FINAL ENVIRONMENTAL IMPACT STATEMENT

Final Environmental Impact Statement (FEIS) to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 7 and 4(d) of the Endangered Species Act

Prepared by the
National Marine Fisheries Service, West Coast Region

February 2019

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
1201 NE Lloyd Boulevard, Suite 1100
PORTLAND, OREGON 97232-1274

January 31, 2019

Dear Recipient:

In accordance with provisions of the National Environmental Policy Act (NEPA), we announce the publication of the Final Environmental Impact Statement (FEIS) to Analyze Impacts of National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 7 and 4(d) of the Endangered Species Act.

The proposed action is the continued propagation and release of hatchery fish in the Upper Willamette River. The programs are funded by the U.S. Army Corps of Engineers and Oregon Department of Fish and Wildlife.

NOAA's Policy and Procedures for Compliance with the NEPA and Related Authorities, Companion Manual for NOAA Administrative Order 216-6A requires that NOAA prepare and publish a Record of Decision that concludes the NEPA process for an Environmental Impact Statement (EIS). NMFS intends to issue the Record of Decision no sooner than 30 days after the publication of the FEIS (40 C.F.R. §1506.10).

NOAA has made available the FEIS electronically through the NMFS West Coast Region's website at:
http://www.westcoast.fisheries.noaa.gov/hatcheries/salmon_and_steelhead_hatcheries.html
The Record of Decision will also be made available at this website.

Sincerely,

Barry A. Thom
Regional Administrator

Enclosure

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Cover Sheet
Final Environmental Impact Statement (FEIS)

Title of Environmental Review:	Final Environmental Impact Statement (FEIS) to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 7 and 4(d) of the Endangered Species Act
Responsible Agency and Official:	Barry Thom, Regional Administrator National Marine Fisheries Service, West Coast Region 1201 NE Lloyd Boulevard, Suite 1100 Portland, Oregon 97232-1274
Contacts:	Lance Kruzic NMFS West Coast Region 2900 NW Stewart Parkway Roseburg, OR 97471 Lance.Kruzic@noaa.gov (note: not for commenting) (541) 957-3381
Location of Proposed Activities:	Upper Willamette River
Proposed Action:	NMFS' ESA approval of Hatchery and Genetics Management Plans in the Upper Willamette River Basin affecting listed spring Chinook salmon and winter steelhead.
Abstract:	The co-managers submitted Hatchery and Genetic Management Plans for spring Chinook, steelhead, and rainbow trout programs in the Upper Willamette River Basin to NMFS for evaluation under the ESA. The analysis herein informs NMFS, hatchery operators, and the public about the current and anticipated direct, indirect, and cumulative environmental effects of operating the hatchery programs under the full range of alternatives considered.

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SUMMARY

Background

The U.S. Army Corps of Engineers (Corps) and Oregon Department of Fish and Wildlife (ODFW), collectively referred to as the "co-managers," have submitted Hatchery and Genetic Management Plans (HGMPs) for the hatchery programs currently in the Upper Willamette River Basin to the National Marine Fisheries Service (NMFS), pursuant to section 7 and Limit 5 of the 4(d) Rule for salmon and steelhead promulgated under the Endangered Species Act (ESA) (65 FR 42422, July 10, 2000). Before a decision is made by NMFS on these HGMPs under the ESA, the National Environmental Policy Act (NEPA) requires Federal agencies to conduct environmental analyses of proposed actions to fully consider their effects on the human environment. NMFS's action of issuing concurrence with the HGMPs under Limit 5 of the 4(d) Rule is a major Federal action subject to environmental review under NEPA. A DEIS was prepared and underwent public review and comment in the spring of 2018. This FEIS provide NMFS' responses to public comments received during that review.

