirements of the species. Each phase of salmon and steelheads life-history has its own biological requirements (Groot and Margolis 1991; NRC 1996; Spence et al. 1996). These biological requirements are inter-related and inter-dependent to the PCEs used to describe critical habitat. Generally speaking, during spawning migrations, adult salmon and steelhead require clean water with cool temperatures and access to thermal refugia, dissolved oxygen near 100 percent saturation, low turbidity, adequate flows and water depths to allow passage over barriers to reach spawning sites, and sufficient holding and resting sites. Anadromous fish select spawning areas based on species-specific requirements of flow, water quality, substrate size, and groundwater upwelling. Embryo survival and fry emergence depend on substrate conditions (*e.g.*, gravel size, porosity, permeability, and oxygen concentrations), substrate stability during high flows, and, for most species, water temperatures of 13ºC or less. Habitat requirements for juvenile rearing include seasonally suitable microhabitats for holding, feeding, and resting. Migration of juveniles to rearing areas, whether the ocean, lakes, or other stream reaches, requires free access to these habitats.

Wide varieties of human activities have affected Upper Columbia spring Chinook salmon and PCEs in the action area. These activities, more recently, include reclamation actions that are having beneficial effects.

2.3.1. Description of Area and Effects on the Landscape and Habitat

Material in this section is primarily taken from RTT (2013b).

2.3.1.1. Methow River Basin

The Methow subbasin is located in north-central Washington and lies entirely within Okanogan County. The subbasin consists of about 1,167,764 acres. About 89% of the subbasin is in public ownership. The remaining 11% is privately owned and is primarily within the valley bottoms. The subbasin consists of fourteen primary subwatersheds: Early Winters Creek, Upper Methow River, Lost River, Wolf Creek, Middle Methow River, Upper and Lower Chewuch River, Upper and Lower Twisp River, Beaver Creek, Gold Creek, Libby Creek, and the Lower Methow rivers. Many factors have historically contributed to habitat degradation in the Methow Basin. Although beaver trapping began in the early 1800s, and no doubt had an effect on riparian - conditions, mining was probably the first major activity affecting riparian and stream conditions. Mining began in the Methow Basin in the 1870s (Mullan et al. 1992).

After the advent of mining was a period of intense livestock grazing. Grazing pressure was highest from the late 1800s to the 1930s, with subsequent reductions as allotment systems replaced the open range. Water diversion began in the mid-1880s, reducing stream flow and in some cases, may have come close to completely drying up the river, undoubtedly affecting adult migration and rearing capacity (Mullan et al. 1992).

Timber harvest began in the 1920s, and up until 1955, selective harvest or "high grading" was the primary harvest method. Since then, partial cutting and clear-cutting have been the predominant practices. The 1980s represent the period of most intense harvest.

The Methow River currently has a high proportion of pristine habitat in the upper portions of major tributaries. The primary habitat conditions in the Methow Basin that limit abundance, productivity, spatial structure, and diversity of spring Chinook salmon are mostly found in the middle and lower mainstem and lower portions of major tributaries that have been affected by state highways, county roads, and housing and agricultural development that have diminished the overall function of the stream channel and floodplain. In Cub, Boulder, Eightmile, and Falls Creeks (all in the Chewuch River subwatershed), and in the Goat (upper Methow subwatershed), Beaver, Libby, and Gold Creek drainages, impacts also extend into the upper reaches of the drainages. These impacts are mostly the result of past timber harvest operations, road building and placement, and grazing (Andonaegui 2000). All of these alterations have impaired instream complexity, wood and gravel recruitment, floodwater retention, and water quality.

In some portions of the watershed, human alterations to the environment are exacerbating naturally limiting conditions by reducing habitat quality and quantity. Additionally, late summer and winter instream flow conditions often reduce migration, spawning, and rearing habitat for native salmonids. This problem is partly natural (a result of watershed-specific weather and geomorphic conditions) but is exacerbated by irrigation withdrawals in late summer.

2.3.1.2. Okanogan River Basin

Many factors have contributed to habitat degradation in the Okanogan Basin. Although beaver trapping began in the early 1800s, and no doubt had an effect on riparian conditions, mining was probably the first major activity affecting riparian and stream conditions. Trappers and traders moved to the Okanogan Basin in the early to mid-1800s. In the later 1800s, gold mining brought a major influx of people to the valley. Mining in the Fraser River basin in British Columbia spurred large cattle drives up the Okanogan River Valley between 1859 and 1870. It is likely that the influx of cattle diminished the riparian areas within the valley to some unknown extent.

After the advent of mining was a period of intense livestock grazing. Grazing pressure was highest from the late 1800s to the 1930s, with subsequent reductions as allotment systems replaced the open range. Water diversion began in the mid 1880s, reducing stream flow and in some cases, may have come close to completely drying up the river, undoubtedly affecting adult salmonid migration and rearing capacity (Mullan et al. 1992).

The Okanogan/Similkameen is the largest and most complex subbasin in the Upper Columbia region. Barriers, poor water quality and low late-summer instream flows (mainstem and tributary) limit the survival, distribution, and productivity of both anadromous and inland

salmonids. Transboundary planning and implementation are ongoing and critical because more than half of the subbasin is within British Columbia.

Summer water temperatures often exceed lethal tolerance levels for salmonids along the Okanogan River mainstem. These high temperatures are partially due to natural phenomena (low gradient, aspect, high ambient air temperatures, upstream lake effects) but are exacerbated by various anthropogenic activities including dam operations irrigation, and land management. High water temperatures and low flows in summer and fall may limit adult run timing as well as juvenile salmonid rearing in the mainstem and in several tributaries.

There are three substantial barriers to upstream migration in the Okanogan Subbasin: lack of stream flow in lower Salmon Creek (between the Okanogan Irrigation District diversion dam and the confluence with the Okanogan River), and Conconully Dam in the upper Salmon Creek watershed. Enloe Dam on the Similkameen River is also a barrier to fish passage; although there is debate whether anadromous salmonids historically passed the natural waterfalls that existed before construction of the dam. Correction of these and other barriers in smaller creeks would result in lasting and important increases in salmon and/or steelhead spatial structure, productivity, and abundance and would enable colonization and expansion from core populations.

On July 11, 2014, NMFS designated the Okanogan River spring Chinook salmon Non-essential Experimental Population, including special rules regarding actions affecting the designated NEP. The proposed action is the first such action towards establishment of the NEP.

2.3.1.3. Recent habitat restoration activities

Since the mid- to late 1990s, various organizations, such as the Upper Columbia Salmon Recovery Board (founded in 1999) have been coordinating, developing, and implementing habitat restoration projects in all of the subbasins within the Upper Columbia Region. The focus of these projects has been to reduce the effects of ecological concerns (formerly known as limiting factors) that impact environmental factors that influence productivity and abundance of salmonids.

In a recent analysis of the implementation of restoration projects, Maier (2014) determined that to date (early 2014), 278 projects have been completed which has restored 22 miles of stream, 11 miles of off-channel habitat, and 127 acres of riparian forest. Ninety-three fish passage barriers have been removed that opened up 282 miles of habitat, and 3,379 acres of habitat and 47 miles of stream bank have been protected. These projects have undoubtedly changed the environmental baseline and will continue to do so in the future.

2.3.1.4. Carlton Complex fire

On July 14, 2014, lightning strikes started the Carlton Complex fire, the largest fire ever recorded in Washington. Contained as of late August 2014, it has burned over 265,000 acres, extending from the Columbia upstream nearly to Winthrop (Figure 6). The large amount of new barren hillsides will result in higher runoff rates generally, and higher impacts from rain on snow events. What the impact on salmon will ultimately be obviously remains to be seen, but it is

inconceivable that this fire will not have a serious impact on salmonid productivity for the next few years. NMFS assumes that extinction risk of the Methow spring Chinook salmon and steelhead populations has been increased significantly as a result of the fire.

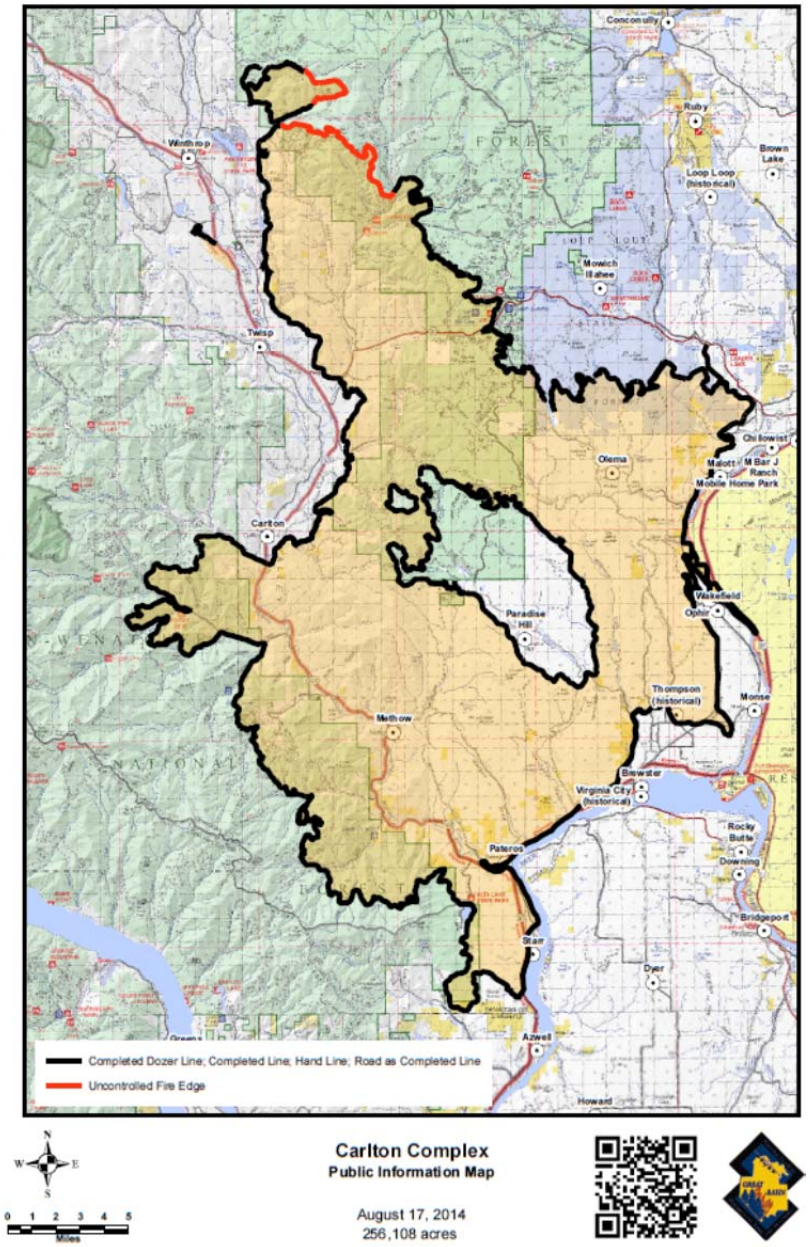

Figure 6. Perimeter map of Carlton Complex fire (http://inciweb.nwcg.gov/incident/maps/3967/, accessed 8/27/2014).

2.3.2. Artificial Propagation

Another important aspect of the Environmental Baseline are hatchery effects – effects from hatchery programs located in the Action Area. The relevance of older (pre 1970s) programs to the current status of fish in these basins is questionable, except for some potential legacy effects. Of more concern are immediate effects such as handling, predation, competition and disease

resulting from ongoing hatchery programs. Therefore, this Opinion will focus more on effects of relatively recent programs. Currently and in the recent past there have been spring Chinook salmon, summer Chinook salmon, coho salmon, and steelhead programs in both the Methow Basin and spring Chinook salmon, summer Chinook salmon and steelhead programs in the Okanogan Basin. In the Entiat Basin, steelhead releases ceased in 1999 and the long term spring Chinook salmon program transitioned to summer Chinook in 2009. Release numbers of all species except coho salmon have recently been revised due to terms of mitigation agreements that allow adjustment based on "no-net-impact" (NNI) analyses of dam mortalities (CPUD 2002b; 2002a; DPUD 2002)[7].

2.3.2.1. History of hatcheries in the Upper Columbia

Hatcheries in the Upper Columbia Basin began operations as early as the late 1800s. The first hatcheries that released spring Chinook began operation in 1899 on the Wenatchee River (Chiwaukum Creek) and near the confluence of the Twisp River on the Methow River. These hatcheries, operated by Washington Department of Fish and Game, were built to replenish salmon (primarily Chinook and coho) runs that had virtually been eliminated by the 1890s (Gilbert and Evermann 1895).

The Leavenworth National Fish Hatchery Complex was constructed between 1938 and 1940. The Complex consists of three large hatchery facilities, Leavenworth National Fish Hatchery (LNFH), Entiat National Fish Hatchery (ENFH), and Winthrop National Fish Hatchery (WNFH), which are operated by the USFWS. They were constructed as mitigation facilities to compensate for the loss of spawning and rearing habitat caused by the construction of Grand Coulee Dam. The facility planned for the Okanogan River was never constructed. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP)[8] on April 3, 1937, and reauthorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. LNFH currently produce non-listed spring Chinook salmon. WNFH produces listed spring Chinook salmon.

In 1989, new artificial propagation programs funded by Chelan PUD began as mitigation for Rock Island Dam, including the Chiwawa River spring Chinook program. In 1991, Douglas PUD began funding artificial propagation programs of spring Chinook salmon in the Methow basin as mitigation for Wells Dam.

In 2002, HCP agreements among Chelan PUD, Douglas PUD, NOAA Fisheries, USFWS, WDFW, the Colville Tribes, and the Yakama Nation formalized funding and actions setting the stage for continued operation of both the hatchery programs initiated in the 1960's and the

[7] The concept of NNI as defined by the HCPs requires virtual 100% survival of "plan species" passing the hydroelectric projects of the agreements. NNI consists of two components: (1) 91% Combined Adult and Juvenile Project Survival achieved by project improvement measures implemented within the geographic area of the Project, (2) 9% compensation for Unavoidable Project Mortality provided through hatchery and tributary programs, with 7% compensation provided through hatchery programs and 2% compensation provided through tributary programs. The 7% hatchery component is recalculated every 10 years and is based on juvenile survival through the projects and the abundance of adults returning past the projects.

[8] Historically, artificial propagation efforts have also had a significant impact on spring-run populations, either through hatchery-based enhancement or the extensive trapping and transportation activities associated with the GCFMP. Because spring-run Chinook salmon populations were at severely depressed levels at the time of the GCFMP, naturally spawning populations in this ESU were founded by the same GCFMP homogenized stock.

relatively newer programs started in 1989 and 1991. Recently, the Grant County PUD has begun spring Chinook programs in the Wenatchee River that will be discussed below.

Current artificial propagation programs operated by the Colville Tribes include a (non-listed) spring Chinook salmon program that will be operated at the new Chief Joseph Hatchery. Spring Chinook will be provided from WNFH and acclimated and released in the Okanogan subbasin.

2.3.2.2. Species Overview

2.3.2.2.1. Spring Chinook salmon

The Winthrop National Fish Hatchery began rearing spring Chinook salmon in 1974 using Carson stock. After the ESA listing in 1999, the Winthrop NFH spring Chinook salmon program switched to the more-native Methow composite stock (see description below) in 2000, and currently releases up to 600,000 smolts per year, with an anticipated decrease to 400,000 released into the Methow River (and an additional 200,000 reared for release in the Okanogan River; see below). Between 1994 and 2014, the average number of spring Chinook salmon released from Winthrop NFH is just under 623,000, and has ranged from approximately 15,000 to 1.2 million (Table 8).

A state-run, PUD funded, spring Chinook salmon program began at the Methow Hatchery in 1992, designed to produce up to 550,000 smolts annually. The program has since been reduced by NNI recalculations to 223,764 fish per year. The number of spring Chinook salmon released into the Methow River basin from the Methow hatchery between 1994-2014 has averaged approximately 332,000 fish and ranged from approximately 29,000 to 612,000 (Table 8). The total releases of spring Chinook salmon from both hatcheries has ranged from approximately 44,000 to 1.4 million fish.

One of the challenges of managing the spring Chinook salmon hatchery programs in the Methow Basin is the lack of infrastructure to manage the number of returning adults, and returning hatchery fish from both programs interbreed with natural-origin fish.

The CTCR have applied for a permit begun a reintroduction program for spring Chinook salmon in the Okanogan River. Currently spring Chinook salmon do not occur in the Okanogan River (except for occasional strays), but the experimental population designation (NMFS 2014) was intended to begin hatchery operations with the goal of re-establishing this population. The proposed action is a key component of the re-establishment of an Okanogan River spring Chinook population. Methow Composite spring Chinook collected in the Methow River and raised until fall will be transferred to an acclimation pond in the Okanogan River basin for over-winter rearing and release the following spring. Current production goals for this program are 200,000 fish. This program is analyzed in this biological opinion.

Table 8. Annual spring Chinook smolt releases into the Methow Basin 1976-2014 (Cooper 2014; Snow 2014)

Release Year	PUD Releases (Methow H.)	WNFH Releases	Total
1976		271,139	271,139
1977		412,000	412,000
1978		365,800	365,800
1979		427,240	427,240
1980		1,207,000	1,207,000
1981		966,000	966,000
1982		712,700	712,700
1983		953,508	953,508
1984		903,181	903,181
1985		1,205,102	1,205,102
1986		1,098,688	1,098,688
1987		1,104,566	1,104,566
1988		1,090,200	1,090,200
1989		865,734	865,734
1990		1,121,395	1,121,395
1991		986,862	986,862
1992		624,771	624,771
1993		950,624	950,624
1994	76,734	556,313	633,047
1995	611,763	770,847	1,382,610
1996	36,166	112,395	148,561
1997	28,878	14,620	43,498
1998	371,306	324,851	696,157
1999	491,957	545,062	1,037,019
2000	451,140	377,696	828,836
2001	248,183	175,869	424,052
2002	342,096	201,604	543,700
2003	449,642	461,678	911,320
2004	493,547	578,307	1,071,854
2005	313,443	550,214	863,657
2006	412,564	484,090	896,654
2007	417,102	589,693	1,006,795
2008	411,990	509,045	921,035
2009	299,558	371,959	671,517
2010	540,290	495,978	1,036,268
2011	564,887	517,900	1,082,787
2012	509,708	551,509	1,061,217
2013	507,647	374,086	881,733
2014	229,974	560,379	790,353
Mean	332,444	625,400	825,620

2.3.2.2.2. Summer Chinook salmon

Summer/fall Chinook salmon programs exist in the Methow and Okanogan basins, and originated with the HCP settlement agreements and have been operated under permit 1347 (NMFS 2003c). The Wells Hatchery has also been releasing summer/fall Chinook salmon at the hatchery site (immediately downstream of Wells Dam). Releases of summer/fall Chinook salmon from the Wells Hatchery has averaged approximately 336,000 yearlings and 430,000 sub-yearlings and ranged from approximately 185,000 to 458,000 and 187,000 to 542,000 for yearlings and sub-yearlings, respectively (Table 9).

The Okanogan (primarily Similkameen) program originally released up to 576,000 fish, but has recently been resized by NNI recalculations to 250,000. The Methow program was originally 400,000 but has been resized to 200,000. Releases of summer/fall Chinook in the Methow River have averaged approximately 382,000, ranging from approximately 205,000 to 541,000 and releases into the Okanogan River have averaged approximately 522,000 (range ~ 27,000 - 703,000) and are shown in Table 9.

Total releases (Methow, Okanogan and Columbia River) between 1991 and 2013 have averaged approximately 1.6 million and ranged between about 773,000 to almost 2 million (Figure 7). Fish from all of these programs are not thought to interact to any large degree with spring Chinook salmon or steelhead (NMFS 2003a).

In 2013, the Chief Joseph Hatchery began operation. Summer/fall Chinook salmon will be acclimated and released at the Similkameen River facility, Riverside, and Omak ponds and directly from the main facility on the Columbia River. In total, approximately 1.3 million yearlings and 700,000 sub-yearlings will be released from all of these facilities.

Table 9. Releases of summer/fall Chinook salmon from the Methow (Carlton) acclimation pond, the Similkameen rearing facility and Wells Dam. Data sources: (Snow et al. 2013), (Hillman et al. 2014), and C. Snow (personal communication).

Release Year	Number of Smolts Released				
	Methow (Carlton)	Similkameen (and Bonaparte Pond 2009-2011)	Wells Hatchery (yearlings)	Wells Hatchery (subyearlings)	Total
1991	420,000	352,600			772,600
1992	391,650	540,000			931,650
1993	540,900	675,500			1,216,400
1994	402,641	548,182		187,382	1,138,205
1995	433,375	586,000	388,248	450,935	1,858,558
1996	406,560	536,299	365,000	408,000	1,715,859
1997	353,182	587,000	290,000	473,000	1,703,182
1998	298,844	507,913	356,707	541,923	1,705,387
1999	384,909	589,591	381,867	370,617	1,726,984
2000	205,269	293,191	457,770	363,600	1,319,830

Release Year	Number of Smolts Released				
	Methow (Carlton)	Similkameen (and Bonaparte Pond 2009-2011)	Wells Hatchery (yearlings)	Wells Hatchery (subyearlings)	Total
2001	424,363	630,463	312,098	498,500	1,865,424
2002	336,762	532,453	343,423	376,027	1,588,665
2003	248,595	26,642	185,200	473,100	933,537
2004	399,975	388,589	306,810	425,271	1,520,645
2005	354,699	579,019	313,509	471,123	1,718,350
2006	400,734	703,359	312,980	430,203	1,847,276
2007	263,723	275,919	333,587	396,538	1,269,767
2008	419,734	604,035	311,880	402,527	1,738,176
2009	433,256	615,138	310,063	427,131	1,785,588
2010	397,554	519,357	336,881	471,286	1,725,078
2011	404,956	675,903	446,313	442,821	1,969,993
2012	439,000	617,950	350,218	492,777	1,899,945
2013	436,092	627,978	289,998	493,451	1,847,519
Mean	**382,468**	**522,308**	**336,450**	**429,811**	**1,556,462**

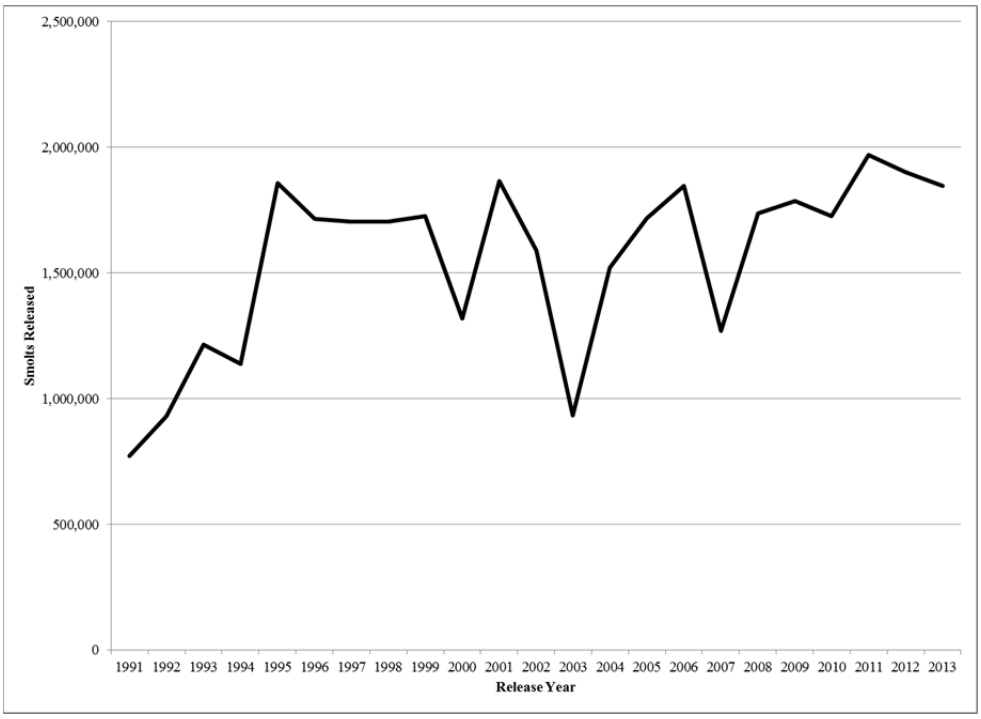

Figure 7. Total summer/fall Chinook salmon releases into the Columbia (Wells Dam), Methow, and Okanogan basins 1991-2013.

Table 10. Production goals of summer/fall Chinook salmon for the Chief Joseph Hatchery (**http://www.colvilletribes.com/cjhp_website_production_table_doc.php**).

Life stage	Release Location	Release Goal
Yearling	Similkameen Facility	250,000
Yearling	Riverside Pond	275,000
Yearling	Omak Pond	275,000
Yearling	Chief Joseph Hatchery	500,000
Sub-yearling	Omak Pond	300,000
Sub-yearling	Chief Joseph Hatchery	400,000
Total		**2,000,000**
Total yearling		**1,300,000**
Total sub-yearling		**700,000**

2.3.2.2.3. Steelhead

Until 1998, steelhead released into all UCR subbasins were produced at Wells Hatchery,[9] from broodstock collected at Wells Dam and Priest Rapids Dam[10]. This changed with creation of the Wenatchee program at Eastbank Hatchery (using broodstock collected in the Wenatchee Basin), which was authorized to release up to 400,000 fish annually, and was recently resized by the HCP Hatchery Committee to 247,300 in 2011.

Wells stock continues to be released by both WNFH and Wells Hatchery, but WNFH is developing an endemic Methow stock for conservation purposes and the Wells Hatchery Committee continues to explore options for development of a locally adapted broodstock program. Collectively the two hatcheries have been authorized under permit 1395 to release up to 448,000 steelhead into the Methow Basin, but this has been reduced through the NNI recalculation to 348,000. Releases in the Methow River basin (including a small number of fish released into the Columbia River) have averaged nearly 413,000 fish from 1992 to 2013, ranging from approximately 260,000 to 711,000 (Table 11, Figure 8). Table 11 shows the distribution of the releases, where the WNFH has averaged approximately 113,000, ranging from about 99,000 to 150,000 between 1999 and 2013. The Wells program has released fish into the Methow, Twisp, Chewuch and Columbia Rivers and averages are shown in Table 11.

Returning fish from both programs interbreed with natural-origin fish. Although there is uncertainty about the precision and accuracy of estimates of the percentage of hatchery-origin fish on the spawning grounds, it is thought to be very high (> 80%).

As part of the Wells Hatchery program, summer steelhead have been released into the Okanogan Basin also. These fish are derived from broodstock collected at Wells Dam, like the Methow portion of the Wells program. Grant PUD has funded this portion of the program recently, and

[9] The Wells steelhead program began in 1968.

[10] From 1964 to 1983, steelhead broodstock were obtained at Priest Rapids Dam, which were propagated at Chelan FH. From 1984 through 1995, broodstock for the steelhead production throughout the entire Upper Columbia region was derived from Wells Dam and fish hatchery. WDFW initiated changes in mitigation hatchery steelhead production in 1996, which re-directed artificial production programs toward development of locally adapted broodstocks and improvement in the perceived fitness of the Wells Fish Hatchery population.

the release target is 100,000 fish. Historically, most fish were released into the mainstem Okanogan and Similkameen Rivers (Table 12). In 2002, the Colville Tribe initiated a locally-adapted pilot broodstock program in Omak Creek, a tributary to the Okanogan River. Initially, the locally-adapted steelhead production program was operated at Cassimer Bar Fish Hatchery (CBFH). Past production targets at CBFH were 20,000 yearling steelhead smolts. In 2010, the CBFH was closed due to program failures, including low smolt-to-adult return rates and it was decided that the entire Okanogan Basin portion of summer steelhead production would be moved to Wells Fish Hatchery.

Currently, the CTCR are developing an expansion of the endemic steelhead program and will be releasing a greater proportion of the target production (100,000 smolts) in various tributaries throughout the U.S. portion of the Okanogan subbasin.

Releases of steelhead in the Okanogan River basin have averaged about 129,000 and ranged from approximately 68,000 to 229,000 (Table 12, Figure 8).

Table 11. Releases of summer steelhead into the Methow Basin. Data sources: (Snow et al. 2013), DART, and C. Snow (personal communication).

Release Year	Number of Smolts Released					
	Methow R. (WNFH)	Methow R.	Twisp R.	Chewuch R.	Columbia R.	Methow Total
1992		395,350				395,350
1993		392,815				392,815
1994		324,200				324,200
1995		359,170			18,200	377,370
1996		242,400			17,500	259,900
1997		310,480			64,703	375,183
1998		127,020	126,000	125,300	34,099	412,419
1999	112,908	320,250	113,583	116,403	47,782	710,926
2000	105,510	139,900	136,680	138,300		520,390
2001	98,834	116,830	109,950	99,490		425,104
2002	150,488	94,020	84,475	85,615		414,598
2003	119,370	96,420	105,323	117,495		438,608
2004	114,713	80,580	117,545	78,205		391,043
2005	110,368	86,041	96,405	82,280		375,094
2006	102,600	99,820	107,245	119,500		429,165
2007	122,515	96,219	111,770	107,545		438,049
2008	116,897	99,464	100,446	92,670		409,477
2009	102,418	103,236	104,903	100,373		410,930
2010	100,378	125,801	74,766	92,760		393,705
2011	107,141	154,370	93,297	83,858		438,666
2012	117,210	205,330	41,170		31,860	395,570
2013	111,721	99,933	51,473		55,541	318,668
Mean	**112,871**	**174,967**	**98,439**	**102,842**	**38,526**	**412,953**

Table 12. Releases of summer steelhead into the Okanogan Basin. Data sources: (Snow et al. 2013), (Tibbits et al. 2014), and C. Snow (personal communication).

Release Year	Number of Smolts Released								
	Wells program							Locally adapted program	
	Okanogan R.	Similkameen R.	Omak Cr.	Ninemile Cr.	Antoine Cr.	Tunk Cr.	Salmon Cr.	Omak Cr.	Okanogan Total
1992	72,045	47,215							119,260
1993	67,120	51,360							118,480
1994	46,110	49,800							95,910
1995	40,875	50,350							91,225
1996	30,000	37,500							67,500
1997	49,920	49,800							99,720
1998	39,998	50,002	10,005						100,005
1999	73,401	71,820	10,635				4,900		160,756
2000	46,235	68,580	19,440				10,395		144,650
2001	112,605	82,415	19,950				13,800		228,770
2002	87,310	39,545							126,855
2003	65,920	50,860	25,110					3,450	145,340
2004	12,000	57,750	9,855					13,442	93,047
2005		68,940	10,000					19,862	98,802
2006		146,862						19,772	166,634
2007	16,403	106,024		5,152	2,856	4,993	13,120	19,917	168,465
2008	14,200	108,477		1,904			25,105	13,601	163,287
2009		120,230					26,403	23,618	170,251
2010		61,090					40,000	32,333	133,423
2011	3,960	73,623					50,000	41,285	168,868
2012		10,080					50,000	9,070	69,150
2013		26,350					40,032	25,111	91,493
Mean	**45,638**	**66,505**	**18,302**	**3,528**	**2,856**	**4,993**	**27,376**	**20,133**	**131,279**

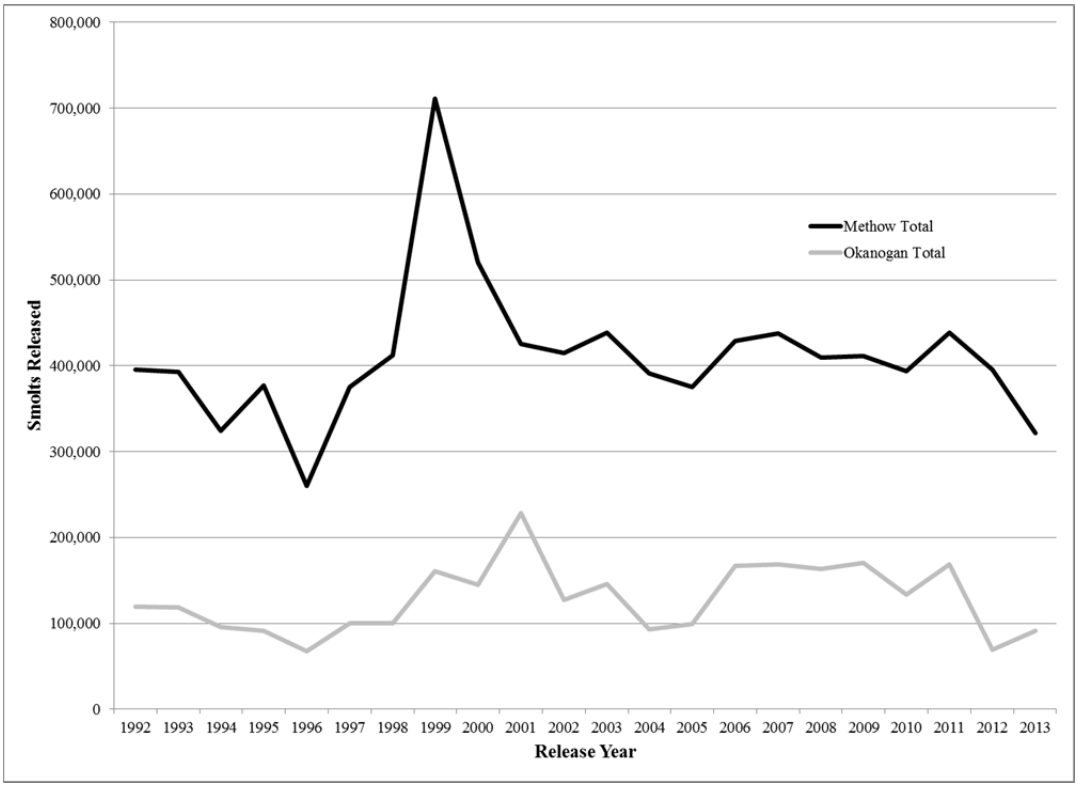

Figure 8. Total summer steelhead releases into the Methow and Okanogan River basins 1992-2013.

2.3.2.2.4. Coho salmon

Substantial natural coho salmon production has not existed in the Upper Columbia Region for many decades (YN 2012). Sizable releases of hatchery coho salmon occurred sporadically since 1942 (Mullan 1984). However, in the mid-1990s, the Yakama Nation began a pilot program to reintroduce coho into the Wenatchee and Methow basins (mid-Columbia coho reintroduction program (MCCRP)). That program was recently granted full implementation status, and in terms of relevance to the current status of listed species in these basins, the MCCRP releases are the only releases that need to be considered. As can be seen from Table 13, annual releases into the Methow Basin, has averaged about 332,000 and ranged from approximately 74,000 to 538,000 (excluding 1999, when no fish were released). The previous goal in the Methow River was to release 500,000 fish, and now with full implementation, the goal has risen to 1.0 million.

Table 13. Annual coho salmon smolt releases into the Methow Basin 1996-2012 (Kamphaus 2013).

Release Year	Number of Fish Released
1996	335,300
1997	74,200
1998	341,146
1999	0
2000	199,763
2001	260,319
2002	186,053
2003	242,355
2004	308,019
2005	283,695
2006	460,795
2007	477,688
2008	519,585
2009	469,102
2010	529,984
2011	425,968
2012	537,569
Mean	332,444

2.3.3. Harvest

The final important aspect of the Environmental Baseline is harvest effects – effects from fisheries located inside the Okanogan and Methow Basins. Spring Chinook salmon are not harvested in any of the three basins, although selective fisheries for adult management purposes, similar to that done in the Wenatchee Basin (NMFS 2013) is a future possibility in the Methow Basin. Mark-selective steelhead fisheries operate in all three basins under permit 1395 (NMFS 2003b). Mainstem Columbia River fisheries targeting Chinook salmon and steelhead produced by these programs have been evaluated and authorized under a separate opinion under the *United States v. Oregon* Management Agreement (NMFS 2008c).

2.3.4. Other

The Pacific Coastal Salmon Recovery Fund (PCSRF) was established by Congress to help protect and recover salmon and steelhead populations and their habitats (NMFS 2007b). The states of Washington, Oregon, California, Idaho, and Alaska, and the Pacific Coastal and Columbia River tribes, receive PCSRF appropriations from NMFS each year. The fund supplements existing state, tribal and local programs to foster development of Federal-state-tribal-local partnerships in salmon and steelhead recovery. The PCSRF has made substantial progress in achieving program goals, as indicated in annual Reports to Congress, workshops, and independent reviews.

Information relevant to the environmental baseline is also discussed in detail in Chapter 5 of the Supplemental Comprehensive Analysis (SCA), which in turn cross-references back to the related 2008 FCRPS biological opinion (NMFS 2008b; 2008e). Chapter 5 of the SCA (NMFS 2008e),

and related portions of the FCRPS Opinion, provide an analysis of the effects of past and ongoing human and natural factors on the current status of the species, their habitats and ecosystems, within the entire Columbia River Basin. In addition, chapter 5 of the SCA, and related portions of the FCRPS Opinion, evaluate the effects of those ongoing actions on designated critical habitat with that same area. Those portions of chapter 5 of the SCA, and environmental baseline section of the FCRPS Opinion, that deal with effects in the action area (as described in Section 1.4 above) are hereby incorporated here by reference. In addition, the environmental baseline for this opinion includes the impacts of the proposed action described in the FCRPS and Reclamation biological opinions (NMFS 2008b).

2.4. Effects on ESA Protected Species and on Designated Critical Habitat

This section describes the effects of the Proposed Action, independent of the Environmental Baseline and Cumulative Effects. The methodology and best scientific information NMFS follows for analyzing hatchery effects is summarized first in Section 2.4.1 and then application of the methodology and analysis of the Proposed Action itself follows in Section 2.4.2. The "effects of the action" means the direct and indirect effects of the action on individuals within the population and how these may affect the VSP parameters for the populations that make up the species and on designated critical habitat, together with the effects of other activities that are interrelated or interdependent, 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. Effects of the Proposed Action that are expected to occur later in time (i.e., after the 10-year timeframe of the Proposed Action) are included in the analysis in this opinion to the extent they can be meaningfully evaluated. In Section 2.6, the Proposed Action, the status of ESA-protected species and designated critical habitat, the Environmental Baseline, and the Cumulative Effects of future state and private activities within the action area that are reasonably certain to occur are analyzed comprehensively to determine whether the Proposed Action is likely to appreciably reduce the likelihood of survival and recovery of ESA protected species or result in the destruction or adverse modification of their designated critical habitat.

2.4.1. Factors That are Considered When Analyzing Hatchery Effects

The NMFS has substantial experience with hatchery programs and has developed and published a series of guidance documents for designing and evaluating hatchery programs following best available science. These documents are available upon request from the NMFS SFD in Portland, Oregon. "Pacific Salmon and Artificial Propagation under the Endangered Species Act" (Hard et al. 1992) was published shortly following the first ESA-listings of Pacific salmon on the West Coast and it includes information and guidance that is still relevant today. In 2000, NMFS published "Viable Salmonid Populations and the Recovery of Evolutionarily Significant Units" (McElhany et al. 2000b) and then followed that with a "Salmonid Hatchery Inventory and Effects Evaluation Report" for hatchery programs up and down the West Coast (NMFS 2004b). In 2005, NMFS published a policy that provided greater clarification and further direction on how it analyzes hatchery effects and conducts extinction risk assessments (NMFS 2005c). NMFS then updated its inventory and effects evaluation report for hatchery programs on the West Coast (Jones 2006) and followed that with "Artificial Propagation for Pacific Salmon: Assessing Benefits and Risks & Recommendations for Operating Hatchery Programs Consistent with Conservation and Sustainable Fisheries Mandates" (NMFS 2008a). More recently, NMFS

published its biological analysis and final determination for the harvest of Puget Sound Chinook salmon, which included discussion on the role and effects of hatchery programs (NMFS 2011d).

A key factor in analyzing a hatchery program for its effects, positive and negative, on the status of salmon and steelhead are the genetic resources that reside in the program. Genetic resources that represent the ecological and genetic diversity of a species can reside in a hatchery program. "Hatchery programs with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU and will be included in any listing of the ESU" (NMFS 2005c). NMFS monitors hatchery practices for whether they promote the conservation of genetic resources included in an ESU or steelhead DPS and updates the status of genetic resources residing in hatchery programs every five years. Jones (2011) provides the most recent update of the relatedness of Pacific Northwest hatchery programs to 18 salmon ESUs and steelhead DPSs listed under the ESA. Generally speaking, hatchery programs that are reproductively connected or "integrated" with a natural population, if one still exists, and that promote natural selection over selection in the hatchery, contain genetic resources that represent the ecological and genetic diversity of a species and are included in an ESU or steelhead DPS.

When a hatchery program actively maintains distinctions or promotes differentiation between hatchery fish and fish from a native population, then NMFS refers to the program as "isolated" (also sometimes referred to as a "segregated" program). Generally speaking, isolated hatchery programs have a level of genetic divergence, relative to the local natural population(s), that is more than what occurs within the ESU and are not considered part of an ESU or steelhead DPS. They promote domestication or selection in the hatchery over selection in the wild and select for and culture a stock of fish with different phenotypes, for example, different ocean migrations and spatial and temporal spawning distribution, compared to the native population (extant in the wild, in a hatchery, or both). For Pacific salmon, NMFS evaluates extinction processes and effects of the Proposed Action beginning at the population scale (McElhany et al. 2000b). NMFS defines population performance measures in terms of natural-origin fish and four key parameters or attributes: abundance, productivity, spatial structure, and diversity and then relates effects of the Proposed Action at the population scale to the MPG level and ultimately to the survival and recovery of an entire ESU or DPS.

"Because of the potential for circumventing the high rates of early mortality typically experienced in the wild, artificial propagation may be useful in the recovery of listed salmon species. However, artificial propagation entails risks as well as opportunities for salmon conservation" (Hard et al. 1992). A Proposed Action is analyzed for effects, positive and negative, on the attributes that define population viability, including abundance, productivity, spatial structure, and diversity. The effects of a hatchery program on the status of an ESU or steelhead DPS "will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery fish within the ESU affect each of the attributes" (NMFS 2005c). The presence of hatchery fish within the ESU can positively affect the overall status of the ESU by increasing the number of natural spawners, by serving as a source population for repopulating unoccupied habitat and increasing spatial distribution, and by conserving genetic resources. "Conversely, a hatchery program managed without adequate consideration can affect a listing determination by reducing adaptive genetic diversity of the ESU, and by reducing the

reproductive fitness and productivity of the ESU" (NMFS 2005c). NMFS also analyzes and takes into account the effects of hatchery facilities, for example, weirs and water diversions – on each VSP attribute and on designated critical habitat.

NMFS' analysis of the Proposed Action is in terms of effects it would be expected to have on ESA-listed species and on designated critical habitat, based on the best scientific information available, on the general type of effect of that aspect of hatchery operation in the context of the specific application in the Methow and Okanogan Rivers. This allows for quantification (wherever possible) of the various factors of hatchery operation to be applied to each applicable life-stage of the listed species at the population level (in Section 2.4.2), which in turn allows the combination of all such effects with other effects accruing to the species to determine the likelihood of posing jeopardy to the species as a whole (Section 2.6).

The effects, positive and negative, for the two categories of hatchery programs are summarized in Table 14. Generally speaking, effects range from beneficial to negative for programs that use local fish[11] for hatchery broodstock and from negligible to negative when a program does not use local fish for broodstock[12]. Hatchery programs can benefit population viability but only if they use genetic resources that represent the ecological and genetic diversity of the target or affected natural population(s). When hatchery programs use genetic resources that do not represent the ecological and genetic diversity of the target or affected natural population(s), NMFS is particularly interested in how effective the program will be at isolating hatchery fish and avoiding co-occurrence and effects that potentially disadvantage fish from natural populations. The range in effects for a specific hatchery program are refined and narrowed after available scientific information and the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Information that NMFS needs to analyze the effects of a hatchery program on ESA-listed species must be included in an HGMP. Draft HGMPs are reviewed by NMFS for their sufficiency before formal review and analysis of the Proposed Action can begin.

Analysis of an HGMP or Proposed Action for its effects on ESA-listed species and on designated critical habitat depends on seven factors. These factors are:

(1) the hatchery program does or does not remove fish from the natural population and use them for hatchery broodstock,
(2) hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities,
(3) hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas,
(4) hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean,
(5) RM&E that exists because of the hatchery program,

[11] The term "local fish" is defined to mean fish with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU or steelhead DPS (70 FR 37215, June 28, 2005).
[12] Exceptions include restoring extirpated populations and gene banks.

(6) the operation, maintenance, and construction of hatchery facilities that exist because of the hatchery program, and
(7) fisheries that exist because of the hatchery program, including terminal fisheries intended to reduce the escapement of hatchery-origin fish to spawning grounds.

The analysis assigns an effect for each factor from the following categories. The categories are:

(1) positive or beneficial effect on population viability,
(2) negligible effect on population viability, and
(3) negative effect on population viability.

"The effects of hatchery fish on the status of an ESU will depend on which of the four key attributes are currently limiting the ESU, and how the hatchery within the ESU affect each of the attributes" (NMFS 2005c). The category of affect assigned is based on an analysis of each factor weighed against the affected population(s) current risk level for abundance, productivity, spatial structure and diversity, the role or importance of the affected natural population(s) in ESU or steelhead DPS recovery, the target viability for the affected natural population(s), and the Environmental Baseline including the factors currently limiting population viability.

Table 14 An overview of the range of effects on natural population viability parameters from the two categories of hatchery programs. The range in effects are refined and narrowed after the circumstances and conditions that are unique to individual hatchery programs are accounted for.

Natural population viability parameter	Hatchery broodstock originate from the local population and are included in the ESU or DPS	Hatchery broodstock originate from a non-local population or from fish that are not included in the same ESU or DPS
Productivity	**Positive to negative effect** Hatcheries are unlikely to benefit productivity except in cases where the natural population's small size is, in itself, a predominant factor limiting population growth (i.e., productivity) (NMFS 2004b).	**Negligible to negative effect** This is dependent on differences between hatchery fish and the local natural population (i.e., the more distant the origin of the hatchery fish the greater the threat), the duration and strength of selection in the hatchery, and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).
Diversity	**Positive to negative effect** Hatcheries can temporarily support natural populations that might otherwise be extirpated or suffer severe bottlenecks and have the potential to increase the effective size of small natural populations. Broodstock collection that homogenizes population structure is a threat to population diversity.	**Negligible to negative effect** This is dependent on the differences between hatchery fish and the local natural population (i.e., the more distant the origin of the hatchery fish the greater the threat) and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).
Abundance	**Positive to negative effect** Hatchery-origin fish can positively affect the status of an ESU by contributing to the abundance and productivity of the natural populations in the ESU (70 FR 37204, June 28, 2005, at 37215).	**Negligible to negative effect** This is dependent on the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect), handling, RM&E[13] and facility operation, maintenance and construction effects.
Spatial Structure	**Positive to negative effect** Hatcheries can accelerate re-colonization and increase population spatial structure, but only in conjunction with remediation of the factor(s) that limited spatial structure in the first place. "Any benefits to spatial structure over the long term depend on the degree to which the hatchery stock(s) add to (rather than replace) natural populations" (70 FR 37204, June 28, 2005 at 37213).	**Negligible to negative effect** This is dependent on facility operation, maintenance, and construction effects and the level of isolation achieved by the hatchery program (i.e., the greater the isolation the closer to a negligible affect).