Proposed Action

The co-managers have submitted HGMPs for the continued operation of hatchery programs in the Upper Willamette River Basin propagating spring Chinook salmon, summer steelhead, and rainbow trout for approval by NMFS under the ESA section 7 and Limit 5 of the 4(d) Rule for ESA-listed spring Chinook salmon and winter steelhead in the Upper Willamette River. Under the Proposed Action, NMFS would make a determination that submitted HGMPs meet the requirements of section 7 and Limit 5 under the 4(d) Rule of the ESA. The HGMPs for Upper Willamette hatcheries would be approved under the ESA and continue to be implemented by the co-managers.

Purpose and Need

The purpose and need of the Proposed Action is two-fold: (1) for NMFS to evaluate the submitted HGMPs to ensure the hatchery programs are not jeopardizing ESA-listed salmon and steelhead, and (2) for the co-managers to operate the hatchery programs for the conservation and recovery of ESA-listed salmon and steelhead, while providing hatchery-origin fish for recreational and commercial fisheries in the Willamette River, lower Columbia River, and ocean.

Project Area and Analysis Area

The project area is the geographic area where the Proposed Action would take place. In this case, it is the geographical area for hatchery salmon, steelhead, and trout and associated hatchery facilities used to collect, propagate, rear, and release hatchery-origin fish in specified rivers, streams, and reservoirs in the Upper Willamette River Basin (above Willamette Falls), lower Willamette River, lower Columbia River, and the ocean. The hatchery facilities (and ancillary facilities) are: Marion Forks hatchery, Minto Fish Collection Facility, South Santiam Hatchery, Foster Fish Collection Facility, Roaring River Hatchery, McKenzie hatchery, Leaburg Hatchery, Leaburg Dam, Dexter Fish Collection Facility, and Willamette Hatchery. Hatchery fish are released into the following waterbodies: Molalla, North Santiam, South Santiam, McKenzie, Middle Fork Willamette, and Coast Fork Willamette rivers.

The "analysis area" is the geographic extent that is being evaluated for a particular resource. For some resources, the analysis area may be larger than the project area, since some of the effects of the alternatives may occur outside the project area. For example, some socioeconomic effects of the hatchery programs are evaluated at the project area level (the streams and rivers where hatchery fish are released), but others are evaluated within a larger geographic scope (fisheries occurring in the Pacific Ocean off the Oregon and Washington coasts where hatchery fish are also caught). The analysis area for each resource is described in Chapter 3, Affected Environment. Direct and indirect effects on various resources within the project and analysis areas are analyzed in Chapter 4, Environmental Consequences.

In addition, a larger analysis area was defined to consider actions with effects that are potentially cumulative with the Proposed Action and, thus, require evaluation of effects outside the Upper Willamette River Basin. The evaluation of this larger analysis area for cumulative effects is described in Chapter 5, Cumulative Effects.

Alternatives Including the Proposed Action

This FEIS analyzes five alternatives in detail:

Alternative 1 (No-action)

The No-action Alternative is the continuation of the existing hatchery programs for spring Chinook salmon, summer steelhead, and rainbow trout in the Upper Willamette River Basin. These hatchery programs are currently being managed under the mandates of NMFS' 2008 section 7 Biological Opinion for the Willamette Project (13 multi-purpose federal dams in the Upper Willamette River Basin). Hatchery fish are released into the Molalla, North Santiam, South Santiam, McKenzie, Middle Fork Willamette, and Coast Fork Willamette rivers.

Alternative 2 (Proposed Action/Preferred Alternative)

Alternative 2 is the proposed action where updated HGMPs have been submitted to NMFS for approval under section 7 and limit 5 of the 4(d) Rule. The primary difference between this alternative and the No-action alternative is the spring Chinook salmon programs propose to use natural-origin salmon for broodstock purposes. The use of natural-origin salmon is a Reasonable and Prudent Alternative (#6.2) of NMFS' Biological Opinion on the Willamette Project (NMFS 2008). Purposefully using natural-origin Chinook salmon for hatchery broodstock requires additional evaluation under the ESA and can only be authorized by a section 10(a)(1)(A) permit or by limit 5 of the 4(d) Rule. This alternative evaluates this proposed management change of the salmon hatchery programs to allow natural-origin salmon to be included in hatchery broodstocks.

Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)

Alternative 3 evaluates a reduced hatchery production scenario compared to the No-action Alternative, where only hatchery fish needed for reintroduction purposes above the Federal dams are produced. This level of production would return sufficient numbers of adult salmon and steelhead for outplanting needs above the dams to seed available habitat.

Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)

Alternative 4 evaluates eliminating all hatchery programs in the Upper Willamette River Basin and the consequences of this action compared to the No-action Alternative. No hatchery fish would be produced for any purpose.

Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
Alternative 5 evaluates increasing hatchery production in existing hatchery facilities up to maximum capacity in order to support enhanced fishery opportunities in the ocean and freshwater. The existing fishery impact limits authorized under the ESA would still apply under this alternative.

Affected Environment

Seven resources are described in the affected environment of the Upper Willamette River Basin by the implementation of the five alternatives:

- Water quantity
- Water quality
- Salmon and Steelhead and Their Habitats
- Other Fish and Their Habitats
- Wildlife
- Socioeconomics
- Environmental justice

Current conditions include effects of the past operation of hatchery programs in the Upper Willamette River Basin.

Environmental Consequences

This FEIS is a comprehensive evaluation of all hatchery programs in the Upper Willamette River Basin. The genetic, ecological, and social effects of hatchery fish are evaluated at multiple local and regional scales. The five alternatives evaluate a wide range of impacts associated with the identified resources for the alternatives. The relative magnitude and direction of impacts is described using the following terms:

- Undetectable: The impact would not be detectable.
- Negligible: The impact would be at the lower levels of detection.
- Low: The impact would be slight, but detectable.
- Medium: The impact would be readily apparent.
- High: The impact would be severe or greatly beneficial.

Table S-1 below provides a summary of the predicted resource effects under each of the five alternatives. The summary reflects the detailed resource discussions in Chapter 4, Environmental Consequences.

Table S-1. Summary of environmental consequences for FEIS alternatives for each resource.

Resource	Alternative 1 (No-action)	Alternative 2 (Proposed Action/Preferred Alternative)	Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)	Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)	Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
Water Quantity	Negligible to low impacts at the hatchery facilities and fish collection facilities from water diversion in affected reaches. Negligible overall on a watershed scale.	Overall same as Alternative 1.	Impacts would be reduced compared to the No-action alternative because reduced hatchery production and therefore reduced water use in affected reaches. Negligible effect overall on a watershed scale.	Impacts would be eliminated under this alternative compared to the No-action alternative, with exception of continued operation of fish collection facilities. Expected benefits from not using water for hatchery purposes is negligible for all populations.	Impacts expected to be low at the hatchery facilities and fish collection facilities under this alternative compared to the No-action alternative. Maximum authorized water rights may be used, but impacts still expected to be low overall.
Water Quality	Negligible impacts downstream from the hatchery facilities. No effect on current water quality issues (303d listings) in all populations.	Overall, same as Alternative 1.	Impacts would be reduced since fewer hatchery fish would be produced. However, potential improvements would be undetectable compared to the No-action alternative.	Impacts on water quality would be eliminated, with the exception of continued operation of fish collection facilities. Negligible benefit to water quality compared to the No-action alternative.	Impacts expected to be low at and downstream of the hatchery facilities and fish collection facilities under this alternative compared to the No-action alternative. Maximum authorized water rights may be used, but impacts still expected to be negligible overall and not affect current 303(d) listings.