[13] Monitoring, Evaluation and Research

2.4.1.1. Factor 1. The hatchery program does or does not and other remove fish from the natural population and use them for hatchery broodstock

This factor considers the risk to a natural population from the removal of natural-origin fish for hatchery broodstock. The level of effect for this factor ranges from neutral or negligible to negative.

A primary consideration in analyzing and assigning effects for broodstock collection is the origin and number of fish collected. The analysis considers whether broodstock are of local origin and the biological pros and cons of using ESA-listed fish (natural or hatchery-origin) for hatchery broodstock. It considers the maximum number of fish proposed for collection and the proportion of the donor population tapped to provide hatchery broodstock. "Mining" a natural population to supply hatchery broodstock can reduce population abundance and spatial structure. Also considered here is whether the program "backfills" with fish from outside the local or immediate area. The physical process of collecting hatchery broodstock and the effect of the process on ESA-listed species is considered under Factor 2.

2.4.1.2. Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

NMFS also analyzes the effects of hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds. The level of effect for this factor ranges from positive to negative.

There are two aspects to this part of the analysis: genetic effects and ecological effects. NMFS generally views genetic effects as detrimental because at this time, based on the weight of available scientific information, we believe that artificial breeding and rearing is likely to result in some degree of genetic change and fitness reduction in hatchery fish and in the progeny of naturally spawning hatchery fish relative to desired levels of diversity and productivity for natural populations. Hatchery fish can thus pose a risk to diversity and to natural population rebuilding and recovery when they interbreed with fish from natural populations.

However, NMFS recognizes that there are benefits as well, and that the risks just mentioned may be outweighed under circumstances where demographic or short-term extinction risk to the population is greater than risks to population diversity and productivity. Conservation hatchery programs may accelerate recovery of a target population by increasing abundance faster than may occur naturally (Waples 1999). Hatchery programs can also be used to create genetic reserves for a population to prevent the loss of its unique traits due to catastrophes (Ford 2011). Furthermore, NMFS also recognizes there is considerable debate regarding genetic risk. The extent and duration of genetic change and fitness loss and the short and long-term implications and consequences for different species, for species with multiple life-history types, and for species subjected to different hatchery practices and protocols remains unclear and should be the subject of further scientific investigation. As a result, NMFS believes that hatchery intervention is a legitimate and useful tool to alleviate short-term extinction risk, but otherwise managers should seek to limit interactions between hatchery and natural-origin fish and implement hatchery practices that harmonize conservation with the implementation of fishing rights of federally recognized Indian tribes and other applicable laws and policies (NMFS 2011d).

2.4.1.2.1. Genetic effects

Hatchery fish can have a variety of genetic effects on natural population productivity and diversity when they interbreed with natural-origin fish. Although there is biological interdependence between them, NMFS considers three major areas of genetic effects of hatchery programs: within-population diversity, outbreeding effects, and hatchery-induced selection. As we have stated above, in most cases, the effects are viewed as risks, but in small populations these effects can sometimes be beneficial, reducing extinction risk.

Within-population genetic diversity is a general term for the quantity, variety and combinations of genetic material in a population (Busack and Currens 1995). Within-population diversity is gained through mutations or gene flow from other populations (described below under outbreeding effects) and is lost primarily due to genetic drift, a random loss of diversity due to population size. The rate of loss is determined by the population's effective population size (N_e), which can be considerably smaller than its census size. For a population to maintain genetic diversity reasonably well, the effective size should be in the hundreds (e.g., Lande and Barrowclough 1987), and diversity loss can be severe if N_e drops to a few dozen.

Hatchery programs, simply by virtue of creating more fish, can increase N_e. In very small populations this can be a benefit, making selection more effective and reducing other small-population risks (e.g., Lacy 1987; Whitlock 2000; Willi et al. 2006). Conservation hatchery programs can thus serve to protect genetic diversity; several, such as the Snake River sockeye salmon program are important genetic reserves. However, hatchery programs can also directly depress N_e by two principal methods. One is by the simple removal of fish from the population so that they can be used in the hatchery. If a substantial portion of the population is taken into a hatchery, the hatchery becomes responsible for that portion of the effective size, and if the operation fails, the effective size of the population will be reduced (Waples and Do 1994). N_e can also be reduced considerably below the census number of broodstock by using a skewed sex ratio, spawning males multiple times (Busack 2007), and by pooling gametes. Pooling semen is especially problematic because when semen of several males is mixed and applied to eggs, a large portion of the eggs may be fertilized by a single male (Gharrett and Shirley 1985; Withler 1988). Factorial mating schemes, in which fish are systematically mated multiple times, can be used to increase N_e (Fiumera et al. 2004; Busack and Knudsen 2007). An extreme form of N_e reduction is the Ryman-Laikre effect (Ryman and Laikre 1991; Ryman et al. 1995), when N_e is reduced through the return to the spawning grounds of large numbers of hatchery fish from very few parents.

Inbreeding depression, another N_e-related phenomenon, is caused by the mating of closely related individuals (e.g., sibs, half-sibs, cousins). The smaller the population, the more likely spawners will be related. Related individuals are likely to contain similar genetic material, and the resulting offspring may then have reduced survival because they are less variable genetically or have double doses of deleterious mutations. The lowered fitness of fish due to inbreeding depression accentuates the genetic risk problem, helping to push a small population toward extinction.

Outbreeding effects are caused by gene flow from other populations. Gene flow occurs naturally among salmon and steelhead populations, a process referred to as straying (Quinn 1993; 1997). Natural straying serves a valuable function in preserving diversity that would otherwise be lost through genetic drift and in re-colonizing vacant habitat, and straying is considered a risk only when it occurs at unnatural levels or from unnatural sources. Hatchery programs can result in straying outside natural patterns for two reasons. First, hatchery fish may exhibit reduced homing fidelity relative to natural-origin fish (Grant 1997; Quinn 1997; Jonsson et al. 2003; Goodman 2005), resulting in unnatural levels of gene flow into recipient populations, either in terms of sources or rates. Second, even if hatchery fish home at the same level of fidelity as natural-origin fish, their higher abundance can cause unnatural straying levels into recipient populations. One goal for hatchery programs should be to ensure that hatchery practices do not lead to higher rates of genetic exchange with fish from natural populations than would occur naturally (Ryman 1991). Rearing and release practices and ancestral origin of the hatchery fish can all play a role in straying (Quinn 1997).

Gene flow from other populations can have two effects. It can increase genetic diversity (e.g., Ayllon et al. 2006) (which can be a benefit in small populations) but it can also alter established allele frequencies (and co-adapted gene complexes) and reduce the population's level of adaptation, a phenomenon called outbreeding depression (Edmands 2007; McClelland and Naish 2007). In general, the greater the geographic separation between the source or origin of hatchery fish and the recipient natural population, the greater the genetic difference between the two populations (ICTRT 2007), and the greater potential for outbreeding depression. For this reason, NMFS advises hatchery action agencies to develop locally derived hatchery broodstocks. Additionally, unusual rates of straying into other populations within or beyond the population's MPG or ESU or a steelhead DPS can have an homogenizing effect, decreasing intra-population genetic variability (e.g., Vasemagi et al. 2005), and increasing risk to population diversity, one of the four attributes measured to determine population viability. Reduction of within-population and among-population diversity can reduce adaptive potential.

The proportion of hatchery fish (pHOS)[14] among natural spawners is often used as a surrogate measure of gene flow. Appropriate cautions and qualifications should be considered when using this proportion to analyze outbreeding effects. Adult salmon may wander on their return migration, entering and then leaving tributary streams before finally spawning (Pastor 2004). These "dip-in" fish may be detected and counted as strays, but may eventually spawn in other areas, resulting in an overestimate of the number of strays that potentially interbreed with the natural population (Keefer et al. 2008). Caution must also be taken in assuming that strays contribute genetically in proportion to their abundance. Several studies demonstrate little genetic impact from straying despite a considerable presence of strays in the spawning population (Saisa et al. 2003; Blankenship et al. 2007). The causative factors for poorer breeding success of strays are likely similar to those identified as responsible for reduced productivity of hatchery-origin fish in general, e.g., differences in run and spawn timing, spawning in less productive habitats,

[14] It is important to reiterate that as NMFS analyzes them, outbreeding effects are a risk only when the hatchery fish are from a different population than the naturally produced fish. If they are from the same population, then the risk is from hatchery-influenced selection. Non-native hatchery fish may also contribute to hatchery-influenced selection.

and reduced survival of their progeny (Reisenbichler and McIntyre 1977; Leider et al. 1990; McLean et al. 2004; Williamson et al. 2010).

Hatchery-influenced selection (often called domestication) occurs when selection pressures imposed by hatchery spawning and rearing differ greatly from those imposed by the natural environment and causes genetic change that is passed on to natural populations through interbreeding with hatchery-origin fish. These differing selection pressures can be a result of differences in environments or a consequence of protocols and practices used by a hatchery program. Hatchery-influenced selection can range from relaxation of selection that would normally occur in nature to selection for different characteristics in the hatchery and natural environments, to intentional selection for desired characteristics (Waples 1999).

Genetic change and fitness reduction resulting from hatchery-influenced selection depends on: (1) the difference in selection pressures; (2) the exposure or amount of time the fish spends in the hatchery environment; and, (3) the duration of hatchery program operation (i.e., the number of generations that fish are propagated by the program). On an individual level, exposure time in large part equates to fish culture, both the environment experienced by the fish in the hatchery and natural selection pressures, independent of the hatchery environment. On a population basis, exposure is determined by the proportion of natural-origin fish in the hatchery broodstock and the proportion of natural spawners consisting of hatchery-origin fish (Lynch and O'Hely 2001; Ford 2002), and then by the number of years the exposure takes place. In assessing risk or determining impact, all three levels must be considered. Strong selective fish culture with low hatchery-wild interbreeding can pose less risk than relatively weaker selective fish culture with high levels of interbreeding.

Most of the empirical evidence of fitness depression due to hatchery-influenced selection comes from studies of species that are reared in the hatchery environment for an extended period – one to two years – prior to release (Berejikian and Ford 2004). Exposure time in the hatchery for fall and summer Chinook salmon and Chum salmon is much shorter, just a few months. One especially well-publicized steelhead study (Araki et al. 2007; Araki et al. 2008), showed dramatic fitness declines in the progeny of naturally spawning Hood River hatchery steelhead. Researchers and managers alike have wondered if these results could be considered a potential outcome applicable to all salmonid species, life-history types, and hatchery rearing strategies.

Besides the Hood River steelhead work, a number of studies are available on the relative reproductive success (RRS) of hatchery-origin and natural-origin fish (e.g.,Berntson et al. 2011; Theriault et al. 2011; Ford et al. 2012; Hess et al. 2012). All have shown that generally hatchery-origin fish have lower reproductive success, though the differences have not always been statistically significant and in some years in some studies the opposite is true. Lowered reproductive success of hatchery-origin fish in these studies is typically considered evidence of hatchery-influenced selection. Although RRS may be a result of hatchery-influenced selection, studies must be carried out for multiple generations to unambiguously detect a genetic effect. To date only the Hood River steelhead (Araki et al. 2007; Christie et al. 2011) and Wenatchee spring Chinook salmon (Ford et al. 2012) RRS studies have reported multiple-generation effects.

Critical information for analysis of hatchery-induced selection includes the number, location and timing of naturally spawning hatchery fish, the estimated level of interbreeding between hatchery-origin and natural-origin fish, the origin of the hatchery stock (the more distant the origin compared to the affected natural population, the greater the threat), the level and intensity of hatchery selection and the number of years the operation has been run in this way.

Critical information for analysis of hatchery-induced selection includes the number, location and timing of naturally spawning hatchery fish, the estimated level of gene flow between hatchery-origin and natural-origin fish, the origin of the hatchery stock (the more distant the origin compared to the affected natural population, the greater the threat), the level and intensity of hatchery selection and the number of years the operation has been run in this way. Efforts to control and evaluate the risk of hatchery-influenced selection are currently largely focused on gene flow between natural-origin and hatchery-origin fish[15]. The Interior Columbia Technical Recovery Team (ICTRT) developed guidelines based on the proportion of spawners in the wild consisting of hatchery-origin fish (pHOS) (Figure 9).

More recently, the Hatchery Scientific Review Group (HSRG) developed gene flow criteria/guidelines based on mathematical models developed by Ford (2002) and by Lynch and O'Hely (2001). Guidelines for isolated programs are based on pHOS, but guidelines for integrated programs are also based on a metric called proportionate natural influence (PNI), which is a function of pHOS and the proportion of natural-origin fish in the broodstock (pNOB)[16]. PNI is in theory a reflection of the relative strength of selection in the hatchery and natural environments: a PNI value greater than 0.5 indicates dominance of natural selective forces. The HSRG guidelines vary according to type of program and conservation importance of the population. For a population of high conservation importance their guidelines are a pHOS of no greater than 5% for isolated programs or a pHOS no greater than 30% and PNI of at least 67% for integrated programs (HSRG 2009). Higher levels of hatchery influence are acceptable, however, when a population is at high risk or very high risk of extinction due to low abundance and the hatchery program is being used to conserve the population and reduce extinction risk, in the short-term. HSRG (2004) offered additional guidance regarding isolated programs, stating that risk increases dramatically as the level of divergence increases, especially if the hatchery stock has been selected directly or indirectly for characteristics that differ from the natural population. The HSRG recently produced an update report (HSRG 2014) in which they stated that the guidelines for isolated programs may not provide as much protection from fitness loss as the corresponding guidelines for integrated programs.

[15] Gene flow between natural-origin and hatchery-origin fish is often, and quite reasonably, interpreted as meaning actual matings between natural-origin and hatchery-origin fish. In some contexts it can mean that. However, in this document, unless otherwise specified, gene flow means contributing to the same progeny population. For example, hatchery-origin spawners in the wild will either spawn with other hatchery-origin fish or with natural-origin fish. Natural-origin spawners in the wild will either spawn with other natural-origin fish or with hatchery-origin fish. But all these matings, to the extent they are successful, will generate the next generation of natural-origin fish. In other words, all will contribute to the natural-origin gene pool.

[16] PNI is computed as pNOB/(pNOB+pHOS). This statistic is really an approximation of the true proportionate natural influence (HSRG 2009, Appendix A), but operationally the distinction is unimportant.

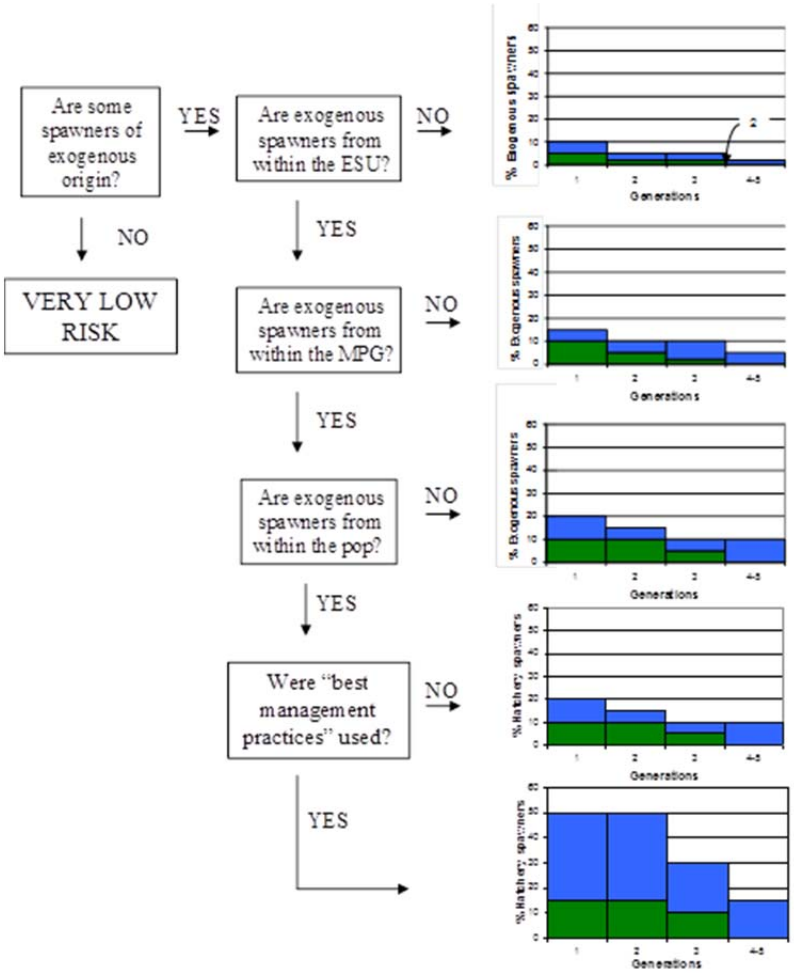

Figure 9. ICTRT (2007) risk criteria associated with spawner composition for viability assessment of exogenous spawners on maintaining natural patterns of gene flow. Green (darkest) areas indicate low risk combinations of duration and proportion of spawners, blue (intermediate areas indicate moderate risk areas and white areas and areas outside the graphed range indicate high risk. Exogenous fish are considered to be all fish hatchery origin, and non-normative strays of natural origin.

Another HSRG team recently reviewed California hatchery programs and developed guidelines that differed considerably from those developed by the earlier group (California HSRG 2012). The California HSRG felt that truly isolated programs in which no hatchery-origin returnees interact genetically with natural populations were impossible in California, and was "generally unsupportive" of the concept. However, if programs were to be managed as isolated, they recommend a pHOS of less than 5%. They rejected development of overall pHOS guidelines for integrated programs because the optimal pHOS will depend upon multiple factors, such as "the amount of spawning by natural-origin fish in areas integrated with the hatchery, the value of pNOB, the importance of the integrated population to the larger stock, the fitness differences between hatchery- and natural-origin fish, and societal values, such as angling opportunity". They recommended that program-specific plans be developed with corresponding population-specific targets and thresholds for pHOS, pNOB, and PNI that reflect these factors. However,

they did state that PNI should exceed 50% in most cases, although in supplementation or reintroduction programs the acceptable pHOS could be much higher than 5%, even approaching 100% at times. They also recommended for conservation programs that pNOB approach 100%, but pNOB levels should not be so high they pose demographic risk to the natural population.

Discussions involving pHOS can be problematic due to variation in its definition. Most commonly the term pHOS refers to the proportion of the total natural spawning population consisting of hatchery fish, and the term has been used in this way in all NMFS documents. However, the HSRG has defined pHOS inconsistently in its Columbia Basin system report, equating it with "the proportion of the natural spawning population that is made up of hatchery fish" in the Conclusion, Principles and Recommendations section (HSRG 2009), but with "the proportion of *effective* hatchery origin spawners" in their gene flow criteria. In addition, in their Analytical Methods and Information Sources section (HSRG 2009, appendix C) they introduce a new term, *effective pHOS*. Despite these inconsistencies, their overall usage of pHOS indicates intent to use pHOS as a surrogate measure of gene flow potential. This is demonstrated very well in the fitness effects appendix (HSRG 2009, appendix A1), in which pHOS is substituted for a gene flow variable in the equations used to develop the criteria. This confusion was cleared up in the 2014 update document (HSRG 2014), where it is clearly stated that the metric of interest is effective pHOS.

NMFS concludes that if pHOS guidelines are used in analysis of genetic hatchery effects, the pHOS metric should as much as possible represent gene flow potential, therefore pHOS should be considered the *effective* proportion of hatchery-origin spawners in the natural spawning population. Thus, the "census" pHOS should be adjusted as appropriate for RRS or other factors limiting the success of hatchery-origin spawners to yield a value closer to the true expected gene flow, or "effective pHOS". This adjustment should not be done indiscriminately, however. As discussed above, enough research has been done to conclude that hatchery-origin spawners are generally less successful in the wild than natural spawners, but unless population-specific information is available, assumptions about effectiveness should be conservative.

A simple analysis of the expected proportions of mating types provides additional perspective on pHOS. Figure 10 shows the expected proportion of mating types in a mixed population of natural-origin (N) and hatchery-origin (H) fish as a function of the census pHOS, assuming that N and H adults mate randomly[17]. For example, the vertical line on the diagram marks the situation at a census pHOS level of 10%. At this level, expectations are that 81% of the matings will be NxN, 18% will be NxH, and 1% will be HxH. This diagram can also be interpreted as probability of parentage of naturally produced progeny, assuming random mating and equal reproductive success of all mating types. Under this interpretation, progeny produced by a parental group with a pHOS level of 10% will have an 81% chance of having two natural-origin parents, etc.

[17] These computations are purely theoretical, based on a simple mathematical binomial expansion ($(a+b)^2=a^2 + 2ab + b^2$).

Random mating assumes that the natural-origin and hatchery-origin spawners overlap completely spatially and temporally. As overlap decreases, the proportion of NxH matings decreases and with no overlap the proportion of NxN matings is (1-pHOS) and the proportion of HxH matings is pHOS. RRS does not affect the mating type proportions directly, but changes their effective proportions. Overlap and RRS can be related. In the Wenatchee River, hatchery spring Chinook salmon tend to spawn lower in the system than natural-origin fish, and this accounts for a considerable amount of their lowered reproductive success (Williamson et al. 2010). In that particular situation the hatchery-origin fish were spawning in inferior habitat.

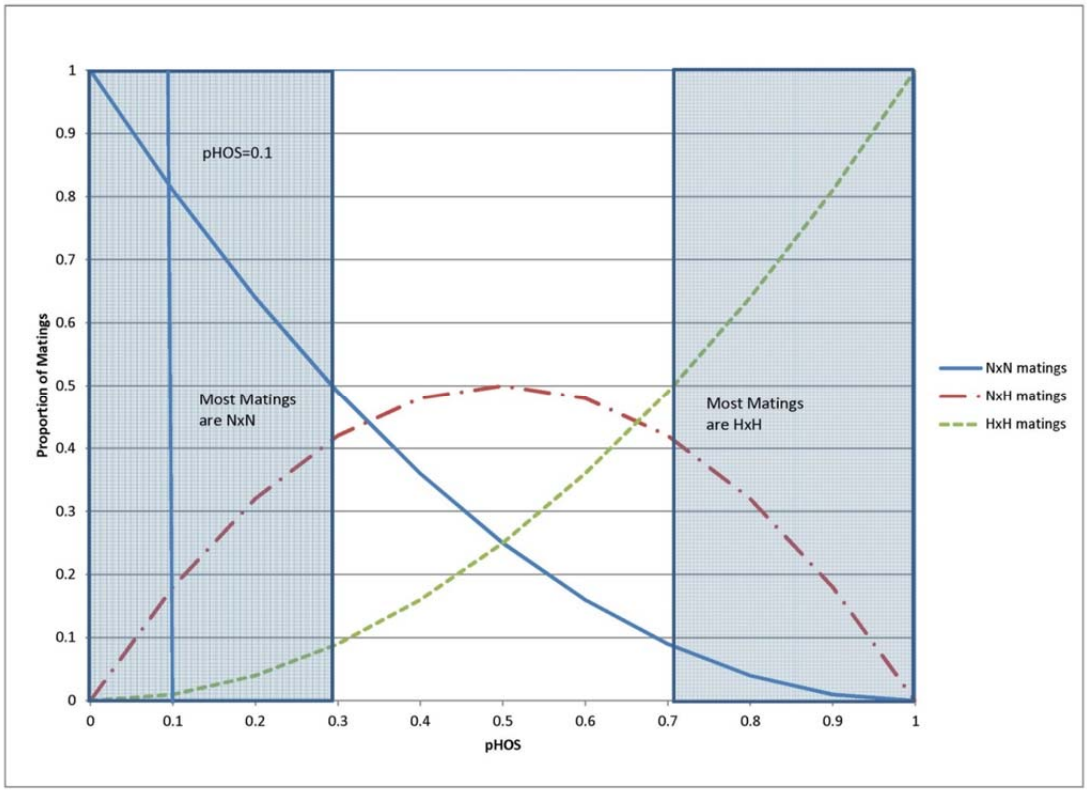

Figure 10. Relative proportions of types of matings as a function of proportion of hatchery-origin fish on the spawning grounds (pHOS) (NxN – natural-origin x natural-origin; NxH – natural-origin x hatchery; HXH – hatchery x hatchery).

2.4.1.2.2. Ecological effects

Ecological effects for this factor (i.e., hatchery fish and the progeny of naturally spawning hatchery fish on the spawning grounds) refer to effects from competition for spawning sites and redd superimposition, contributions to marine-derived nutrients, and the removal of fine sediments from spawning gravels. Ecological effects on the spawning grounds may be positive or negative. To the extent that hatcheries contribute added fish to the ecosystem, there can be positive effects. For example, when anadromous salmonids return to spawn, hatchery-origin and

natural-origin alike, they transport marine-derived nutrients stored in their bodies to freshwater and terrestrial ecosystems. Their carcasses provide a direct food source for juvenile salmonids and other fish, aquatic invertebrates, and terrestrial animals, and their decomposition supplies nutrients that may increase primary and secondary production (Kline et al. 1990; Piorkowski 1995; Larkin and Slaney 1996; Gresh et al. 2000; Murota 2003; Quamme and Slaney 2003; Wipfli et al. 2003). As a result, the growth and survival of juvenile salmonids may increase (Hager and Noble 1976; Bilton et al. 1982; Holtby 1988; Ward and Slaney 1988; Hartman and Scrivener 1990; Johnston et al. 1990; Larkin and Slaney 1996; Quinn and Peterson 1996; Bradford et al. 2000; Bell 2001; Brakensiek 2002).

Additionally, studies have demonstrated that perturbation of spawning gravels by spawning salmonids loosens cemented (compacted) gravel areas used by spawning salmon (e.g., Montgomery et al. 1996). The act of spawning also coarsens gravel in spawning reaches, removing fine material that blocks interstitial gravel flow and reduces the survival of incubating eggs in egg pockets of redds.

The added spawner density resulting from hatchery-origin fish spawning in the wild can have negative consequences in that to the extent there is spatial overlap between hatchery and natural spawners, the potential exists for hatchery-derived fish to superimpose or destroy the eggs and embryos of ESA-listed species. Redd superimposition has been shown to be a cause of egg loss in pink salmon and other species (e.g., Fukushima et al. 1998).

The analysis also considers the effects from encounters with natural-origin fish that are incidental to the conduct of broodstock collection. Here, NMFS analyzes effects from sorting, holding, and handling natural-origin fish in the course of broodstock collection. Some programs collect their broodstock from fish volunteering into the hatchery itself, typically into a ladder and holding pond, while others sort through the run at large, usually at a weir, ladder, or sampling facility. Generally speaking, the more a hatchery program accesses the run at large for hatchery broodstock – that is, the more fish that are handled or delayed during migration – the greater the negative effect on natural-origin and hatchery-origin fish that are intended to spawn naturally and to ESA-listed species. The information NMFS uses for this analysis includes a description of the facilities, practices, and protocols for collecting broodstock, the environmental conditions under which broodstock collection is conducted, and the encounter rate for ESA-listed fish.

NMFS also analyzes the effects of structures, either temporary or permanent, that are used to collect hatchery broodstock. NMFS analyzes effects on fish, juveniles and adults, from encounters with these structures and effects on habitat conditions that support and promote viable salmonid populations. NMFS wants to know, for example, if the spatial structure, productivity, or abundance of a natural population is affected when fish encounter a structure used for broodstock collection, usually a weir or ladder. NMFS also analyzes changes to riparian habitat, channel morphology and habitat complexity, water flows, and in-stream substrates attributable to the construction/installation, operation, and maintenance of these structures. NMFS also analyzes the effects of structures, either temporary or permanent, that are used to remove hatchery fish from the river or stream and prevent them from spawning naturally, effects on fish, juveniles and adults, from encounters with these structures and effects on habitat conditions that support and promote viable salmonid populations.

2.4.1.2.3. Acclimation

One factor the can affect hatchery fish distribution and the potential to spatially overlap with natural-origin spawners, and thus the potential for genetic and ecological impacts, is the acclimation of hatchery juveniles before release. Acclimation of hatchery juvenile before release increases the probability that hatchery adults will home back to the release location reducing their potential to stray into natural spawning areas. Dittman and Quinn (2008) provide an extensive literature review and introduction to homing in Pacific Salmon. They note that as early as the 19th century marking studies had shown that salmonids would home to the stream, or even the specific reach, where they originated. The ability to home to their home or "natal" stream is thought to be due to odors to which the juvenile salmonids were exposed while living in the stream and migrating from it years earlier (Dittman and Quinn 2008; Keefer and Caudill 2013). Fisheries managers use this innate ability for salmon and steelhead to home to specific streams when using acclimation ponds to support the reintroduction of species into newly accessible habitat or into areas where they have been extirpated as well as a way to provide for fisheries (Quinn 1997; Dunnigan 2000; YKFP 2008).

Dittman and Quinn (2008) reference numerous experiments that indicated that a critical period for olfactory imprinting is during the parr-smolt transformation, which is the period when the salmonids go through changes in physiology, morphology, and behavior in preparation for transitioning from fresh water to the ocean (Hoar 1976; Beckman et al. 2000). Salmon species with more complex life histories (e.g., sockeye salmon) may imprint at multiple times from emergence to early migration (Dittman et al. 2010). Imprinting to a particular location, be it the hatchery, or an acclimation pond, through the acclimation and release of hatchery salmon and steelhead is employed by fisheries managers with the goal that the hatchery fish released from these locations will return to that particular site and not stray into other areas (Fulton and Pearson 1981; Quinn 1997; Hard and Heard 1999; Bentzen et al. 2001; Kostow 2009; Kostow 2012; Westley et al. 2013), although it does not always show a clear benefit (e.g.,Kenaston et al. 2001; Clarke et al. 2011). Acclimating fish for a period of time also allows them to recover from the stress due to transporting the fish to the release location and from handling.

Having hatchery salmon and steelhead home to a particular location is one measure that can be taken to reduce the proportion of hatchery fish in the naturally spawning population. By having the hatchery fish home to a particular location, those fish can be removed (e.g., through fisheries, use of a weir) or they can be isolated from primary spawning areas. Factors that can affected the success of this measure include the timing the acclimation such that a majority of the hatchery juveniles are going through the parr-smolt transformation during acclimation; whether the water source is unique enough to attract returning adults; whether or not the hatchery fish can access the stream reach where they were released; and whether the water quantity and quality is such that returning hatchery fish will hold in that area before removal and/or their harvest in fisheries.

2.4.1.3. Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas

NMFS also analyzes the potential for competition, predation, and premature emigration when the progeny of naturally spawning hatchery fish and hatchery releases share juvenile rearing areas. The level of effect for this factor ranges from neutral or negligible to negative.

Generally speaking, competition and a corresponding reduction in productivity and survival may result from direct interactions when hatchery-origin fish interfere with the accessibility to limited resources by natural-origin fish or through indirect means, when the utilization of a limited resource by hatchery fish reduces the amount available for fish from the natural population (SIWG 1984). Naturally produced fish may be competitively displaced by hatchery fish early in life, especially when hatchery fish are more numerous, are of equal or greater size, when hatchery fish take up residency before naturally produced fry emerge from redds, and if hatchery fish residualize. Hatchery fish might alter naturally produced salmon behavioral patterns and habitat use, making them more susceptible to predators (Hillman and Mullan 1989; Steward and Bjornn 1990). Hatchery-origin fish may also alter naturally produced salmonid migratory responses or movement patterns, leading to a decrease in foraging success (Hillman and Mullan 1989; Steward and Bjornn 1990). Actual impacts on naturally produced fish would thus depend on the degree of dietary overlap, food availability, size-related differences in prey selection, foraging tactics, and differences in microhabitat use (Steward and Bjornn 1990).

Specific hazards associated with competitive impacts of hatchery salmonids on listed naturally produced salmonids may include competition for food and rearing sites (NMFS 2012a). In an assessment of the potential ecological impacts of hatchery fish production on naturally produced salmonids, the Species Interaction Work Group (SIWG 1984) concluded that naturally produced coho and Chinook salmon and steelhead are all potentially at "high risk" due to competition (both interspecific and intraspecific) from hatchery fish of any of these three species. In contrast, the risk to naturally produced pink, chum, and sockeye salmon due to competition from hatchery salmon and steelhead was judged to be low.

Several factors influence the risk of competition posed by hatchery releases: whether competition is intra- or interspecific; the duration of freshwater co-occurrence of hatchery and natural-origin fish; relative body sizes of the two groups; prior residence of shared habitat; environmentally induced developmental differences; and, density in shared habitat (Tatara and Berejikian 2012). Intraspecific competition would be expected to be greater than interspecific, and competition would be expected to increase with prolonged freshwater co-occurrence. Although newly released hatchery smolts are commonly larger than natural-origin fish, and larger fish usually are superior competitors, natural-origin fish have the competitive advantage of prior residence when defending territories and resources in shared natural freshwater habitat. Tatara and Berejikian (2012) further reported that hatchery-induced developmental differences from co-occurring natural-origin fish life stages are variable and can favor both hatchery- and natural-origin fish. They concluded that of all factors, fish density of the composite population in relation to habitat carrying capacity likely exerts the greatest influence.

En masse hatchery salmon smolt releases may cause displacement of rearing naturally produced juvenile salmonids from occupied stream areas, leading to abandonment of advantageous feeding

stations, or premature out-migration (Pearsons et al. 1994). Pearsons et al. (1994) reported small-scale displacement of juvenile naturally produced rainbow trout from stream sections by hatchery steelhead. Small-scale displacements and agonistic interactions observed between hatchery steelhead and naturally produced juvenile trout were most likely a result of size differences and not something inherently different about hatchery fish.

A proportion of the smolts released from a hatchery may not migrate to the ocean but rather reside for a period of time in the vicinity of the release point. These non-migratory smolts (residuals) may directly compete for food and space with natural-origin juvenile salmonids of similar age. They also may prey on younger, smaller-sized juvenile salmonids. Although this behavior has been studied and observed, most frequently in the case of hatchery steelhead, residualism has been reported as a potential issue for hatchery coho and Chinook salmon as well. Adverse impacts from residual Chinook and coho hatchery salmon on naturally produced salmonids is definitely a consideration, especially given that the number of smolts per release is generally higher; however the issue of residualism for these species has not been as widely investigated compared to steelhead. Therefore, for all species, monitoring of natural stream areas in the vicinity of hatchery release points may be necessary to determine the potential effects of hatchery smolt residualism on natural-origin juvenile salmonids.

The risk of adverse competitive interactions between hatchery-origin and natural-origin fish can be minimized by:

- Releasing hatchery smolts that are physiologically ready to migrate. Hatchery fish released as smolts emigrate seaward soon after liberation, minimizing the potential for competition with juvenile naturally produced fish in freshwater (Steward and Bjornn 1990; California HSRG 2012).
- Operating hatcheries such that hatchery fish are reared to sufficient size that smoltification occurs in nearly the entire population.
- Releasing hatchery smolts in lower river areas, below areas used for stream-rearing by naturally produced juveniles.
- Monitoring the incidence of non-migratory smolts (residuals) after release and adjusting rearing strategies, release location and timing if substantial competition with naturally rearing juveniles is determined likely.

Critical to analyzing competition risk is information on the quality and quantity of spawning and rearing habitat in the action area,[18] including the distribution of spawning and rearing habitat by quality and best estimates for spawning and rearing habitat capacity. Additional important information includes the abundance, distribution, and timing for naturally spawning hatchery fish and natural-origin fish; the timing of emergence; the distribution and estimated abundance for progeny from both hatchery and natural-origin natural spawners; the abundance, size, distribution, and timing for juvenile hatchery fish in the action area; and the size of hatchery fish relative to co-occurring natural-origin fish.

[18] "Action area" means all areas to be affected directly or indirectly by the action in which the effects of the action can be meaningfully detected and evaluated.

Another potential ecological effect of hatchery releases is predation. Salmon and steelhead are piscivorous and can prey on other salmon and steelhead. Predation, either direct (direct consumption) or indirect (increases in predation by other predator species due to enhanced attraction), can result from hatchery fish released into the wild. Considered here is predation by hatchery-origin fish and by the progeny of naturally spawning hatchery fish and by avian and other predators attracted to the area by an abundance of hatchery fish. Hatchery fish originating from egg boxes and fish planted as non-migrant fry or fingerlings can prey upon fish from the local natural population during juvenile rearing. Hatchery fish released at a later stage, so they are more likely to emigrate quickly to the ocean, can prey on fry and fingerlings that are encountered during the downstream migration. Some of these hatchery fish do not emigrate and instead take up residence in the stream (residuals) where they can prey on stream-rearing juveniles over a more prolonged period. The progeny of naturally spawning hatchery fish also can prey on fish from a natural population and pose a threat. In general, the threat from predation is greatest when natural populations of salmon and steelhead are at low abundance and when spatial structure is already reduced, when habitat, particularly refuge habitat, is limited, and when environmental conditions favor high visibility.

SIWG (1984) rated most risks associated with predation as unknown, because there was relatively little documentation in the literature of predation interactions in either freshwater or marine areas. More studies are now available, but they are still too sparse to allow many generalizations to be made about risk. Newly released hatchery-origin yearling salmon and steelhead may prey on juvenile fall Chinook and steelhead, and other juvenile salmon in the freshwater and marine environments (Hargreaves and LeBrasseur 1986; Hawkins and Tipping 1999; Pearsons and Fritts 1999). Low predation rates have been reported for released steelhead juveniles (Hawkins and Tipping 1999; Naman and Sharpe 2012). Hatchery steelhead timing and release protocols used widely in the Pacific Northwest were shown to be associated with negligible predation by migrating hatchery steelhead on fall Chinook fry, which had already emigrated or had grown large enough to reduce or eliminate their susceptibility to predation when hatchery steelhead entered the rivers (Sharpe et al. 2008). Hawkins (1998) documented hatchery spring Chinook salmon yearling predation on naturally produced fall Chinook salmon juveniles in the Lewis River. Predation on smaller Chinook salmon was found to be much higher in naturally produced smolts (coho salmon and cutthroat, predominately) than their hatchery counterparts.

Predation may be greatest when large numbers of hatchery smolts encounter newly emerged fry or fingerlings, or when hatchery fish are large relative to naturally produced fish (SIWG 1984). Due to their location in the stream or river, size, and time of emergence, newly emerged salmonid fry are likely to be the most vulnerable to predation. Their vulnerability is believed to be greatest immediately upon emergence from the gravel and then their vulnerability decreases as they move into shallow, shoreline areas (USFWS 1994). Emigration out of important rearing areas and foraging inefficiency of newly released hatchery smolts may reduce the degree of predation on salmonid fry (USFWS 1994).

Some reports suggest that hatchery fish can prey on fish that are up to 1/2 their length (Pearsons and Fritts 1999; HSRG 2004) but other studies have concluded that salmonid predators prey on fish 1/3 or less their length (Horner 1978; Hillman and Mullan 1989; Beauchamp 1990;

Cannamela 1992; CBFWA 1996). Hatchery fish may also be less efficient predators as compared to their natural-origin conspecifics, reducing the potential for predation impacts (Sosiak et al. 1979; Bachman 1984; Olla et al. 1998).

There are several steps that hatchery programs can implement to reduce or avoid the threat of predation:

- Releasing all hatchery fish as actively migrating smolts through volitional release practices so that the fish migrate quickly seaward, limiting the duration of interaction with any co-occurring natural-origin fish downstream of the release site.
- Ensuring that a high proportion of the population have physiologically achieved full smolt status. Juvenile salmon tend to migrate seaward rapidly when fully smolted, limiting the duration of interaction between hatchery fish and naturally produced fish present within, and downstream of, release areas.
- Releasing hatchery smolts in lower river areas near river mouths and below upstream areas used for stream-rearing young-of-the-year naturally produced salmon fry, thereby reducing the likelihood for interaction between the hatchery and naturally produced fish.
- Operating hatchery programs and releases to minimize the potential for residualism.

2.4.1.4. Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, in the estuary, and in the ocean

Based on a review of the scientific literature, NMFS' conclusion is that the influence of density-dependent interactions on the growth and survival of salmon and steelhead is likely small compared with the effects of large-scale and regional environmental conditions and, while there is evidence that large-scale hatchery production can effect salmon survival at sea, the degree of effect or level of influence is not yet well understood or predictable. The same thing is true for mainstem rivers and estuaries. NMFS will watch for new research to discern and to measure the frequency, the intensity, and the resulting effect of density-dependent interactions between hatchery and natural-origin fish. In the meantime, NMFS will monitor emerging science and information and will consider that re-initiation of Section 7 consultation is required in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.1.5. Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program

NMFS also analyzes proposed RM&E for its effects on listed species and on designated critical habitat. The level of effect for this factor ranges from positive to negative.

Generally speaking, negative effects on the fish from RM&E are weighed against the value or benefit of new information, particularly information that tests key assumptions and that reduces critical uncertainties. RM&E actions including but not limited to collection and handling (purposeful or inadvertent), holding the fish in captivity, sampling (e.g., the removal of scales and tissues), tagging and fin-clipping, and observation (in-water or from the bank) can cause harmful changes in behavior and reduced survival. These effects should not be confused with

handling effects analyzed under broodstock collection. In addition, NMFS also considers the overall effectiveness of the RM&E program. There are five factors that NMFS takes into account when it assesses the beneficial and negative effects of hatchery RM&E: (1) the status of the affected species and effects of the proposed RM&E on the species and on designated critical habitat, (2) critical uncertainties over effects of the Proposed Action on the species, (3) performance monitoring and determining the effectiveness of the hatchery program at achieving its goals and objectives, (4) identifying and quantifying collateral effects, and (5) tracking compliance of the hatchery program with the terms and conditions for implementing the program. After assessing the proposed hatchery RM&E and before it makes any recommendations to the action agencies, NMFS considers the benefit or usefulness of new or additional information, whether the desired information is available from another source, the effects on ESA-listed species, and cost.

Hatchery actions also must be assessed for masking effects. For these purposes, masking is when hatchery fish included in the Proposed Action mix with and are not identifiable from other fish. The effect of masking is that it undermines and confuses RM&E and status and trends monitoring. Both adult and juvenile hatchery fish can have masking effects. When presented with a proposed hatchery action, NMFS analyzes the nature and level of uncertainties caused by masking and whether and to what extent listed salmon and steelhead are at increased risk. The analysis also takes into account the role of the affected salmon and steelhead population(s) in recovery and whether unidentifiable hatchery fish compromise important RM&E.

2.4.1.6. Factor 6. Construction, operation, and maintenance, of facilities that exist because of the hatchery program

The construction/installation, operation, and maintenance of hatchery facilities can alter fish behavior and can injure or kill eggs, juveniles and adults. It can also degrade habitat function and reduce or block access to spawning and rearing habitats altogether. Here, NMFS analyzes changes to riparian habitat, channel morphology and habitat complexity, in-stream substrates, and water quantity and water quality attributable to operation, maintenance, and construction activities and confirms whether water diversions and fish passage facilities are constructed and operated consistent with NMFS criteria. The level of effect for this factor ranges from neutral or negligible to negative.

2.4.1.7. Factor 7. Fisheries that exist because of the hatchery program

There are two aspects of fisheries that are potentially relevant to NMFS' analysis of HGMP effects in a Section 7 consultation. One is where there are fisheries that exist because of the HGMP (i.e. the fishery is an interrelated and interdependent action) and listed species are inadvertently and incidentally taken in those fisheries. The other is when fisheries are used as a tool to prevent the hatchery fish associated with the HGMP, including hatchery fish included in an ESA-listed ESU or steelhead DPS from spawning naturally. The level of effect for this factor ranges from neutral or negligible to negative.

"Many hatchery programs are capable of producing more fish than are immediately useful in the conservation and recovery of an ESU and can play an important role in fulfilling trust and treaty obligations with regard to harvest of some Pacific salmon and steelhead populations. For ESUs

listed as threatened, NMFS will, where appropriate, exercise its authority under Section 4(d) of the ESA to allow the harvest of listed hatchery fish that are surplus to the conservation and recovery needs of the ESU, in accordance with approved harvest plans" (NMFS 2005c). In any event, fisheries must be strictly regulated based on the take, including catch and release effects, of ESA-listed species.

2.4.2. Effects of the Proposed Action

Analysis of the Proposed Action identified that within the Action Area, ESA-listed species are likely to be negatively affected and take will occur from five of the seven factors described in Section 2.4.1. They are hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities; hatchery fish and progeny of naturally spawning hatchery fish in juvenile rearing areas (i.e., competition, and predation); RM&E that exists because of the hatchery program; and operation, maintenance of the hatchery facilities. An overview of the analysis is described below.

The terms of the 10(j) rule (NMFS 2014) make the scope of effects analysis done on spring Chinook salmon for this program distinctive. The effects on listed spring Chinook must be considered from broodstock collection through release into the Okanogan Basin (i.e. when the fish move into the NEP area), and take must be accounted for when involving members of the listed ESU, i.e., fish that are outside the NEP area). Once released into the Okanogan, these spring Chinook salmon and their progeny are part of the NEP. Effects on the NEP are considered through conferencing because the NEP must be treated as a species proposed for listing (see section 2.11).

Table 15. A summary of the effects of the Okanogan spring Chinook salmon hatchery program on ESA-listed UCR spring Chinook salmon and steelhead, and on designated critical habitat. The framework NMFS followed for analyzing effects of the hatchery program is described in Section 2.4.1.

Factor		Range in potential effects for this factor	Effects on UCR spring Chinook salmon	Effects on UCR steelhead
1	The hatchery program does or does remove fish from the natural population and use them for broodstock	Negligible to negative effect	**No effect-** Fish used for broodstock are 100% hatchery-origin	**N/A-** Program does not propagate steelhead.
2	Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities	Positive to negative effect	**Negligible-** Broodstock will be collected almost entirely at WNFH outfall, where few natural-origin are expected. Broodstock are collected from a ladder which is not associated with a weir or passage impediment. Some natural-origin fish volunteer into the ladder, though numbers are low. Interactions with natural-origin spring Chinook salmon in Okanogan are not a concern because currently population is extirpated, and population being introduced is a non-essential experimental population, in which impacts are not a concern. There will be no genetic or ecological concerns because the broodstock fish will not spawn in the wild	**Negligible**- Spring Chinook salmon and steelhead spawning seasons do not overlap, so no interactions are expected on spawning grounds. Spring Chinook salmon spawners will increase marine-derived nutrients and condition spawning gravel. Steelhead may occasionally be trapped during spring Chinook salmon broodstock collection in Methow. Ladder is not associated with weir or passage impediment, but captured fish may experience some handling stress and slight migration delays.
3	Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas	Negligible to negative effect	**N/A** No fish from program are released in Methow Basin.	**Small negative effect:** Because of habitat segregation and complexity, and relative sizes, effects of competition from released hatchery spring Chinook salmon are expected

Factor		Range in potential effects for this factor	Effects on UCR spring Chinook salmon	Effects on UCR steelhead
				to be very low, and predation to be non-existent. Competition can potentially arise from increased numbers of natural-origin spring Chinook salmon juveniles, but at current and expected near-term population levels competition is expected to be minimal
4	Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean	Negligible to negative effect		
5	RM&E that exists because of the hatchery program	Positive to negative effect	**Negligible effect-** Fish will be subjected only to routine hatchery fish health monitoring	**Slight negative effect-**Proposed RM&E activities (i.e., the trapping, sampling, and tagging) may cause injury and death to ESA-listed steelhead in the Okanogan Basin.
6	Construction, operation, and maintenance of facilities that exist because of the hatchery program	Negligible to negative effect	**Negligible effect** Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria. Operation of the facility is not expected to degrade water quality. Water is treated before it is returned to the river and the program has a current NPDES permit.	**Negligible effect** Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria. Operation of the facility is not expected to degrade water quality. Water is treated before it is returned to the river and the program has a current NPDES permit. Water withdrawal at acclimation sites is not expected to impact juvenile steelhead spatial distribution in the Okanogan River, water withdrawals are typically less

Factor		Range in potential effects for this factor	Effects on UCR spring Chinook salmon	Effects on UCR steelhead
				than 3% of river flows.
7	Fisheries that exist because of the hatchery program	Negligible to negative effect	**N/A-** Mainstem Columbia River fisheries targeting spring Chinook salmon produced by this program have been evaluated and authorized in a separate opinion (NMFS 2008c). These fisheries are included in the environmental baseline.	