Resource	Alternative 1 (No-action)	Alternative 2 (Proposed Action/Preferred Alternative)	Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)	Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)	Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
Salmon and Steelhead and Their Habitats	The benefits and risks depend upon species and program. <u>Spring Chinook Salmon Programs:</u> Benefits include: increased spawning abundances, increased marine derived nutrients, and fishery harvest opportunities. Risks include: genetic domestication effects, masking, competition and predation by hatchery fish on natural-origin salmon. <u>Summer Steelhead Programs:</u> Benefits include fishery harvest opportunities. Risks include: genetic impacts (out of DPS), and predation and competition, especially from residual smolts. <u>Rainbow Trout Programs:</u> Benefits include fishery harvest opportunities.	For spring Chinook salmon, integration of natural-origin salmon into hatchery increases demographic risk by reducing spawning abundances, but benefit from reduced genetic domestication effects of hatchery fish. For summer steelhead and rainbow trout, overall same as Alternative 1.	For the spring Chinook salmon program, a benefit would be that domestication effects would be reduced by having smaller program and higher integration of natural-origin broodstock compared to No-action alternative. However, fishery harvest opportunities would be reduced compared to No-action alternative. The summer steelhead program would be changed to a reintroduction program for winter steelhead. This would benefit winter steelhead because out-of-DPS genetic effects would be eliminated compared to No-action alternative. Other benefits would include increased spawning abundances of winter steelhead, increase marine derived nutrients. Risks would include domestication	For spring Chinook, salmon, demographic risks would increase because population viability would decrease in populations where hatchery program would be eliminated compared to No-action alternative from not having hatchery Chinook salmon spawning in the wild. However, the genetic risk would decrease compared to the No-action and preferred alternative. For winter steelhead, a benefit would be that population viability may increase from the elimination of genetic effects in populations where summer steelhead releases would be terminated in the North Santiam and South Santiam rivers. For the rainbow trout program, spring Chinook	For spring Chinook salmon, all risks would increase for this alternative compared to the No-action alternative. Harvest opportunity would increase, as would marine derived nutrients from hatchery fish. For winter steelhead, all risks would increase for this alternative from increased production of summer steelhead and rainbow trout. Fishery harvest benefits would be greater compared to the No-action alternative.

Resource	Alternative 1 (No-action)	Alternative 2 (Proposed Action/Preferred Alternative)	Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)	Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)	Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
	Risks include: predation and competition, disease transfer, increased exploitation of natural-origin salmon and steelhead.		effects, predation, and competition. The rainbow trout program would be eliminated under this alternative because there are no conservation benefits of this program to salmon and steelhead.	salmon and winter steelhead competition/predation risks would decrease from termination of releases. Catch and release mortality effects may increase on salmon and steelhead from termination of harvestable trout stockings.	

Resource	Alternative 1 (No-action)	Alternative 2 (Proposed Action/Preferred Alternative)	Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)	Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)	Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
Other Fish and Their Habitats	Mix of risks and benefits from the hatchery programs. Salmon, steelhead, and trout can compete and prey upon these fish species (and vice versa). Hatchery carcasses provide valuable ecosystem nutrients. Overall low impact.	Overall, same as Alternative 1.	Negligible difference on these fish species from this alternative compared to the No-action alternative.	Mix of risks and benefits from termination of the hatchery programs. Low impact from loss of hatchery nutrient enhancement. Predation and competition by hatchery fish on native fishes would decrease. Hatchery fish as a prey source will be eliminated for many species.	Negligible difference on these fish species from this alternative compared to the No-action alternative.
Wildlife	Mix of risks and benefits from the hatchery programs. Salmon, steelhead, and trout are potential food source for most wildlife species. Hatchery carcasses provide valuable ecosystem nutrients. Overall low impact.	Overall, same as Alternative 1.	Mix of risks and benefits from the reduced hatchery production. Hatchery fish as a prey source for certain species will be reduced compared to the No-action Alternative.	Mix of risks and benefits from the termination of the hatchery programs. Hatchery fish as a prey source for many species would be eliminated. Hatchery nutrient enhancement would be eliminated.	Mix of risks and benefits from the increased hatchery production. Hatchery fish as a prey source for certain species will be enhanced compared to the No-action Alternative.