2.4.2.1. Factor 1. The hatchery program does or does not remove fish from the natural population and use them for hatchery broodstock

No effect on UCR spring Chinook salmon, N/A for UCR steelhead: The Okanogan spring Chinook salmon program uses no natural-origin broodstock. It uses only WNFH hatchery-origin returns. In time, as natural-origin spring Chinook salmon begin returning to the Okanogan Basin, the program will begin taking some natural-origin fish for broodstock, but this will beyond the term of the permit.

2.4.2.2. Factor 2. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities

Negligible effect on UCR spring Chinook salmon, UCR steelhead: Effects on spring Chinook salmon are limited to encounters during broodstock collection in the Methow Basin, which are expected to be slight. Chinook salmon and steelhead spawning seasons do not overlap, so no interactions are expected in the Okanogan Basin on spawning grounds between steelhead and either the returning hatchery-origin fish from the program or their natural-origin descendants. As the NEP grows, genetic and ecological interactions between the returning hatchery fish and their natural-origin counterparts may become a concern, as in any supplementation program, but the NEP is not predicted to establish and grow a natural population to a substantial size either by supplementation, natural reproduction, or both, during the permit's ten-year term. Therefore, concern over genetic and ecological interactions is highly unlikely to arise during the term of the proposed action.

2.4.2.2.1. Ecological interactions between adult spring Chinook salmon and steelhead in the Okanogan Basin

The Proposed Action should have a negligible impact on steelhead in terms of direct competitive interactions, as the spawning times of the two species do not overlap. In the Okanogan Basin, the introduction of spring Chinook salmon will increase the ecological benefits of gravel conditioning and marine-derived nutrient delivery, so the Proposed Action should result in a small positive effect.

2.4.2.2.2. Encounter of listed species at adult collection facilities

Hatchery programs that collect returning adults may impact both target and non-target species through the physical activities of trapping, removal, handling, sampling, tagging, and transport during the collection of adults for broodstock. The program uses various trapping methods for broodstock collection in the Methow River. Trapping would include for the most part taking volunteer spring Chinook salmon returning to WNFH, but some fish may also be collected at Methow Hatchery, and possibly at Wells Dam using a fish-ladder trap combination. Steelhead could be encountered during spring Chinook salmon broodstock collection.

2.4.2.2.2.1. Weir, ladder, and trap operations

All facilities that capture and handle UCR Chinook salmon (in this case, primarily WNFH, but also Methow Hatchery, and possibly Wells Dam) pose a risk to fish through physical stress. Any physical handling or psychological disturbance is known to be stressful to fish (NMFS 2010; 2011e; 2011a). Primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and holding vessel), dissolved oxygen conditions, the amount of time fish are held out of the water, and physical trauma. Stress increases rapidly if the water temperature exceeds 18ºC or dissolved oxygen is below saturation. Fish transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not emptied regularly. Decreased survival can result from high stress levels because stress can be immediately debilitating, and may also increase the potential for vulnerability to subsequent challenges (Sharpe et al. 1998). Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared regularly. For trap operations in this proposed action, daily monitoring and processing of adults should reduce delays. All fish captured in the trap, regardless of species or listing status, will be processed, collected or passed above or below the weir, within 24 hours of initial trapping.

Methow Hatchery and WNFH Ladders

Though broodstock for the Okanogan program are primarily taken from the Winthrop broodstock, both Methow and Winthrop Hatcheries collect adults that volunteer into the ladder and trap at the outfall of the hatchery facility, which may be used for Okanogan production. In general, volunteer ladder collection minimizes the impact to natural origin fish because they don't typically seek or volunteer into hatchery outfalls when homing. The Okanogan program will use up to 120 of the total 400 broodstock (approximately 30%) adults needed for the Winthrop program. Because there is no weir or passage barrier associated with ladder and trap, migration is not impeded for fish that pass the facility entrance. Those that do not volunteer into the ladder can move freely upstream. Natural-origin fish that enter the Methow or WNFH ladder and trap will likely be held for broodstock, and therefore not experience the potential effects of fish would be passed to spawn in the wild. All fish that are handled and passed may experience physical handling stress, injury, migration delay, or delayed mortality, though these impacts are expected to be small.

Wells Dam

Wells Dam is equipped with two fish ladders (on the east and west ends of the dam), which provide passage above the dam into Lake Pateros, and can be used to collect broodstock. Both east and west side ladders are equipped with a trap for sampling adults and/or colleting broodstock. Each week, one of the traps will operate up to 16 hours/day for 3 days/week to capture broodstock. A weekly quota of 160 adult UCR spring/summer Chinook salmon is set, though the weekly quota is rarely met. The number of Chinook salmon handled annually is summarized in Table 19 below. Most fish will be sampled and passed, and may experience the effects listed below, though some Chinook salmon will be held for broodstock, and transferred to WNFH for spawning. During Chinook salmon broodstock collection, and prior to steelhead broodstock collection, steelhead may be encountered in the trap. The number of steelhead encountered during Chinook broodstock collection is summarized in Table 20 below. Though the Okanogan program uses only about 30% of the total broodstock collected for the Winthrop program, the total handled and collected is considered here because broodstock will be collected throughout the run, and Okanogan program fish are not separated from the Winthrop component until smolts are ready for release.

2.4.2.2.2.2. Summary of all spring Chinook salmon adult trapping and handling facility effects

The program will obtain juveniles from WNFH, which collects broodstock by physical handling and trapping at the WNFH ladder, Wells Dam, and possibly the Methow Hatchery. An overview of handling of UCR Chinook salmon at the various locations is provided in Section 1.3 as well as in Table 19.

Migration Delay

Delay in the upstream migration of spring Chinook salmon and steelhead due to the operation of in-river traps may affect the date of first spawning, and the peak spawning date. Because the WNFH and Methow ladders are passive traps, the Wells Dam ladder is the primary instream structure that may delay returning adults Chinook salmon for the Okanogan program. In this case, migration delays would occur even without the hatchery program because the collection is opportunistic because the dam and ladder already exist. Therefore, any migration delay is unrelated to the Okanogan hatchery program.

Though the handling of fish may result in small delays, the facilities involved in this program are all operated in a manner that NMFS considers low risk. Structures do not require routine in-water maintenance or construction activities. The handling and processing of live, listed salmonids, entering any of the facility structures, occurs in an expedited manner, with minimal handling. Sampling and tagging provide information for program management, and do not result in high mortality rates. Delays in migration or changes in spawning distribution for either Chinook salmon or steelhead have not been a concern during operations in the past. Though facility operation poses some risk, overall the effects to listed salmonids from the facilities involved in this program is expected to be minimal and below levels of concern.

2.4.2.3. Factor 3. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas

N/A for UCR spring Chinook salmon; small negative effect on steelhead: Because the hatchery fish are not released in the Methow Basin as part of the proposed action, this factor is not applicable to Methow spring Chinook salmon. But these interactions are of interest for Okanogan steelhead. Small negative impacts may occur to Okanogan steelhead as a result of ecological interactions with released hatchery fish.

2.4.2.3.1. Ecological impacts from released hatchery fish

Recently, a multiagency technical team called HETT[19] completed a large-scale effort (Mackey et al. 2014) to model the ecological impacts (predation, disease, competition) of all Upper Columbia salmon and steelhead hatchery programs on various non-target taxa of concern (NTTOC), including juvenile spring Chinook salmon and steelhead using the PCD Risk model (Busack et al. 2005; Pearsons and Busack 2012). This is a novel approach. Although it often depends on expert panel input for many parameters of interest, it is a more quantitative approach than has been taken in most past consultations. Because it is new, however, it requires some explanation.

PCD Risk is an individual-based model that simulates predation, competition, and disease impacts on naturally produced salmonids caused by hatchery smolts in fresh water as they move downstream or residualize after release. The model is far too complex to describe in detail here, but briefly, it relies upon user-specified inputs of up to 45 variables, such as number and size of hatchery and wild fish, and water temperature. The model generates hatchery and natural fish of specified size distributions, then randomly pairs them for interactions for a specified number of days and encounters. Wild fish are subjected to predation if they are less than 50% the length of hatchery fish, otherwise they are subjected to competition. After all of the allowable competition and predation occurs, survivors are subjected to disease risk. The model can provide either deterministic or probabilistic output. Deterministic output includes the number and proportion of wild fish that die from predation, competition, disease, and from all interactions combined. Probabilistic output includes probability distributions of the number and proportion of mortalities, based on user-specified uncertainty input either as uniform or triangular distributions for any of several variables.

Although the model is a simulation involving many variables for which quantitative data are currently unavailable and must be estimated from expert opinion, many of the variables included are key factors in determining the quantity and type of ecological interaction, such as habitat segregation and complexity. Thus, even though the modeling involves a considerable degree of expert panel input,[20] the simulations involve a considerably greater degree of realism than previous approaches, such as making evaluations based on comparisons of size and timing of hatchery and natural-origin fish. Additionally, the NTTOC report (Mackey et al. 2014) documents all data inputs.

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[19] Hatchery Evaluation Technical Team for the HCP Wells Hatchery Committee, HCP Rocky Reach Hatchery Committee, HCP Rock Island Hatchery Committee, and the Priest Rapids Hatchery Sub-Committee

[20] In the HETT modeling effort twelve experts were consulted.

Results of the NTTOC report with respect to impacts of salmon and steelhead releases on natural-origin salmon and steelhead were quite striking. Within basins, estimated mortality rates from predation, competition, and disease combined often were on the order of a few percent of a percent, and rarely exceeded 1%. Impacts of releases directly into the Columbia ranged from a few percent of a percent to rarely, just above 5%. So, in general, the impacts of ecological interactions were very low.

Two caveats must be considered in considering these overall results, however. First, the study focused on non-target taxa of concern. Within species, this meant that the only impacts considered were releases affecting fish away from the release area. For example, in the case of the Methow Hatchery spring Chinook salmon program, the impact of Twisp releases on fish in the Methow was evaluated, and the impact of Methow releases on fish in the Twisp was evaluated, but the impact of Twisp releases on Twisp fish, or Methow releases on Methow fish was not. This omission could have a substantial effect on results because the temporal-spatial overlap could be expected to be higher in the "target' areas than in the "non-target" areas. This is not a concern in considering the Proposed Action, because we are evaluating a cross-species, that of the hatchery spring Chinook salmon on Okanogan Basin steelhead, but it needs to be considered in the context of the general conclusion of the study.

The second problem is that 40% of the computer runs the HETT researchers attempted crashed, or did not run to completion in the time allotted for them, which could indicate that there is a bug in the PCD Risk code. If so, it is not clear how it would affect the results from the runs that did complete, but again, the results should be viewed with caution. NMFS concluded that because a complete set of results was not available because some scenarios we were interested in had not been run, and others had been attempted but failed, that we could not use the PCD Risk output of the study to evaluate ecological risk in this opinion. In addition, PCD Risk outputs for the interactions of interest in the Okanogan Basin were not included in the NTTOC report.

Although we could not use the PCD Risk results of the NTTOC simulations we found that key input data for PCD Risk could allow us to make strong inferences about the potential for ecological interactions between released spring Chinook salmon and steelhead in the Okanogan Basin. Thus we have used those input data to analyze the potential for ecological interactions between the released spring Chinook salmon in both the Methow and Okanogan Basins, and the listed juvenile salmon and steelhead in those basins.

Below, we characterize for important variables the natural-origin juveniles, the hatchery fish that may interact with them, and the interaction environment. Natural-origin fish are characterized in terms of size and year-class composition. Hatchery-origin fish are classified in terms of size, residence time, interactions expected per day, residence time, and probability of piscivory (e.g., given appropriate conditions that a fish will actually eat another fish).

The interaction environment is largely characterized by use of three variables, described nearly verbatim from the NTTOC report:

- *Percentage population overlap*: Percentage of natural-origin population spatially or temporally available for interaction. For example, 100% overlap occurs if hatchery fish are released above and before emigration of wild occurs and they totally overlap the entire wild fish distribution.
- *Percentage habitat segregation*: Percentage of hatchery-origin population in overlap that are excluded from competitive interactions because they occupy different habitats (e.g., deeper and faster water). The modal values for habitat segregation were 30% and 60% for interactions with spring Chinook and steelhead, respectively. Exclusion of hatchery-origin from the interacting population is based on size (e.g., a 30% habitat segregation means that the 30% largest fish are removed). Obviously this variable is subject to more uncertainty in the Okanogan, where spring Chinook salmon have been extirpated, than it would in basins where the two species still coexist.
- *Percentage habitat complexity*: Percentage of natural-origin population in overlap protected by habitat from competitive interactions (i.e., visual isolation). An environment with high visual isolation has many physical features (e.g., wood, rocks) that preclude fish from seeing and competing with each other. Habitat complexity was modeled at 15% for steelhead in the Okanogan Basin.

Percentage population overlap and habitat complexity was combined to give an estimate of natural-origin juvenile availability for interactions, which we term *interaction availability* (IA). Mathematically, IA is the percentage population overlap multiplied by 100-habitat complexity.

In consultation with Todd Pearsons of GPUD, Craig Busack of NMFS[21] developed predation and competition indices that were intended to give some sense of the probability or either a predation or dominance event based on the relative sizes of randomly drawn pairs of interacting fish. Using the modal means and standard deviations of hatchery and natural-origin fish provided in the NTTOC report, distributions of 10000 hatchery-origin and 10000 natural-origin fish were generated. Hatchery-origin fish distributions were truncated by habitat segregation. Then 10000 random draws of pairs of hatchery-origin and natural-origin fish were done. For the predation index a pairing could result in predation if the natural-origin fish was 33% or less the length of the hatchery-origin fish. The index was the proportion of draws in which predation was possible. For the completion index, for each pairing the proportional difference in size was assigned a probability of dominance according to dominance mode 3 (Mackey et al. 2014), and then the average dominance probability calculated over all 10000 runs. In addition, a competition decrement was calculated for each of the simulated 10000 natural-origin fish, converting fish lengths to weights using the tables of Piper et al. (1982) and the bioenergetics equations in the PCD Risk model, using the HETT-assumed temperature of 12.1°C for the Okanogan Basin. The calculation assumes that a fish will die if it loses 50% of its weight and that if dominated, a fish will not eat for the rest of the days, so the competitive decrement is the amount of weight lost

[21] Pearsons and Busack were the original developers of the PCD Risk program on which the NTTOC exercise was based.

from one negative interaction. Multiplying the decrement by the number of interactions gives the competition equivalents, which is the maximum number of fish that could die. This concept is explained more fully in (Busack et al. 2005) and Pearsons and Busack (2012). Computation of the indices and competition decrement was done by means of an R script written by Busack (2014).

Although the PCD Risk program also deals with disease, this portion of the model is not nearly as well developed as the material on competition and predation. Therefore we have not utilized the NTTOC modelling information in dealing with disease.

The HETT researchers used triangular distributions for nearly all variables. Unless otherwise specified, we used only the modal (most likely) values. Data either came from the NTTOC report (Mackey et al. 2014), supporting database (HETT 2014), or were provided by Greg Mackey of DPUD or Kirk Truscott of CTCR. Although the impact to Okanogan steelhead from spring Chinook hatchery releases in the Okanogan Basin was not modeled in the NTTOC report (Mackey et al. 2014), Okanogan data were in the NTTOC dataset, and were provided (Mackey 2014b) to assess impacts. The Okanogan sites in the NTTOC data set are lower in the Okanogan Basin (Omak and Salmon creeks) than the upper most site intended to be used for the Okanogan program (Tonasket Pond, mainstem Okanogan release location), the spatial overlap is likely to be greater than if released lower in the Okanogan Basin as originally assessed via the Mackey 2014b data. Adjustments to original Okanogan modeled values were provided by Truscott (2014). Based on the highest location intended for spring Chinook releases in the Okanogan River Basin (i.e. Tonasket Pond) and the average 2007-2013 steelhead spawn escapement abundance and distribution within the U.S. portion of the Okanogan River mainstem (provided by the Confederated Tribes of the Colville Reservation), the spatial overlap increased from an estimated 16.2% to 18.4%, with a resultant total population overlap of 36%. The estimated IA (total population overlap x 100-habitat complexity) was 31%.

Table 16 presents key modeled parameter values we used for spring Chinook salmon released into the Okanogan Basin, and Table 17 presents size information for juvenile Okanogan steelhead.

Table 16. Modeled modal lengths, residence, times, and encounters/day for juvenile spring Chinook salmon released by the Okanogan program.

Length	Residence (days)	Encounters/day
153	5	2

Table 17. Modeled mean fork length (mm), competition indices, and percentage of population for Okanogan steelhead juveniles potentially involved in ecological interactions with juvenile hatchery fish juveniles (HETT 2014; Mackey 2014b; 2014a; Mackey et al. 2014). Estimates are weighted means of intrinsic potential estimates for individual streams and are rounded to nearest mm and %.

	Age 1	**Age 2**	**Age 3**	**Weighted average**
Length	128 (60)	165 (34)	192 (6)	144
Competition Index	0.62	0.13	0.03	0.42

The overall IA for Okanogan steelhead is 31%. Predation indices are 0%. Competition indices are shown in Table 17. Putting all this together, 31% of the juvenile steelhead are available for competition, and when they encounter hatchery fish, the probability of being dominated is approximately 42%. Assuming a 5% probability of weight loss from a dominance event, an average survival rate for hatchery fish of 95%, and the 5% probability that a dominant interaction results in weight loss, and further assuming as did HETT that a 50% weight loss is required to kill a fish, the net impact is a maximum of 130 fish lost from competition, about 0.05% of the population.

This slight negative impact to the Okanogan steelhead population from the release of spring Chinook salmon poses no threat to the population.

2.4.2.3.1.1. Disease

Prevention of disease is an important aspect of WNFH operations. This starts when adults enter the holding ponds, includes careful handling of adults and eggs during spawning and incubation, and continues through release of the fish. Specifically this includes gentle handling of all life stages, the use of disinfectant agents for articles used in the raceways such as brushes, nets, crowders, and waders. The USFWS staff also maintains detailed records on water flows, temperatures, densities, mortality, and fish growth. Attention is also given to other environmental conditions which enhance the health of the fish such as cleaning, feed quality, dissolved oxygen, shade/cover, etc. Operations are conducted to minimize the use of therapeutic drugs and chemicals and to comply with conditions of the National Pollutant Discharge Elimination System (NPDES) permit as well as FDA laws and regulations.

Major handling stresses such as crowding, tagging, clipping, and transport are kept to a minimum and whenever possible conducted when water temperatures are moderate and nutritional status is adequate. These actions optimize the ability of the fish to handle stress without causing an adverse reaction such as a disease outbreak.

The USFWS Olympia Fish Health Center (OFHC) in Lacey, Washington provides Fish Health Services for WNFH and Chief Joseph Hatchery using as minimal standards the USFWS Fish Health Policy (http://www.fws.gov/policy/manual.html Part 713), the "Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries," by the Integrated Hatchery Operations Team (IHOT 1996), and the State of Washington Fisheries Co-manager Fish Health Policy

(Northwest Indian Fisheries Commission et al. 1997). These documents provide guidance for preventing or minimizing diseases within and outside of the hatchery. In general, movement of live fish into or out of the hatchery are approved in the U.S. v Oregon Production Advisory Committee forum and noted on the State of Washington Brood Document. If a fish transfer or release is not on the Brood Document, permits from the WDFW, the USFWS, and any other states through which the fish travel must be obtained and approved by co-managers. Fish health exams and certifications must be completed prior to any releases or transfers from the hatchery to minimize the risk of disease transmittance to other populations. Any vehicle that transfers the fish or eggs is disinfected before being brought onto the station and after use at the hatchery; this also includes fish marking equipment. Carcasses of adult and juvenile fish are disposed of or released in a manner which minimizes any negative impact on wild fish populations or the aquatic environment.

Fish Health Examinations:

Routine Examination: A Fish Health Specialist visits approximately once per month to examine juvenile fish at WNFH and at Chief Joseph Hatchery and its acclimation sites. Fish are sampled to ascertain general health on each stock and brood year throughout the rearing period. Based on pathological signs, age of fish, and concerns of the Fish Culture Staff, the examining Fish Health Specialist determines the appropriate tests. Tests typically include microscopic examinations of the skin, gills, and internal organs. Kidneys (and other tissues, if necessary) are checked for the common bacterial pathogens by culture and/or other tests specific for the particular pathogen of interest as warranted. Blood may be examined for signs of infection and cellular or biochemical abnormalities. Additional tests for virus or parasites are done if warranted. The Fish Health Specialist may also examine fish which are moribund or freshly dead to ascertain potential disease problems in the stocks.

Diagnostic Examination: The Fish Health Specialist conducts diagnostic exams when needed or when requested by hatchery personnel. Moribund, freshly dead fish or fish with unusual signs or behavior are examined for disease using necropsy and appropriate diagnostic and laboratory tests. Randomly caught fish representative of the population are also examined and tested for comparison as considered appropriate by the Fish Health Specialist.

Pre-release/Transfer Examination: Hatchery staff notifies OFHC at least eight weeks prior to the planned date for release or transfer of fish from the hatchery. Tissue samples are collected on 60 fish of the stock being transferred or released. The pathogens screened for include: Infectious Hematopoietic Necrosis Virus (IHNV); Infectious Pancreatic Necrosis Virus (IPNV); Viral Hemorrhagic Septicemia Virus (VHSV); *Renibacterium salmoninarum; Aeromonas salmonicida; Yersinia ruckeri; Flavobacterium psychrophilum, Flavobacterium columnare*, and under certain circumstances other pathogens such as *Myxobolus cerebralis, Ceratomyxa shasta,* and *Nucleospora salmonis*.

Adult Certification Examination:

During spawning, tissues are collected from adult spring Chinook salmon to ascertain viral, bacterial, and parasitic infections and to provide the facility and brood health profile necessary for some fish and egg movements. Females used as broodstock are assigned a number and tested for *Renibacterium salmoninarum*, causative agent of Bacterial Kidney Disease (BKD). This ID

number is also used to track the eggs. Females are then ranked by level of risk they pose for their progeny to develop BKD. Typically, the eggs from high and moderate risk females are culled. However, progeny from moderate risk fish may be kept under certain circumstances. Eggs and fish from moderate risk parents are reared at lower densities and in separate rearing units to reduce the potential for horizontal transmission of *R. salmoninarum* and to reduce the likelihood of amplification of this bacteria and development of disease in the juveniles.

No significant bacterial or viral pathogens have been found in spring Chinook salmon juveniles at WNFH since BY2009, indicating that disease is a negligible concern. The fish health monitoring measures are adequate to deal with any emerging fish health problems.

2.4.2.3.2. Impacts to steelhead from natural spawning of hatchery-origin spring Chinook salmon

Steelhead are ESA-listed in the Okanogan Basin. Therefore the intent is to recover steelhead in at the same time a reintroduction effort for spring Chinook salmon is beginning in that basin. Implicit in this planning, and similar planning elsewhere in the region, where there are efforts to simultaneously recovery multiple species, is that the plans for the individual species will not conflict. This is not guaranteed. Because spring Chinook salmon historically coexisted in with steelhead in this basin, it follows that there must have been adequate passage and habitat to allow both species to be productive and abundant. It does not follow automatically, however, that the historical situation can be restored under present-day conditions. Habitat and passage conditions have changed considerably over time to the point that both species are so depleted that steelhead they are listed under the ESA, and spring Chinook salmon are considered extinct. The NTTOC modelers (Mackey et al. 2014) assumed a considerable degree of habitat partitioning between spring Chinook salmon and steelhead (60%), but even if habitat partitioning that minimizes direct interaction occurs, this does not mean that the reintroduction effort for either species will not be to the detriment of the other, as the partitioning may result in competition for space and resources, further pressuring the listed populations. This may be exacerbated by the fact that the original populations that coevolved may have changed considerably as a result of habitat changes and hatchery influence, so the restorations are possibly being attempted with populations substantially different from those that shared the basins decades ago. This especially true of the Okanogan, where the original spring Chinook salmon population is gone.

The upshot of all this is that in analyzing this hatchery program, in addition to considering the direct effects of the spring Chinook salmon releases on steelhead, we need to consider the ecological impacts of the naturally produced progeny of the hatchery-origin spring Chinook salmon on steelhead. At present, the Okanogan effort, not having started, obviously poses no risk. Because of habitat partitioning, the two species may not interact for some time. But ecological impacts may increase in the future as the new spring Chinook salmon population in the Okanogan Basin grows. Obviously, should the situation arise in which it appears that spring Chinook salmon natural production is limiting steelhead natural production in the Okanogan Basin, recovery planners would have to prioritize one species over another[22]. NMFS concludes that that the monitoring effort in the Okanogan should be able to detect negative impacts before they reach problematic levels, and we have included language in the ITS (Section 2.8.4) to ensure that monitoring takes place.

[22] Prioritization may not be a concern in the Okanogan, because the spring Chinook salmon population is considered non-essential.

2.4.2.4. Factor 4. Hatchery fish and the progeny of naturally spawning hatchery fish in the migration corridor, estuary, and ocean

Negligible effect: Best available information does not indicate that the release of hatchery fish from the Okanogan spring Chinook program would exacerbate density-dependent effects on ESA-listed species in the mainstem Columbia River, in the estuary, or in the Pacific Ocean and thus, NMFS concluded that this factor is not a threat.

NMFS has been investigating this factor for some time. The Proposed Recovery Plan for Snake River Salmon (NMFS 1995b) described the issue in this manner. There is intense debate over the issues of carrying capacity and density-dependent effects on natural populations of salmon. However, there is little definitive information available to directly address the effects of ecological factors on survival and growth in natural populations of Pacific salmon. Thus, many of the ecological consequences of releasing hatchery fish into the wild are poorly defined. The proposed recovery plan called on hatchery operators and funding entities to "limit annual releases of anadromous fishes from Columbia Basin hatcheries" and in fact, releases have declined substantially. Hatchery releases for the entire Columbia River Basin now vary between 130 and 145 million fish annually compared to a previous annual production of approximately 200 million fish back in the late 1990s.

More recently, NMFS reviewed the literature for new and emerging scientific information over the role and the consequences of density-dependent interactions. At full production, hatchery releases from the program analyzed in this biological opinion will constitute less than one percent of the total hatchery production and less than .05 percent of all juvenile salmonids in the Columbia basin. The SCA for the FCRPS opinion (NMFS 2008e) and the September 2009 FCRPS Adaptive Management Implementation Plan (NMFS 2009a) both concluded that available knowledge and research abilities are insufficient to discern any important role or contribution of hatchery fish in density dependent interactions affecting salmon and steelhead growth and survival in the mainstem Columbia River, the Columbia River estuary, and in the Pacific Ocean.

From the scientific literature, the general conclusion is that the influence of density dependent interactions on growth and survival is likely small compared with the effects of large scale and regional environmental conditions and while there is evidence that hatchery production, on a scale many times larger than the proposed action, can impact salmon survival in the migration corridor, estuary, and ocean, the degree of impact or level of influence is not yet understood or predictable. Regardless, hatchery production on the scale considered in this opinion is very unlikely to substantially affect salmon survival or recovery in these life stages. NMFS will monitor emerging science and information and will reinitiate Section 7 consultation in the event that new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this consultation (50 CFR 402.16).

2.4.2.5. Factor 5. Research, monitoring, and evaluation that exists because of the hatchery program

Negligible effect on UCR spring Chinook salmon; small negative effect on UCR steelhead - UCR spring Chinook salmon are subjected only to routine fish health monitoring while at WNFH, at CJH (if applicable), and in the acclimation ponds in the Okanogan Basin. In-basin monitoring in the Okanogan Basin will include the use of screw traps, nets, and electrofishing (juveniles), and weirs (adults) to capture, measure, and mark Chinook salmon to evaluate population status and trends throughout the Okanogan basin. Passive PIT-tag arrays also track movement of tagged fish through the basin.

Rather than propose new activities to directly monitor this program, the Proposed Action relies on existing basin-wide monitoring to ensure compliance with this opinion, and inform future decisions regarding how the hatchery program can be adjusted to meet their goals while further reducing impacts on ESA-listed salmon and steelhead. Basin-wide monitoring may include the use of PIT-tag arrays, weirs, electro-fishing, rotary screw traps, seines, hand nets, spawning ground surveys, snorkeling, radio tagging, carcass recovery, and streamside observations. Each sampling method can be used to collect a variety of information, but may be used to observe, capture, mark, or tag both juvenile and adult Chinook salmon and steelhead throughout the basin. In the Okanogan basin, much of the monitoring occurs passively through the use of PIT-tag arrays in various locations in the basin. The arrays detect fish with PIT-tags as they freely pass through an area. This type of monitoring is expected to have little or no measurable effect on Chinook salmon or steelhead. There is a weir on Omak Creek and one proposed on Salmon Creek which are likely to encounter spring Chinook, though there is no way at present to estimate the number of spring Chinook that may be encountered at these weirs. The other active sampling methods listed may have more of an impact, and are discussed below.

Under the ESA, monitoring and evaluation programs for hatchery production are not only necessary for adaptive management purposes but are required to ensure that hatchery programs do not limit the recovery of listed populations. Monitoring and evaluation of hatchery programs are necessary to determine if management actions are adequate to reduce or minimize the impacts of the general effects.

Active sampling methods can adversely impact listed fish, both those targeted for data collection and those taken incidentally. The monitoring described in the proposed action necessary to evaluate impacts on listed populations from hatchery programs has been coordinated with other plans to maximize the data collection while minimizing take of listed fish. Monitoring in the for the program falls into two categories: (1) monitoring directly associated with fish culture (like in-hatchery marking for identification), which focuses more on the immediate effects of culture methods, and (2) monitoring focused on natural areas, which will include post-release performance of the hatchery fish and the effects of the hatchery program on natural production.

The proposed RM&E directly related to fish culture uses well-established (e.g., AHSWG 2008) methods and protocols. Mortality rates of 15% are expected both for the egg-fry and fry-smolt stage. In addition, fish health monitoring, which requires killing sample groups of 60 fish from each release group, is expected to result from the monitoring itself. These rates pose no risk to

the population, as the survival still greatly exceeds that which would be expected in wild population fending for themselves outside of the hatchery setting.

Methodology for RM&E associated with the hatchery program but not directly related to fish culture, both the existing work and that proposed, is varied, but all the methods are well established, and have been applied to Upper Columbia River Chinook salmon before without problems. These include use of PIT-tags, radio or acoustic tags, screw traps, seines, weirs, adult traps, genetic analysis of small tissue samples, and elemental analysis of otoliths.

Outside of the hatchery, the primary effect of the proposed RM&E activities on listed species is to capture, handle, and release fish, which may be harmed or killed in the process. Stress and other sub-lethal effects are difficult to assess in terms of their impact on individuals, and even more difficult to apply an impact level to the entire species because the effects can be mall or unknown. The following subsections describe the types of activities being proposed. Each is described in terms broad enough to apply to the permit and indirect take statement (Section 2.8).

The proposed action will include the capturing and handling of juvenile spring Chinook salmon and steelhead during the operation of screw traps in the Okanogan River. Adult salmon and steelhead are also monitored at Wells Dam. The effect of the monitoring on natural-origin adults in these locations is related to broodstock collection, and thus was addressed in Section 2.4.1.2 above. Steelhead adults and juveniles may also be subject to observation/harassment during spring Chinook spawning ground and carcass surveys.

2.4.2.5.1. Observing/Harassing

For some parts of the proposed studies, listed fish would be observed in-water (e.g., by snorkel surveys wading instream, or by observing from the banks of the stream) in spawning ground surveys or juvenile sampling. Direct observation is the least disruptive method for determining a species' presence/absence and estimating their relative numbers. Its effects are also generally the shortest-lived and least harmful of the research activities discussed in this section because a cautious observer can effectively obtain data while only slightly disrupting the fishes' behavior. Fry and juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge in deeper water, or behind/ under rocks or vegetation. In extreme cases, some individuals may leave a particular pool or habitat type and then return when observers leave the area. At times, the research involves observing adult fish, which are more sensitive to disturbance. During some of the research activities discussed below, redds may be visually inspected, but would not be walked on. Harassment is the primary form of take associated with these observation activities, and few if any injuries (and no deaths) are expected to occur particularly in cases where the researchers observe from the stream banks rather than in the water. There is little a researcher can do to decrease these small effects except to avoid disturbing sediments and gravels, and, to the extent possible, avoid disturbing the fish. Disturbed fish should be allowed the time they need to reach cover. Fish that are displaced are expected to return unharmed in a short amount of time, and therefore spawning ground surveys are not expected to result in any measurable lethal or sub-lethal effects either on Okanogan steelhead.

Spawning ground surveys will be conducted annually to determine spawning density, and proportion of hatchery-origin fish in the wild, which is critical to monitoring program performance. Dead or moribund fish may be encountered or handled during spawning ground surveys to inspect carcasses and/or take biological samples. Because these fish are already dead or moribund, NMFS does not consider this an impact.

Capturing/handling

Any physical handling or psychological disturbance is known to be stressful to fish (Sharpe et al. 1998). Primary contributing factors to stress and death from handling are excessive doses of anesthetic, differences in water temperatures (between the river and holding vessel), dissolved oxygen conditions, the amount of time fish are held out of the water, and physical trauma. Stress increases rapidly if the water temperature exceeds 18ºC or dissolved oxygen is below saturation. Fish transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps if the traps are not emptied regularly. Decreased survival can result from high stress levels because stress can be immediately debilitating, and may also increase the potential for vulnerability to subsequent challenges (Sharpe et al. 1998). Debris buildup at traps can also kill or injure fish if the traps are not monitored and cleared regularly. The operators have committed to follow guidelines for handling to minimize these effects, and based on experience, and the description included in the Proposed Action, NMFS anticipates that mortality will be less than 2% of fish handled, for Okanogan steelhead.

2.4.2.5.2. Fin clipping

Fin clipping can involve part or all of one or more fins. When entire fins are removed, it is expected that they will never grow back. A permanent mark can also be made when the fin end or a few fin rays are clipped. Marks can also be made by punching holes or cutting notches in fins, severing individual fin rays (Welch and Mills 1981), or removing single prominent fin rays (Kohlhorst 1979). Although researchers have used all fins for marking, the current preference is to clip the adipose, pelvic, or pectoral fins. Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat varied; however, it can be said that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (e.g., Brynildson and Brynildson 1967). Moreover, wounds caused by fin clipping usually heal quickly especially those caused by partial clips.

Mortality among fin-clipped fish is also variable. Mortality may occur during the marking process, especially if fish have been handled extensively. The degree of mortality also depends on which fin is clipped. Recovery rates are generally higher for adipose- and pelvic-fin-clipped fish than for those that have pectoral, dorsal, or anal fin clipped (Nicola and Cordone 1973), probably because the adipose and pelvic fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Adipose- and pelvic-fin-clipped coho salmon fingerlings can have as high as a 100% recovery rate (Stolte 1973). RM&E activities in the proposed action include clipping the adipose fin on a large proportion of the juvenile fish released and in some cases a small portion of the caudal fin on adults. In this program, initially 100% of the released

fish will be ad-clipped. Based on experience, NMFS anticipates that mortality from all marking and tagging will be less than 2%.

2.4.2.5.3. Tagging

In addition to fin clipping, passive integrated transponder (PIT)-tagging and coded wire tagging are included in the proposed action: 5000 fish from each release will be PIT-tagged, and 100% will be CWT-tagged. PIT-tags are inserted into the body cavity of the fish just in front of the pelvic girdle. The tagging procedure requires that the fish be captured and extensively handled, so it is critical that researchers ensure that the operations take place in the safest possible manner. In general, tagging needs to take place where there is cold water of high quality, a carefully controlled environment for administering anesthesia, sanitary conditions, quality control checking, and a recovery holding tank.

Most studies have concluded that PIT-tags generally have very little effect on growth, mortality, or behavior. Early studies of PIT-tags showed no long-term effect on growth or survival (e.g., Prentice and Park 1984; Prentice et al. 1987; Rondorf and Miller 1994). More recently, in a study between the tailraces of LGR and McNary Dam (225 km), (Hockersmith et al. 2000) concluded that the performance of yearling Chinook salmon was not adversely affected by gastrically - or surgically implanted sham radio tags or PIT-tags. However, (Knudsen et al. 2009) found that over several brood years, PIT-tag induced smolt-adult mortality in Yakima spring Chinook salmon averaged 10.3% and was as high as 33.3%.

Coded wire tags (CWTs) are made of magnetized, stainless-steel wire and are injected into the nasal cartilage of a salmon and thus cause little direct tissue damage (Bergman et al. 1968; Bordner et al. 1990). The conditions under which CWTs should be inserted are similar to those required for applying PIT-tags. A major advantage to using CWTs is the fact that they have a negligible effect on the biological condition or response of tagged salmon; however, if the tag is placed too deeply in the snout of a fish, it may kill the fish, reduce its growth, or damage olfactory tissue (Fletcher et al. 1987; Peltz and Miller 1990). This latter effect can create problems for species like salmon because they use olfactory clues to guide their spawning migrations (Morrison and Zajac 1987).

Fish with internal tags often die at higher rates than fish tagged by other means because tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982; Matthews and Reavis 1990; Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance, but at present this is not quantifiable.

CWT-tagging can be expected to result in a loss of up to 2% of the tagged fish, which in this case is 100% of the release. PIT-tagging, assuming the worst-case results, will cause the 2.5% of the release that receive tags to have a 33% survival reduction. Overall tagging will have a small effect, and will provide important information on the performance of the program.

2.4.2.5.4. Summary of RM&E impacts

NMFS has developed general guidelines to reduce impacts when collecting listed adult and juvenile salmonids (NMFS 2000b; NMFS 2008a) that have been incorporated as terms and conditions into Section 10 and Section 7 permits for research and enhancement (e.g., NMFS 2007c). Additional monitoring principles for supplementation programs have been developed by the Ad Hoc Supplementation Work Group (Galbreath et al. 2008)

Though capturing and handling of juveniles salmonids is expected to adversely affect individual fish, in general, incidental mortality of trapping, handling, and tagging for monitoring activities will be small (2% or less). The number of juveniles handled and tagged annually is summarized in Section 2.8.1.The proposed research activities will have no measurable effects on the listed salmonids' habitat. The actions are therefore not likely reduce the ability of that habitat to contribute to their survival and recovery.

2.4.2.6. Factor 6. Construction, operation, and maintenance of facilities that exist because of the hatchery programs

Negligible effect: NMFS also evaluated the construction, operation, and the maintenance of hatchery facilities associated with the hatchery program in the Methow and Okanogan basins and concluded that this factor has a small negative effect on ESA-listed species.

In this section we evaluate how the facilities themselves affect the fish and designated critical habitat. Water intake structures and water withdrawal present another set of potential effects on listed salmonids. Each facility with intakes, pumps and screens has the potential to impact fish, as does the release of effluent. Though rearing for the Okanogan program does not occur at Methow Hatchery, it is included in the summary because it shares a diversion structure and delivery canal with WNFH, and thus contributes to the collective impact of the facilities. Below we consider these potential impacts for each facility. Facility water usage is summarized in Table 18.

Table 18. Water use associated with facilities operated as part of the Proposed Action

Hatchery Facility	Total Facility Water Use (cfs)	Surface Water Used[1] (cfs)	Ground-water Used (cfs)	Water Source and Discharge Location	Proportion of flow (%) Average/Maximum
Methow Fish Hatchery	35	25	10	Methow River/Ground-water	1.7% Avg 5.2% Max
Winthrop National Fish Hatchery	75	50	25	Methow River/Ground-water	3.4% Avg 10.4% Max
TOTAL Methow Withdrawal[1]		**75**		**Methow River**	**5.1% Avg** **15.6% Max**
Tonasket Pond	15	15	0	Okanogan River	1.2% Avg Not used in low flow periods.
Riverside Pond	15.3	15.3	0	Okanogan River	1.2% Avg Not used in low flow periods.
Omak Pond	15.3	15.3	0	Okanogan River	1.2% Avg Not used in low flow periods.
TOTAL Maximum Okanogan Withdrawal[2]		**55.6**		**Okanogan River**	**4.3% Avg** **Not used in low flow**

[1] Both Methow and Winthrop Hatcheries divert water from the Methow River at Foghorn Ditch. Collectively, they can divert 75 cfs.

[2] The total listed here is unlikely to ever occur because Riverside and Omak ponds are used as back-up for Tonasket, and thus all three ponds will likely never be used concurrently for spring Chinook salmon. The total is still listed for reference.

All facilities use surface water diverted from anadromous waters for production, and both Methow hatchery and WNFH supplement with well water. A water permit is required for groundwater withdrawal within Washington, and all hatchery wells used by hatchery facilities supporting the Chinook salmon hatchery programs in the basin are permitted by the Washington State Department of Ecology (WDOE 2014). Unless groundwater withdrawals have been shown to have a direct connection to surface water levels through direct connection of the surface and ground water, it is unlikely that groundwater withdrawals impact any ESA-listed salmonids, unless the water withdrawal is later discharged into surface water. NMFS is not aware of a direct connection between groundwater withdrawals at any of the facilities.

Surface water withdrawals for hatcheries within spawning and rearing areas can diminish stream flow, impede migration, and affect the spawning behavior of listed fish. Water withdrawals may also affect other stream-dwelling organisms that serve as food for juvenile salmonids by reducing the amount of quality habitat and through displacement and physical injury. The risks associated with surface water withdrawals can generally be minimized by ensuring that complying with applicable water right permits is sufficient for the protection of ESA-listed salmonids and their habitat within the action area. A key additional measure is to ensure that intakes meet NMFS screening criteria, which include standards for minimizing entrainment and impingement risk to juvenile salmonids. To prevent these outcomes, water rights issued for regional hatcheries include conditions to prevent salmon migration, rearing, or spawning areas from becoming de-watered. Hatcheries can also be designed to be non-consumptive. That is, water used in the facility can be returned near the point of withdrawn to minimize effects on naturally produced fish and other aquatic fauna. None of the facilities de-water stream reaches. They only divert small proportions of water from the river, that are likely imperceptible to salmon and steelhead rearing or migrating through the project area.

All intake facilities were designed to meet the NMFS screening criteria that were current at the time of construction (NMFS 1995a). Facilities are routinely observed for any signs that screens are not effectively excluding fish from intakes.

The Methow Hatchery uses 25 cfs surface water diverted from the Methow River at Foghorn dam. Like the Methow Hatchery, WNFH also uses water diverted from the Methow River at Foghorn dam. WNFH may use up to 50 cfs of surface water from the Methow River. Because both facilities use water diverted from the same location at the same time, it is important to consider the total impact from both facilities collectively. Collectively the facilities use a maximum of 75 cfs diverted from the Methow River.

The Methow River has a mean annual discharge of 1,592 cfs (USFWS 2012a) and a minimum of 505 cfs in 1977 (USGS 2014). The gauge is just below the confluence with the Chewuch River, and therefore, the flow from the Chewuch should be subtracted from measurements in the Methow at Winthrop, Washington. The Chewuch River has a minimum flow of 24 cfs in 2001, and a median flow of 116 cfs (USGS 2014). Using this information, the Methow River flow at Foghorn Dam would have a minimum of 481 cfs and a median flow of 1,476 cfs. During lowest flow conditions, the Methow Hatchery may use up to 5.2% of the total stream flow, but averages about 1.7% during typical flow conditions. Similarly, WNFH could use up to 10.4% of the flow during extreme low flow conditions, but average about 3.4% during typical flow conditions. Collectively, the hatcheries use 75 cfs from the Methow River, which could be up to 15.6% of the flow in extreme low flow, but averages about 5.1% in normal flow conditions. Because both facilities use well water to supplement, and would likely focus on well water during extreme low flows, the impact would rarely (if ever) impact the Methow flow at the maximum rates. Additionally, the hatcheries will add a small proportion of water to the Methow River through the discharge of used well water.

The distance between the water withdrawal at Foghorn dam and discharge into the Methow River is approximately ½ mile, and all water diverted from these rivers (minus evaporation) would be returned after it circulating through the facility. The potentially impacted segment of the river would be limited to the ½ mile distance between the water intake and discharge

structures. This impact is likely difficult to measure, and habitat available to ESA-listed salmonids would not change perceptibly.

The Foghorn Ditch is cleaned every 3-5 years to remove sediment that deposits there over time. Though sediment is removed from in-water, the upper 300 yards of the ditch which requires cleaning occurs downstream from the intake screens which effectively exclude listed salmonids from entering the work area. Sediment-laden effluent from the site will go through settling ponds at the hatchery, and is ¼ upstream from the point where the ditch returns to the Methow River. As a result, sediment from ditch cleaning is not expected to enter the Methow River where it could impact listed Chinook salmon or steelhead.

Collectively, the hatcheries use 45.6 cfs from the Okanogan River, which averages about 3.5% in of the flow normal flow conditions. Because all three facilities use water during the spring, the impact would rarely impact the Okanogan River flow at 3.5%. Additionally, the facilities return water directly to the Okanogan River just less than 100 feet from the point of withdrawal.

Tonasket pond acclimation site uses 15 cfs surface water diverted from the Okanogan River. The Okanogan River has a mean annual discharge of 1,300 cfs, however the acclimation ponds are used over the winter and during spring, when flows are typically higher. Using this information, the Tonasket pond acclimation site may take up to 1.2%.

Similarly, both Riverside and Omak pond acclimation sites will each divert up to 15.3 cfs (30.6 cfs total) from the Okanogan River, and are acclimation ponds which are used from fall through mid-spring. Using this information, the each pond acclimation site may take up to 1.2%.

Though the Tonasket, Riverside, and Omak acclimation sites all use surface water from the Okanogan River, they will not all be used at the same time for spring Chinook salmon. In most years, only Tonasket pond will be used for spring Chinook, whereas, either Riverside or Omak ponds may be used for spring Chinook salmon as a substitute if Tonasket is not usable. Riverside and Omak will be used separately for summer Chinook (unrelated to the Okanogan program in this Opinion). Overall, the annual impact will be a total withdrawal of up to 15.3 cfs from the Okanogan River during spring flows, and would use less than 1.2% of the flow in most years.