Resource	Alternative 1 (No-action)	Alternative 2 (Proposed Action/Preferred Alternative)	Alternative 3 (Reduce Hatchery Production to Reintroduction Needs)	Alternative 4 (Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)	Alternative 5 (Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits)
Socio-economics	Depending upon the specific fishery, low to medium economic benefits of the hatchery programs and facilities from employment, goods and services, fisheries, and tourism. The hatchery programs that have the highest harvest rates on hatchery fish typically exhibit the greatest economic contributions.	Overall, same as Alternative 1.	Reduced economic benefits from reduced hatchery production for fisheries under this alternative compared to the No-action alternative.	Depending upon the specific fishery, low to medium impact on socioeconomics from termination of the hatchery programs compared to the No-action Alternative.	Increased economic benefits in all fisheries under this alternative compared to the No-action alternative. Most benefits expected to accrue in Willamette Basin recreational fisheries.
Environmental Justice	Undetectable to negligible impacts on low income and minority groups in the local communities.	Overall, same as Alternative 1.	Undetectable to negligible impacts on low income and minority groups in the local communities compared to the No-action Alternative.	Undetectable to negligible impacts on low income and minority groups in the local communities compared to the No-action Alternative.	Undetectable to negligible impacts on low income and minority groups in the local communities compared to the No-action Alternative.

Summary of Major Changes Made in Response to Public Comments on the Draft EIS

Below is a summary of the major changes made to the draft EIS. Editorial revisions were also made, and these are not listed below. The location of text modification is denoted by chapter.

Summary:

1. No substantive changes.

Chapter 1:

1. No substantive changes.

Chapter 2:

1. No substantive changes.

Chapter 3:

1. Additional information on water quality and impairments.
2. Included additional information from ODFW's most recent status assessments of spring Chinook salmon and winter steelhead.

Chapter 4:

1. Included additional information on the proportion of hatchery origin spawners, proportion of natural-origin broodstock, and proportionate natural influence calculations for alternatives.
2. Included additional information on the impact of sea lions at Willlamette Falls.

Chapter 5:

1. Included additional information on the threat of sea lions at Willamette Falls.
2. Included additional information on climate change on freshwater ecosystems.

Appendices:

1. Appendix A - no substantive changes.
2. Included new Appendix B providing additional information on the risk classifications for ecological interactions between hatchery- and natural-origin fish.
3. Included Appendix C- NMFS' responses to public comments on the Draft EIS.

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ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
BPA	Bonneville Power Administration
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CFS	Cubic feet per second
Corps	U.S. Army Corps of Engineers
DPS	Distinct population segment
EA	Environmental assessment
EFH	Essential Fish Habitat
EIS	Environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act
ESU	Evolutionarily Significant Unit
FONSI	Finding of No Significant Impact
FTE	Full-time equivalent
HGMP	Hatchery and genetic management plan
HOR	Hatchery-origin returns
HSRG	Hatchery Scientific Review Group
IHOT	Integrated Hatchery Operations Team
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act
NFCP	Native Fish Conservation Policy
NMFS	National Marine Fisheries Service (also called NOAA Fisheries Service)
NOR	Natural-origin returns
NPDES	National Pollutant Discharge Elimination System
ODFW	Oregon Department of Fish and Wildlife
pHOS	Proportion of hatchery-origin spawners on spawning grounds
PNI	Proportionate Natural Influence (pNOB/(pNOB+pHOS))
pNOB	Proportion of natural-origin fish in the broodstock
ROD	Record of Decision
TRT	Technical Recovery Team
UWR	Upper Willamette River Basin
USC	U.S. Code

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GLOSSARY OF KEY TERMS[1]

Abundance: Generally, the number of fish in a defined area or unit. It is also one of four parameters used to describe the viability of natural-origin fish populations (McElhany et al. 2000).

Adaptive management: A deliberate process of using research, monitoring, and scientific evaluation in making decisions in the face of uncertainty.

Acclimation pond: A concrete or earthen pond or a temporary structure used for rearing and imprinting juvenile fish in the water of a particular stream before their release into that stream.

Adipose fin: A small fleshy fin with no rays, located between the dorsal and caudal fins of salmon and steelhead. The adipose fin is often "clipped" on hatchery-origin fish so they can be differentiated from natural-origin fish.

Anadromous: A term used to describe fish that hatch and rear in fresh water, migrate to the ocean to grow and mature, and return to freshwater to spawn.