The facilities associated with the Okanogan spring Chinook salmon hatchery program, both fulltime and seasonally-operated, have properly permitted water rights for their water supply systems. The water right for surface water withdrawal stipulates the allowable volume of water that can be withdrawn by the right holder. As discussed above, the volume of water withdrawn under the current water rights permits is not expected to de-water any streams or rivers or reduce the availability of habitat available for ESA-listed anadromous salmonids. Therefore, exercising the currently permitted water rights managed at the hatchery facilities is expected to minimize risks that the hatchery facilities pose to listed salmonids from water withdrawals.

All facilities included in the proposed action, both fulltime and seasonally-operated, have screened intake structures. These structures were designed to meet the 1995 NMFS screening criteria. These criteria ensure that the mesh or slot-size in the screening material and the approach velocity of water toward the intake screening meet standards that reduce the risk of

both entrainment and impingement of listed juvenile salmonids. All of the hatchery facilities listed above are either operated under NPDES permits, or do not need a NPDES permit because rearing levels in the acclimation pond are below permit minimums. Effluents from the facilities are monitored to ensure compliance with permit requirements. Though compliance with NPDES permit conditions is not an assurance that effects will not occur to ESA-listed ESA salmonids, the facilities use the water specifically for the purposes of rearing ESA-listed Chinook salmon, which have a low mortality. This suggests that the impacts of effluent that will be diluted in larger rivers once discharged will have a minimal impact on ESA-listed salmonids in the area. As a result, effluent impacts from facilities will be very small.

2.4.2.7. Factor 7. Fisheries that exist because of the hatchery program

Not Applicable. No fisheries currently exist because of these hatchery programs or are planned during the permit period. Spring Chinook salmon produced by this program will be harvested in mainstem Columbia River fisheries targeting spring salmon, but these fisheries have been evaluated and authorized in a separate opinion (NMFS 2008c). These fisheries are included in the environmental baseline. The CTCR will implement a tribal fishing season in the Columbia River upstream of the mouth of the Okanogan River to target returning unlisted Chief Joseph Hatchery segregated program Leavenworth stock spring Chinook. NMFS is currently in review of a Tribal Resource Management Plan (TRMP) that will, among other things, provide ESA authorization for incidental take of listed species encountered in this fishery. A sliding scale take limit on natural origin spring Chinook is proposed within the TRMP, which would limit the take of natural origin spring Chinook from one to nine percent. Take levels of listed hatchery origin fish in that fishery would also vary depending on escapement to the Methow and a sliding scale of pHOS objectives. Encounter rate is expected to be very low and the take limit thresholds for listed natural and hatchery origin spring Chinook via the TRMP are expected to provide adequate protection for stray Okanogan 10(j) fish. Effects of this proposed fisheries targeting Okanogan spring Chinook will be evaluated in a separate biological opinion, which will include, as appropriate, reanalysis of the Okanogan spring Chinook hatchery program.

2.4.2.8. Effects of the Action on Critical Habitat

Negligible effect: This consultation analyzed the Proposed Action for its effects on designated critical habitat and has determined that operation of the hatchery programs will have a negligible effect on PCEs in the action area, and may have an overall beneficial effect in the Okanogan River Basin.

The beneficial effects on critical habitat in the Okanogan River are from the introduction of marine-derived nutrients from the carcasses of hatchery spawners and from conditioning of spawning gravel by hatchery spawners. As described in Section 2.4.1.2, salmon carcasses provide a direct food source for juvenile salmonids and other fish, aquatic invertebrates, and terrestrial animals, and their decomposition supplies nutrients that may increase primary and secondary production. These marine-derived nutrients can increase the growth and survival of the ESA-listed species by affecting PCEs associated with juvenile rearing such as increasing forage species (i.e., aquatic and terrestrial insects), aquatic vegetation, and riparian vegetation to name a few.

Habitat features likely affected in the Okanogan River would be freshwater spawning and rearing habitat water quantity and water quality associated with water withdrawals and effluent return. Existing hatchery facilities have not led to altered channel morphology and stability, reduced and degraded floodplain connectivity, excessive sediment input, or the loss of habitat diversity.

Proposed surface water diversions for rearing juvenile fish in the hatchery and the return of that water to the originating stream, will not affect the spatial distribution of adult or juvenile ESA protected spring Chinook salmon or steelhead. The proposed hatchery programs include strict criteria for diverting water from the river and will not have any discernible effect or result in any adverse modification to critical habitat concerning freshwater spawning, rearing, and migration conditions.

Hatchery diversion screens protect juvenile fish from entrainment and injury and satisfy NMFS screen criteria (NMFS 1995; NMFS 1996; NMFS 2011a). Operation of the facility is not expected to degrade water quality. All hatchery facilities have current NPDES permits, and effluent would be monitored to ensure compliance with permit requirements.

Operation and maintenance activities would include pump maintenance, debris removal from intake and outfall structures, building maintenance, and ground maintenance. These activities would not be expected to degrade water quality or adversely modify designated critical habitat, because they would occur infrequently, and only result in minor temporary effects.

Non-routine maintenance (e.g., construction of facilities or reconstruction of in-river hatchery structures) is not considered in this opinion and would require separate consultation.

2.5. 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). For the purpose of this analysis, the action area is that part of the Columbia River Basin described in the Section 1.4. To the extent ongoing activities have occurred in the past and are currently occurring, their effects are included in the environmental baseline (whether they are federal, state, tribal, or private). To the extent those same activities are reasonably certain to occur in the future (and are tribal, state, or private), their future effects are included in the cumulative effects analysis. This is the case even if the ongoing, tribal, state, or private activities may become the subject of Section 10(a)(1)(B) incidental take permits in the future. The effects of such activities are treated as cumulative effects unless and until an opinion has been issued.

A full discussion of cumulative effects can be found in the FCRPS opinion (NMFS 2008b), many of which are relevant to this discussion and incorporated by reference.

State, tribal, and local governments have developed plans and initiatives to benefit listed species and these plans must be implemented and sustained in a comprehensive manner for NMFS to consider them "reasonably foreseeable" in its analysis of cumulative effects. The Federally approved Recovery Plan for UCR Spring Chinook Salmon and steelhead (UCSRB 2007) is such a plan and it describes, in detail, the on-going and proposed Federal, state, tribal and local

government actions that are targeted to reduce known threats to ESA-listed UCR spring Chinook salmon in the Methow River, and steelhead in the Methow and Okanogan Rivers. It is acknowledged, however, that such future state, tribal, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives, and land use and other types of permits and that government actions are subject to political, legislative and fiscal uncertainties and is also incorporated by reference.

2.6. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the benefits and risks posed to ESA-listed species and critical habitat as a result of implementing the Proposed Action. In this section, NMFS add the effects of the Proposed Action (Section 2.4.2) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5) to formulate the agency's opinion as to whether the Proposed Action is likely to: (1) result in appreciable reductions in the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat. This assessment is made in full consideration of the status of the species and critical habitat and the status and role of the affected populations in recovery (Sections 2.2.1, 2.2.2, and 2.2.3).

In assessing the overall risk of the Proposed Action on each species, NMFS considers the benefits and risks of each factor discussed in Section 2.4.2, above, in combination, considering their potential additive effects with each other and with other actions in the area (environmental baseline and cumulative effects). This combination serves to translate the positive and negative effects posed by the Proposed Action into a determination as to whether the Proposed Action as a whole would appreciably reduce the likelihood of survival and recovery of the ESA-listed species and their designated critical habitat. To do this, NMFS considers how all of the effects impact individuals within the different populations and how these impacts on individuals affect the VSP parameters for those populations. If there are changes to the VSP parameters from the Proposed Action, NMFS then determines whether the changes in VSP parameters affects the overall status of the population, and then determines if the resulting change in the overall status of the population affects the likelihood of survival and recovery of the entire ESA-listed ESU/DPS (i.e., the species). Similarly, NMFS considers how all these impacts affect critical habitat in the Action Area and whether these impacts adversely modify the habitat such that the status of the ESA-listed population is affected.

2.6.1. UCR Spring Chinook Salmon

Best available information indicates that the species, in this case the UCR Chinook Salmon ESU, is at risk and remains at endangered status (Ford 2011). The Environmental Baseline (Section 2.3) evaluated whether changes to factors affecting the VSP parameters had changed over the period from 2004-2005 to the present (information not available to Ford (2011)), and determined that overall, the new information considered did not indicate a change in the biological risk category since the time of the last BRT status review (Figure 3).

The Okanogan program will at no cost to Methow spring Chinook salmon provide a net benefit to the UCR spring Chinook salmon ESU by extending its range through creation of an

nonessential experimental spring Chinook salmon in a contiguous basin outside the geographical range of the ESU.

Hatchery programs all pose risk as well as benefits to the species they culture. This is not a concern in the Okanogan program because of the protective terms of the 10(j) rule. Although to this point discussed as seven factors, the risk factors fall into three groups: risks posed by the facilities, directly (such as trapping) or indirectly (such as water withdrawal); RM&E; and biological interactions with the natural spring Chinook salmon population. In Section 2.4.2 we analyzed these risks for each program, and in Section 2.5 we considered cumulative effects as well. We concluded that facility effects were negligible for hatchery operations and small for trapping. These are both essential activities, and given the importance of the programs to restoration of the Okanogan spring Chinook salmon population, the risk from facilities poses a negligible threat to the ESU.

The proposed hatchery program will also contribute to marine-derived nutrient input in the Okanogan River Basins at levels beneficial to spring Chinook salmon by increasing the number of naturally-spawning salmonid carcasses, and through distribution of hatchery carcasses. Decaying carcasses of spawned adult hatchery-origin fish would contribute nutrients that increase productivity in watershed areas, enhancing food resources for naturally-produced spring Chinook salmon. The programs can also be expected to improve the condition of spawning gravel (Montgomery et al. 1996).

Added to the Environmental Baseline and effects of the Proposed Action are the effects of future state, private, or tribal activities, not involving Federal activities, within the action area. To the extent those same activities are reasonably certain to occur in the future, their future effects are included in the cumulative effects analysis. The Federally approved Recovery Plan for UCR Spring Chinook Salmon and steelhead (UCSRB 2007) describes, in detail, the on-going and proposed state, tribal and local government actions that are targeted to reduce known threats to ESA-listed UCR spring Chinook salmon in the Methow Basin.

In summary, the analysis above has considered recovery planning documents and the potential effects of the proposed propagation programs on the listed Methow River spring Chinook salmon populations, combined with other ongoing activities within the action area, and determined that the proposed hatchery programs would not appreciably reduce the likelihood of survival and recovery in the wild by reducing the reproduction, number, or distribution of the UCR spring Chinook salmon ESU or the Methow population component of the ESU. In fact, the Proposed Action is likely to benefit the Methow spring Chinook salmon by diverting 200,000 fish from the WNFH spring Chinook salmon program from the Methow to the Okanogan Basin, reducing the risk from large numbers of hatchery fish on the spawning grounds. Most importantly, however, the program reduces risk to the ESU by reintroducing spring Chinook salmon to the Okanogan Basin. In addition, the program is consistent with the UCR recovery plan (UCSRB 2007). The Proposed Action is thus a net benefit to the UCR spring Chinook salmon ESU.

2.6.2. UCR Steelhead

Best available information indicates that the species, in this case the UCR Steelhead DPS, is at risk and remains at threatened status (Ford 2011). Ford (2011) determined that the ESU is

currently at very high risk of extinction. The Environmental Baseline (Section 2.3) evaluated whether changes to factors affecting the VSP parameters had changed over the period from 2004-2005 to the present (information not available to Ford (2011)), and determined that overall, the new information considered did not indicate a change in the biological risk category since the time of the last BRT status review.

As set out in the Environmental Baseline (Section 2.3), habitat conditions in the action area may have a negative effect on ESA-listed summer steelhead in the Methow and Okanogan Basins. Although land and water management activities have improved, factors such as dams, diversions, roads and railways, agriculture (including livestock grazing), residential development, and historic forest management continue to threaten UCR steelhead (UCSRB 2007). The Methow and Okanogan steelhead populations may be adversely affected by climate change.

NMFS analyzes seven factors to determine the effects of a hatchery program on ESA-listed species and on designated critical habitat (Section 2.4). The project proponents have applied for ESA 10(a)(1)(A) permits to enhance the status of ESA-listed UCR spring Chinook salmon and all factors considered, the proposed supportive breeding programs are expected to have negligible effects on ESA-listed UCR summer steelhead (see Section 2.4.2.).

After taking into account the current critically depressed viability status of the species, the Environmental baseline, the benefits and risks of the proposed hatchery programs, and pertinent cumulative effects, NMFS concluded (Section 2.6.1) that the Okanogan program will have negligible impacts to Methow and Okanogan steelhead.

While directly benefiting the species they culture (the target species), hatchery programs may pose risk to other species (nontarget species). The Okanogan spring Chinook salmon hatchery program may affect ESA-listed steelhead in both the Methow and Okanogan Basins. Although to this point discussed as seven factors, the risk factors fall into three groups: risks posed by the facilities, directly (such as trapping) or indirectly (such as water withdrawal); RM&E; and biological interactions with the natural spring Chinook salmon population. In Section 2.4.2 we analyzed these risks for each program, and in Section 2.5 we considered cumulative effects as well. We concluded that facility effects on steelhead were negligible for hatchery operations and small for trapping. These are both essential activities for the spring Chinook salmon program, and we find that they pose a negligible threat to the Methow and Okanogan steelhead populations. This is especially true of the Okanogan program because it does not involve in-basin broodstock collection.

The same is true of RM&E activities. The activities capture and possibly delay fish, on occasion kill a small number of fish, but the effect is small. Given the essential nature of the RM&E activities in terms of making sure the programs comply with best management practices, providing information on population status, providing information on the performance of the hatchery programs and their interactions with the natural population, and through all these activities combining with RM&E programs elsewhere to provide much needed information on how to use hatchery programs in attempting to reduce extinction risk and promote recovery of target species while not disadvantaging target species, the risk is negligible.

This leaves the area of highest visibility, the biological interactions of the hatchery programs with the natural steelhead population. Our analysis shows that the ecological impact of the hatchery releases themselves, based on the most up to date interactions modelling available, is small, less than 1%, in the Okanogan Basin. This poses no threat to the steelhead population. Spawning of steelhead and spring Chinook salmon also do not overlap temporally. The situation with naturally produced progeny of hatchery-origin adults is more complex, and illustrates well one of the seeming contradictions in putting hatchery fish on the spawning ground to increase the population size, yet having concerns about the risks of doing that. There is no genetic risk in this case because spring Chinook salmon and steelhead do not interbreed, but ecological risks due to increased abundance of spring Chinook salmon juveniles is possible. Although this is identical to the situation that would occur with increased natural production of spring Chinook salmon without any hatchery production, this is a concern in the Okanogan Basin. Historically the two species co-occurred in both basins, and ecological interaction modelers (Mackey et al. 2014) assume a high degree of habitat segregation between the two species, but in depressed habitat conditions, it cannot be assumed that increased abundance of one species caused by a hatchery recovery program will not disadvantage the other. Currently this is not a concern in the Okanogan Basin because there is no spring Chinook salmon population. NMFS does not feel that competition from increased production of spring Chinook salmon juveniles will be a risk during the life of the permits. However, RM&E will be implemented to detect this effect.

The proposed spring Chinook salmon hatchery programs may well benefit steelhead by adding marine-derived nutrients in the Methow and Okanogan River Basins at levels beneficial to spring Chinook salmon by increasing the number of naturally-spawning salmonid carcasses, and through distribution of hatchery carcasses. Decaying carcasses of spawned adult hatchery-origin fish would contribute nutrients that increase productivity in watershed areas, enhancing food resources for naturally-produced spring Chinook salmon. The programs can also be expected to improve the condition of spawning gravel (Montgomery et al. 1996).

Added to the Environmental Baseline and effects of the Proposed Action are the effects of future state, private, or tribal activities, not involving Federal activities, within the action area. To the extent those same activities are reasonably certain to occur in the future, they are included in the cumulative effects analysis. The Federally approved recovery plan for UCR Spring Chinook salmon and steelhead (UCSRB 2007) describes, in detail, the on-going and proposed state, tribal and local government actions that are targeted to reduce known threats to ESA-listed UCR spring Chinook salmon in the Methow Basin.

In summary, the analysis above has considered recovery planning documents and the potential effects of the proposed propagation programs on the listed Methow and Entiat River spring Chinook salmon populations, combined with other ongoing activities within the action area, and determined that the proposed hatchery programs would not appreciably reduce the likelihood of survival and recovery in the wild by reducing the reproduction, number, or distribution of the UCR steelhead DPS or the Methow and Okanogan River population components of the DPS. The Proposed Action, in fact, presents less risk to UCR steelhead than the previous spring Chinook salmon hatchery operations.

2.6.3. Critical Habitat

Critical habitat for the ESA-listed species is described in Section 2.2.2 of this opinion. After reviewing the Proposed Action and conducting the effects analysis, NMFS has determined that the Proposed Action will not impair PCEs designated as essential for spawning, rearing, juvenile migration, and adult migration purposes. In reviewing the Proposed Action and after conducting the effects analysis (Section 2.4.2), NMFS has determined that the Proposed Action will not impair PCEs designated as essential for spawning, rearing, juvenile migration, and adult migration purposes.

Operation of the hatchery program is not expected to substantially impact PCEs within the action area. Hatchery facilities are either located high in the floodplain, or are protected by streambank armoring or abutments authorized previously through other ESA consultations (NMFS 2002a; 2004a; 2012b), and have not led to altered channel morphology and stability, reduced and degraded floodplain connectivity, excessive sediment, or the loss of habitat diversity. Effects on water quantity and water quality are negligible.

The hatchery facilities are designed and will be used such that they would not reduce access to spawning and rearing habitat, or increase water temperatures. Potential impacts on critical habitat evaluated for UCR spring Chinook and summer steelhead were limited to competition for freshwater spawning sites from hatchery-origin adults and their progeny, and competition for freshwater rearing sites from juvenile fish released from the programs and the progeny of naturally-spawning hatchery-origin adults. However, the design of the hatchery programs will limit co-occurrence of hatchery and natural-origin fish, and the programs will be operating at a time when critical habitat will benefit from the recolonization of spring Chinook salmon habitat above UCR hydropower facilities. Therefore, any impacts on critical habitat from competition and predation will be minimized in significance by this expansion in spatial distribution and the benefits it provides to spring Chinook salmon survival and recovery.

The hatchery water diversion and the discharge have a negligible effect on designated critical habitat in the action area (Section 0). Existing hatchery facilities have not contributed to altered channel morphology and stability, reduced and degraded floodplain connectivity, excessive sediment input, or the loss of habitat diversity and no new facilities or changes to existing facilities are proposed. The Proposed Action includes strict criteria for diverting water from the river that would not impair PCEs.

The Methow River spring Chinook salmon population and Okanogan River steelhead population are affected by a variety of factors. Spawning and rearing habitats are commonly impaired by factors such as agricultural tilling, water withdrawals, sediment from unpaved roads, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. The proposed hatchery program would not impact these habitat factors. Interactions between ESA-listed hatchery-origin and natural-origin spring Chinook salmon and steelhead would be monitored. None of these factors will be affected in a measureable way by the Proposed Action.

In reviewing the Proposed Action and the effects analysis NMFS has determined that the proposed hatchery program will not impact habitat designated as essential for spawning, rearing, juvenile migration, and adult migration in the action area.

2.6.4. Climate Change

Upper Columbia spring Chinook salmon and steelhead may be adversely affected by climate change (see Section 2.2.3). A decrease in winter snow pack would be expected to reduce spring and summer flows and increase water temperatures throughout the Methow and Okanogan Basins.

2.7. Conclusion

After reviewing the current status of the listed species, the environmental baseline within the Action Area, the effects of the Proposed Action, including effects of the Proposed Action that are likely to persist following expiration of the Proposed Action, and cumulative effects, it is NMFS' biological opinion that the Proposed Action is not likely to jeopardize the continued existence of the UCR Spring Chinook Salmon ESU or the UCR Steelhead DPS, or adversely modify designated critical habitat for UCR Chinook salmon and UCR steelhead.

2.8. Incidental Take Statement

Section 9 of the ESA and Federal regulation 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 results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. For purposes of this consultation, we interpret "harass" to mean an intentional or negligent action that has the potential to injure an animal or disrupt its normal behaviors to a point where such behaviors are abandoned or significantly altered. 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.

2.8.1. Amount or Extent of Take

Incidental take of ESA-listed salmon and steelhead will occur as a result of the proposed action from (1) interactions on the spawning grounds; (2) interactions in juvenile rearing areas; and (3) RM&E. The amount and effect of take on ESA-listed salmon and steelhead is detailed in Section 2.4.2. for the majority of the activities where take occurs. Direct take authorized in permit 18928 accounts for the majority of take associated with the proposed action; however, NMFS also anticipates incidental take to occur, and is described below. Here, as in the effects analysis, the material is organized according to the seven factors for each of the two listed species. Take that needs to be discussed occurs under three of the factors: 2, 3, and 5.

2.8.1.1. Hatchery fish and the progeny of naturally spawning hatchery fish on spawning grounds and encounters with natural-origin and hatchery fish at adult collection facilities (Factor 2)

During broodstock collection for this program, the operators will annually handle up to 755 adult natural-origin, and up to 10,414 hatchery-origin UCR Chinook salmon Table 22), of which only a small percentage will be removed for broodstock or die from handling and release. Overall incidental mortality (fish not collected for broodstock) of natural-origin UCR Chinook salmon will be 2% (up to 21 adult salmon) or less[23].

Table 19. UCR Chinook handling and mortality associated with broodstock collection at facilities for the Proposed Action.

Collection Location	Maximum Naturual Handled (2% mortality)	Maximum Hatchery Handled (2% mortality)	Maximum Naturual Collection	Maximum Hatchery Collection (goal)
Methow Hatchery Ladder	Typically less than 100 2 Mortalities	Up to 100% of run (typically less than 1,050) Up to 100% of total handled may be removed, killed, or transported for adult management as described in the HGMP. Broodstock may be collected for Winthrop Program	N/A[a]	Up to 36[a]
Wells Dam East and West Fishways	Up to 33% of run (typically less than 605) 13 Mortalities	Up to 33% of run (typically less than 3,016) Up to 100% of total handled may be removed, killed, or transported for adult management as described in the HGMP.	N/A[a]	Up to 120[b]
WNFH Ladder	Typically less than 10) 2 Mortalities	Up to 33% of run (typically less than 6,348) Up to 100% of total handled may be removed, killed, or transported for adult management as	N/A[a]	Up to 120[b]

[23] As identified above, the Okanogan program uses about 30% of the pooled broodstock collected form the WNFH program. Though the Okanogan broodstock is likely to be collected almost entirely at the WNFH ladder, the WNFH program does use broodstock collected at Methow Hatchery and Wells Dam when needed. Because broodstock are collected throughout the run, and the Okanogan program will just use any available fish from the total pool of broodstock, it is not possible to designate a particular fraction as "Okanogan" fish. Therefore, the total potential handling is included for Methow Hatchery and Wells Dam, even though the relative proportion directly related to the Okanogan program would be smaller.

Collection Location	Maximum Naturual Handled (2% mortality)	Maximum Hatchery Handled (2% mortality)	Maximum Naturual Collection	Maximum Hatchery Collection (goal)
Methow Hatchery Ladder	Typically less than 100 2 Mortalities	Up to 100% of run (typically less than 1,050) Up to 100% of total handled may be removed, killed, or transported for adult management as described in the HGMP. Broodstock may be collected for Winthrop Program	N/A[a]	Up to 36[a]
		described in the HGMP.		

a. If Methow Composite stock are used for WNFH (and thus Okanogan) brood, only 30% of the 120 total broodstock needs (36 adults) would be for Okanogan production.

b. Total collection for Wintrhop is 400 adults (360 spawned), with a hope to collect no more than 30% from Methow Hatchery. Of those, up to 120 will be used from Okanogan production

Like Chinook salmon, adult handling and passage of steelhead will occur in the course of collecting hatchery broodstock at WNFH, Methow Hatchery, and Wells Dam. During collection, the operators will annually handle of up to 298 adult natural-origin and 1,365 hatchery-origin UCR steelhead (Table 20). Overall incidental mortality of natural-origin UCR steelhead will be 2% or less (up to 11 adult steelhead) or less annually for all programs combined.

Table 20. UCR steelhead handling and mortality associated with broodstock collection at facilities for the Proposed Action.

Collection Location	Maximum Natur al Handled (2% mortality)	Maximum Hatchery Handled (2% mortality)
Methow Hatchery	Typically less than 10 2 Mortalities	Typically less than 10) 2 Mortalities
Wells Dam	Up to 6% of the run (typically less than 238) 5 Mortalities	Up to 6% of the run (typically less than 1,282) 26 Mortalities
WNFH	Typically less than 10 2 Mortalities	Typically less than 10 2 Mortalities

2.8.1.2. Hatchery fish and the progeny of naturally spawning hatchery fish in juvenile rearing areas (Factor 3)

Release of spring Chinook salmon into the Okanogan may cause competition with steelhead juveniles. Direct measurement of the take of ESA-listed natural-origin juvenile salmon and steelhead through interactions with juvenile hatchery fish is very difficult. Predation can be measured directly at great expense and logistical difficulty, but our analysis (Section 2.4.2.2.1) shows that predation on naturally produced spring Chinook salmon and steelhead by released hatchery spring Chinook salmon will be negligible. Low levels of competition for food or space are possible, however. It is not possible to quantify the take associated with interactions in rearing areas, because it is not possible to meaningfully measure the number of interactions nor their precise effects. The ecological interactions modelling in Section 2.4.2.3.1 depends a great deal on residence time in the basins of released hatchery fish. Therefore NMFS will rely on a surrogate take indicator that relates to the proportion of hatchery fish in the rearing areas after release. Unlike many rivers, direct observation of hatchery fish not migrating immediately after release is not possible in the Okanogan due to stream turbidity at the time of release. However, migrational behavior can be inferred from PIT-tag detections within the Okanogan Basin and at dams downstream in the Columbia.

The extent of take from interactions between hatchery and natural-origin juvenile salmonids in rearing areas of the Okanogan Basin shall therefore be estimated from the following surrogate: the estimated proportion of the release remaining in the lower Okanogan Basin shall not exceed 1% on or after the 21st day following an en masse hatchery release, or the 21st day after the expected median date of migration from facilities allowing volitional migration. This is a reasonable, reliable and measurable surrogate for incidental take. The co-occurrence of hatchery and natural origin juvenile salmonids is a necessary element of potential take; if the populations do not overlap in the basin, then take by predation is not possible. The 1% threshold is suitably low to limit the amount of predation occurring, but is also a large enough number to encompass the expected potential take and to signal that our expectations are not being met. As discussed above, NMFS expects the ecological effects to be less than 1%, meaning less than 1% of natural-origin steelhead will suffer competition effects as a result of hatchery fish. As discussed above, hatchery releases are expected to exit the system fairly quickly and not linger in the Okanogan basin beyond a few days. This is an element of our assessment of effects concluding that predation and competition effects will be limited. If 1% or more are remaining in the river past 21 days, it is a sign that fish are not exiting the basin as quickly as expected. Finally, this threshold is measurable by observations at PIT-tag detectors in the lower Okanogan River and at downstream mainstem dams such as McNary. Based on experience with previous releases of fish in the basin, a “slow” migration pattern will be observable from the pattern of detections over time.

There may also be take of Okanogan steelhead due to competition with increased densities of NEP juvenile spring Chinook salmon, as the NEP increases natural production, although NMFS considers non-negligible take to be unlikely during the term of the permit. Again, because of the lack of ability to measure this in the field, surrogate variables will be used, based on one developed for the Mid-Columbia coho salmon restoration program. Details will be developed by the applicants (see Section 2.8.4), but essentially the approach will be to do a regression analysis

of steelhead abundance and size on the number of natural-origin NEP juveniles. A statistically significant negative regression will be considered exceedance of take.

2.8.1.3. RM&E that exists because of the hatchery program (Factor 5)

Once NEP fish begin returning spawning ground surveys will be conducted annually to determine the number and location of spawning adults. During these surveys, fish may be temporarily displaced as they attempt to avoid human activity in or near the water. However, NMFS believes little or no take of adult steelhead will occur due to Chinook salmon spawning ground surveys because adults are unlikely to be present during that time. Juvenile steelhead may be temporarily displaced through a fright response, though this take is expected to be of short duration, and is expected to result in no mortalities.

2.8.2. Effect of the Take

In Section 2.7, NMFS concluded that the level of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of the UCR Spring Chinook ESU or the UCR Steelhead DPS, or adversely modify their designated critical habitat.

2.8.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures to minimize 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(a)(2) to apply. NMFS may amend the provisions of this incidental take statement after giving the funders and operators reasonable notice of the amendment.

NMFS concludes that the following reasonable and prudent measures are necessary and appropriate to minimize incidental take. This opinion requires that:

1. The Permit Holders implement the hatchery programs as described in the submitted HGMPs (USFWS 2012a; CTCR 2013).

2. The Permit Holders follow criteria and guidelines specified in this opinion for their respective hatchery facilities, including associated trapping protocols.

3. The Permit Holders follow criteria and guidelines specified in this opinion for their respective monitoring and evaluation activities within the Okanogan Basin.

4. The Permit Holders provide regular annual reports to the Anadromous Production and Inland Fisheries Program (APIF) of the NMFS Sustainable Fisheries Division annually for the Okanogan spring Chinook salmon program, including RM&E activities.

5. The Permit Holders comply with all permit requirements.

2.8.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and the Action Agencies must comply with them in order to implement the reasonable and prudent measures (50 CFR 402.14). The Action Agencies 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 incidental take statement (50 CFR 402.14). If the following terms and conditions are not complied with, the protective coverage of Section 7(o)(2) will lapse. Terms and conditions are outlined by hatchery program below. This opinion requires the Action Agencies to ensure that the Permit Holders and their agents:

1a. Implement the hatchery programs as described in the submitted HGMPs (USFWS 2012a; CTCR 2013), NMFS must be notified, in advance, of any change in implementation of hatchery program operation and implementation or monitoring activities that potentially would result in increased incidental take of ESA-listed species.

1b. Submit annual operation plans for the Okanogan River spring Chinook salmon hatchery programs to NMFS that are consistent with the terms and conditions within this incidental take statement and designed consistent with information on program performance provided by monitoring data.

2a. Monitor the incidence of, and minimize capture, holding, and handling effects on listed species. During broodstock trapping operations and RM&E activities, the mortality of intentionally and incidentally handled ESA-listed steelhead must not exceed levels identified in Section 2.8.1.2. Traps and/or weirs will be operated as proposed in the annual operation plans.

2b Carefully handle and immediately release upstream all trapped adult and juvenile steelhead.

2c ESA-listed juvenile fish must not be handled if the water temperature exceeds 21°C (69.8°F) at the capture site. The trap operation shall cease pending further consultation with NMFS to determine if continued trap operation poses substantial risk to ESA-listed species. Under these conditions, ESA-listed fish may only be identified and counted.

2d Should NMFS determine that a permitted handling procedure provided for is no longer acceptable the Permit Holders must immediately cease such activity until an acceptable substitute procedure is identified and approved by NMFS.

3a Monitor the performance of NEP releases in terms of survival rates and straying. Adaptively manage hatchery release strategies to improve homing fidelity of adult returns and minimize interactions with listed steelhead.

3b Monitor the abundance, distribution, and hatchery/natural composition of NEP spawners.

3c Once natural production of the NEP begins, permit holders will develop, subject to NMFS approval, a method for evaluating the effects of competition between juvenile spring Chinook salmon and steelhead. One approach would be regression analysis, considering the abundance and size of steelhead smolts as the dependent variable and abundance of natural-origin NEP smolts as the independent variable, correcting for as many environmental "noise" variables as possible to avoid a false signal. A negative regression coefficient with a p-value of 0.1 or less would be considered evidence of statistically significant competitive interactions, and therefore exceedance of take.

3d ESA-listed fish must be handled with extreme care and kept in water to the maximum extent possible during sampling and processing procedures. Adequate circulation and replenishment of water in holding units is required. When using methods that capture a mix of species, ESA-listed fish must be processed first. The transfer of ESA-listed fish must be conducted using equipment that adequately holds water during transfer.

3e Each ESA-listed fish handled out-of-water for the purpose of recording biological information must be anesthetized. Anesthetized fish must be allowed to recover (e.g., in a recovery tank) before being released. Fish that are simply counted must remain in water but do not need to be anesthetized.

3f Note all mortalities observed of listed fish during monitoring activities, regardless of whether the mortalities can be attributed to those activities.

3g The permit holders may collect and possess tissue samples from unlimited fish carcasses collected during spawning ground surveys.

3h Visual observation protocols must be used instead of intrusive sampling methods whenever possible. This is especially appropriate when merely ascertaining the presence of anadromous fish.

4a A program annual report must be submitted to NMFS. This can be the same report as the one submitted to BPA, and on that schedule, but it must contain data on the monitoring elements listed above, as well as take levels

4b All reports, as well as all other notifications required in the permits, be submitted to NMFS at:
Anadromous Production and Inland Fisheries Program
NMFS - Sustainable Fisheries Division
National Marine Fisheries Service, Northwest Region
1201 NE Lloyd Blvd, Suite 1100
Portland, Oregon 97232
Phone: (503) 230-5412
Fax: (503) 872-2737

Documents must be submitted electronically. The current point of contact for document submission is Craig Busack (craig.busack@noaa.gov), but this may change during the life of the permits.

5a The Permit Holders, in effectuating the take authorized by this incidental take statement, are considered to have accepted the terms and conditions set forth herein and must be prepared to comply with the provisions of this incidental take statement, the applicable regulations, and the ESA.

5b If the authorized level of take, including mortalities, is exceeded, the Permit Holders must notify the above contact as soon as possible, but no later than two days after, the authorized level of take is exceeded. The Permit Holders must then submit a written report to the above contact describing the circumstances of the unauthorized take within two weeks of take exceedance. Pending review of these circumstances, NMFS may suspend the program activities or amend this permit in order to allow activities to continue.

5c Permit holders must allow any authorized NMFS employee or representative to inspect any records or facilities related to hatchery program monitoring, evaluation, and research activities.

5d NMFS may revoke the incidental take statement if the authorized activities are not conducted in compliance with the statement and the requirements of the ESA or if NMFS determines that its ESA Section 10(d) findings are no longer valid.

5e APIF may amend the provisions of this incidental take statement after reasonable notice to the Permit Holders.

5f 50 CFR Section 222.23(d)(8) allows NMFS to charge a reasonable fee to cover the costs of issuing the permits under the ESA. The fee for these permits has been waived.

5g Any falsification of annual reports or records pertaining to this incidental take statement is a violation of this incidental take statement.

2.9. 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 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 (50 CFR 402.02). NMFS has identified one conservation recommendation appropriate to the proposed action:

1. The operators, in cooperation with the NMFS and other entities, should continue to investigate the level and impact of ecological interactions, and factors contributing to ecological interactions such as habitat partitioning, as they develop, between the spring Chinook salmon NEP and listed steelhead in an effort to improve understanding of ecological interactions between listed salmonid species within the Upper Columbia Basin.

2.10. Reinitiation of Consultation

As provided in 50 CFR 402.16, 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 take 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 to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In addition, reinitiation is required if implementation of the Proposed Action is continued beyond December 31, 2024.

Among other considerations, NMFS may reinitiate consultation if there is significant new information indicating that impacts on ESA-listed species, beyond those considered in this opinion, are occurring from the operation of the proposed hatchery programs, including the operation of weirs and traps, and RM&E in support of the hatchery programs, or if the specific RM&E activities listed in the terms and conditions are not implemented.

If the amount or extent of take considered in this opinion is exceeded, NMFS may reinitiate consultation. SFD will consult with the operators to determine specific actions and measures that can be implemented to address the take or implement further analysis of the impacts on listed species. If the amount and extent of take cannot be reduced to levels considered in this opinion, NMFS will reinitiate consultation.

2.11. Conference Report on Okanogan NEP Spring Chinook Salmon

The Okanogan spring Chinook salmon Non-essential Experimental Population was designated in 79 FR 40004 on July 11, 2014. The fish have NEP status when they are within the Okanogan NEP area, which is defined as the mainstem Okanogan River and all its tributaries between the US-Canadian border and the confluence of the Okanogan with the Columbia River. While spring Chinook salmon are found in this area, they are considered to belong to the NEP, not the UCR

spring Chinook ESU. For clarity's sake, hatchery facilities connected to streams in the Okanogan NEP area, such as Omak, Riverside and Tonasket ponds, are considered to be included within the Okanogan NEP area. Therefore, when spring Chinook are released into these ponds and other hatchery facilities in the basin, they are considered part of the NEP.

2.11.1. Okanogan NEP spring Chinook Salmon

The NEP will consist of a *hatchery-origin* component and a *natural-origin* component. The Proposed Action will create the NEP with the first release of hatchery fish in 2015. The NEP will consist solely of hatchery fish until at least 2017, when adult fish from the releases begin to return. These returning hatchery-origin fish will spawn to create the natural-origin component of the NEP. Juvenile natural-origin NEP fish will be present in the NEP area starting in 2018. Natural-origin NEP fish (likely only males) will appear on the spawning grounds in 2020, and natural-origin NEP fish of both sexes will first be present on the Okanogan spawning grounds in 2021. Therefore, the first evidence of successful reproduction of natural-origin NEP fish will be the appearance of juveniles in 2022.

The Proposed Action is obviously a benefit to the NEP in that the NEP will be created by the Proposed Action, but will also be dependent on it, possibly for several years, as a continual source of new spawners, thus protecting the NEP from extinction risk and loss of genetic diversity. The Proposed Action includes best management practices for this activity. The released fish will be of the Methow-Composite hatchery fish, which is the closest available source population to the extirpated Okanogan spring Chinook salmon population. The fish will be acclimated in the Okanogan basin to maximize returns to that basin. Assuming a projected survival rate of 0.3%, an average of 600 fish are expected to return from a release of 200,000, so if full releases are achieved, 6000 hatchery fish may return over the 10-year life of the permit.

As the natural-origin component of the NEP grows in abundance to the point where NEP extinction is no longer a concern, it will be appropriate to consider the relative abundance of the hatchery-origin and natural-origin components of the NEP, as the risks posed by the hatchery program may then begin to offset its benefits. The risk situation at this point would then be the standard set of concerns about supplementation programs: that the domesticating effect of the hatchery environment may be reducing the fitness of natural-origin fish, that competition for space on the spawning grounds between hatchery-origin fish and natural-origin fish may limit success of natural-origin spawners, and that competition for space or food between the progeny of natural-origin and hatchery-origin fish may limit success of natural-origin reproduction. At that point the management response would likely be some form of adult management to limit the numbers of hatchery-origin fish on the spawning grounds. These possibilities are discussed in the HGMP (CTCR 2013), but are unlikely to be a concern during the life of the permit, since as shown above, natural-origin progeny of natural-origin spawners will not be part of the NEP until 2022. The rate at which the natural-origin component of the NEP grows will depend on the ability of the NEP to become adapted to the Okanogan Basin with its challenging set of habitat conditions, and this is unknown at this point, but it seems very unlikely that it could grow to the point by 2024 where hatchery-natural interactions, either ecological or genetic, would be detectable.

There will be small impacts to both components of the NEP through RM&E activities, specifically collection of juveniles at downstream traps, and eventually (starting in 2020) spawning ground surveys. Trapping will affect only a small portion of the juveniles, likely less than 10%, and of these, at most 2% would be expected to die. Spawning ground surveys may momentarily displace some juvenile fish, with no expected mortalities, and will have no impact on adults, because all adult fish will be either dead or moribund (see Section 2.4.2.5.1). These RM&E activities are essential for monitoring the success of the NEP, and provide an overall net benefit.

Impacts to the NEP from facility operations, which will affect only the natural-origin component of the NEP, will be negligible. Screens satisfying NMFS screening criteria (NMFS 1995a) prevent loss of juvenile fish due to entrainment and impingement. Water is treated before return to the river, and facilities have a current NPDES permit. Water withdrawals are not expected to influence the distribution of juveniles in the Okanogan River. Water withdrawals are typically less than 2% of flow.

After conferring on the effects of the proposed action on Okanogan NEP spring Chinook salmon, it is NMFS' opinion that the Proposed Action is not likely to jeopardize the continued existence of the Okanogan NEP spring Chinook salmon.[24]

We provide the following advisory recommendations on ways to avoid or minimize adverse effects on the NEP:

1. Collecting information on this program and other similar programs elsewhere in the region is vital to the development of successful reintroduction programs. The operators, in cooperation with the NMFS and other entities, should evaluate in detail the effectiveness of this program to establish the Okanogan Basin spring Chinook salmon NEP, and monitor not only the status of the NEP, but also the rate at which its productivity and spatial structure expands.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

The consultation requirement of 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 effects include the direct or indirect physical, chemical, or biological alterations 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 EFH, 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.

[24] NMFS makes no determination with respect to potential critical habitat, because the ESA prohibits the designation of critical habitat for NEP populations.

This analysis is based, in part, on descriptions of EFH for Pacific coast salmon (PFMC 2003) 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 is the implementation of a hatchery programs rearing salmonids in the Methow River and releasing them in the Okanogan River, as described in detail in Section 1.3. The action area of the Proposed Action includes habitat described as EFH for Chinook and coho salmon. Because EFH has not been described for steelhead, the analysis is restricted to the effects of the Proposed Action on EFH for Chinook and coho salmon.

The area affected by the proposed action includes portions of the Methow and Okanogan Basins.

As described by PFMC (2003b); (PFMC 2003a):

> "Freshwater EFH for [C]hinook and coho salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and adult holding habitat."

The aspects of EFH that might be affected by the Proposed Action include effects of hatchery operations on ecological interactions and genetic effects on natural-origin Chinook salmon and coho salmon in spawning and rearing areas.

3.2. Adverse Effects on Essential Fish Habitat

The Proposed Action generally does not have effects on the major components of EFH. Spawning and rearing locations and adult holding habitat are not expected to be affected by the operation of the program, as no modifications to these areas would occur, and no structures that would impede migration are included or proposed to be constructed. Potential effects on EFH by the proposed action are only likely to occur in areas where salmon spawn naturally and in the migration corridor in the Okanogan River.

As described in Section 2.4, water withdrawal for hatchery operations can adversely affect salmon by reducing stream flow, impeding migration, or reducing other stream-dwelling organisms that could serve as prey for juvenile salmonids. Water withdrawals can also kill or injure juvenile salmonids through impingement upon inadequately designed intake screens or by entrainment of juvenile fish into the water diversion structures. The proposed hatchery program includes designs to minimize each of these effects. The water supply systems are designed and operated such that groundwater extraction and surface water diversion are not expected to reduce spatial distribution and productivity of the Methow spring Chinook salmon and steelhead populations, and the Okanogan steelhead population. All of the water used by the hatchery programs would be returned to the streams (less any leakage and evaporation) 300 feet or less from the point of diversion.

Criteria for surface water withdrawal are set to avoid impacts on spring Chinook salmon and coho salmon spatial structure. Further, the minimum flows will be maintained to provide for

juvenile and adult migration through the sections of stream from the point of withdrawal to the hatchery outfall and the intake is screened in compliance with NMFS criteria.

The diversion intakes are screened to protect juvenile fish from entrainment and injury and meet NMFS criteria for protecting anadromous salmonids. Operation of the facilities is not expected to degrade water quality. The programs have current NPDES permits, where applicable, and effluent is monitored weekly to ensure compliance with permit requirements.

The PFMC (2003b) recognized concerns regarding the "genetic and ecological interactions of hatchery and wild fish … [which have] been identified as risk factors for wild populations." The biological opinion describes in considerable detail the impacts hatchery programs might have on natural populations (see Section 2.4.2); greater detail on possible effects of hatchery programs can be found in NMFS (2011c). The aspects of EFH that might be affected by the Proposed Action include effects of hatchery operations on ecological interactions in spawning and rearing areas. Hatchery spring Chinook salmon smolts and the juvenile progeny of naturally spawning hatchery-origin spring Chinook salmon may interact with naturally-produced steelhead progeny. However, released smolts are expected to spend only a few days at most in the Okanogan Basin before they reach the Columbia River and join tens of millions of natural-origin and hatchery smolts bound for the Pacific Ocean, and are expected to have little impact on either species, either due to predation or competition.

3.3. Essential Fish Habitat Conservation Recommandations

For each of the potential adverse effects by the proposed action on EFH for Chinook and coho salmon, NMFS believes that the proposed action, as described in in the HGMPs and the ITS (Section 2.9, above) includes the best approaches to avoid or minimize those adverse effects. The Reasonable and Prudent Measures and Terms and Conditions included in the ITS constitute NMFS recommendations to address potential EFH effects. NMFS shall ensure that the ITS, including Reasonable and Prudent Measures and implementing Terms and Conditions, are carried out.

To address the potential effects on EFH of hatchery fish on natural fish in natural spawning and rearing areas, the PFMC (2003a) provided an overarching recommendation that hatchery programs:

> "[c]omply with current policies for release of hatchery fish to minimize impacts on native fish populations and their ecosystems and to minimize the percentage of nonlocal hatchery fish spawning in streams containing native stocks of salmonids."

The biological opinion explicitly discusses the potential risks of hatchery fish on native fish populations and their ecosystems, and describes operation and monitoring appropriate to minimize these risks to listed salmon and steelhead in the Upper Columbia River Basin. As a result, NMFS has not identified any additional conservation recommendations.

3.4. Statutory Response Requirement

As required by Section 305(b)(4)(B) of the MSA, the NMF must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation from NMFS. 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, mitigating, or offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with NMFS 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)].

NMFS analyzed and determined that the effects of the action on EFH are likely within the range of effects considered in the ESA portion of the opinion, and concluded that the proposed hatchery programs are not likely to adversely affect Pacific Salmon EFH. There will be minimal disturbance of vegetation, and negligible harm to spawning and rearing habitat, and to water quantity and water quality. The small effects on EFH might occur as a result of facility operations on habitat or transitory impacts on the migration corridor would be adequately addressed by the steps described in the HGMPs. Because NMFS has found that the action is not likely to adversely affect EFH, there is not statutory response requirement.

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 our statutory reply to the EFH portion of this consultation, you will clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

NMFS 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

Section 515 of the Treasury and General Government Appropriations Act of 2001 (Public Law 106-554) ("Data Quality Act") specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, document compliance with the Data Quality Act, 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. NMFS has determined, through this ESA Section 7 consultation, that operation of WNFH, Methow, and Okanogan spring Chinook salmon programs as proposed will not jeopardize ESA-listed species and will not destroy or adversely modify designated critical habitat. Therefore, NMFS can issue an ITS. The intended users are NMFS, and the program operators and their agents. The scientific community, resource managers, and stakeholders benefit from the consultation through the anticipated increase in returns of salmonids to the Methow and Okanogan Rivers, and through the collection of data indicating the potential effects of the operation on the viability of natural populations of ESA-listed salmon and steelhead in the Upper Columbia River Basin. This information will improve scientific understanding of hatchery salmon and steelhead effects that can be applied broadly within the Pacific Northwest area for managing benefits and risks associated with hatchery operations.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased, and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA Regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.920(j).

Best Available Information: This consultation and supporting documents use the best available information, as described in the references section. The analyses in this biological opinion/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 Northwest Region ESA quality control and assurance processes.

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