Analysis area: Within this Environmental Impact Statement (EIS), the analysis area is the geographic extent that is being evaluated for each resource. For some resources (e.g., socioeconomics and environmental justice), the analysis area is larger than the project area. See also **Project area**.

Best management practice (BMP): A policy, practice, procedure, or structure implemented to mitigate adverse environmental effects.

Broodstock: A group of sexually mature individuals of a species that is used for breeding purposes as the source for a subsequent generation.

Co-managers: The agencies responsible for funding and implementing the hatchery programs in the Upper Willamette River Basin (Oregon Department of Fish and Wildlife, U.S. Army Corps of Engineers).

Commercial harvest: The activity of catching fish for commercial profit.

Conservation: Used generally in the EIS as the act or instance of conserving or keeping fish resources from change, loss, or injury, and leading to their protection and preservation. This contrasts with the definition under the United States Endangered Species Act (ESA), which refers to use and the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary.

Critical habitat: A specific term and designation within the ESA, referring to habitat area essential to the conservation of a listed species, though the area need not actually be occupied by the species at the time it is designated.

Dewatering: Typically, the immediate downstream habitat effects associated with a water withdrawal action that diverts the entire flow of a stream or river to another location

Distinct Population Segment (DPS): Under the ESA, the term "species" includes any subspecies of fish or wildlife or plants, and any "Distinct Population Segment" of any species or vertebrate fish or wildlife that interbreeds when mature. The ESA thus considers a DPS of vertebrates to be a "species." The ESA does not however establish how distinctness should be determined. Under NMFS policy for Pacific salmon, a population or group of populations will be considered a DPS if it represents an Evolutionarily Significant Unit (ESU) of the biological species. In contrast to salmon, NMFS lists steelhead runs under the joint NMFS-U.S. Fish and Wildlife Service (USFWS) Policy for recognizing DPSs (DPS Policy: 61 Fed. Reg. 4722, February 7, 1996). This policy adopts criteria similar to those in the ESU policy, but applies to a broader range of animals to include all vertebrates.

[1] This list of definitions is for informative purposes. To the extent terms are defined by statute or regulation, those definitions apply.

Diversity: Variation at the level of individual genes (polymorphism); provides a mechanism for populations to adapt to their ever-changing environment. It is also one of the four parameters used to describe the viability of natural-origin fish populations (McElhany et al. 2000).
Domestication: See **Hatchery-influenced selection**.
Emigration: The downstream migration of salmon and steelhead toward the ocean.
Endangered species: As defined in the ESA, any species that is in danger of extinction throughout all or a significant portion of its range.
Endangered Species Act (ESA): A United States law that provides for the conservation of endangered and threatened species of fish, wildlife, and plants.
Environmental justice: The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.
Escapement: Adult salmon and steelhead that survive fisheries and natural mortality, and return to spawn.
Estuary: The area where fresh water of a river meets and mixes with the salt water of the ocean.
Evolutionarily Significant Unit (ESU): A concept NMFS uses to identify Distinct Population Segments of Pacific salmon (but not steelhead) under the ESA. An ESU is a population or group of populations of Pacific salmon that 1) is substantially reproductively isolated from other populations, and 2) contributes substantially to the evolutionary legacy of the biological species. See also **Distinct Population Segment** (pertaining to steelhead).
Federal Register: The United States government's daily publication of Federal agency regulations and documents, including executive orders and documents that must be published per acts of Congress.
Fingerling: A juvenile fish.
Fishery: Harvest by a specific gear type in a specific geographical area during a specific period of time.
Fitness: As used in this EIS, the propensity of a group of fish (e.g., populations) to survive and reproduce.
Forage fish: Small fish that breed prolifically and serve as food for predatory fish.
Fry: Juvenile salmon and steelhead that are usually less than one year old and have absorbed their egg sac.
Habitat: The physical, biological, and chemical characteristics of a specific unit of the environment occupied by a specific plant or animal; the place where an organism naturally lives.
Hatchery and genetic management plan (HGMP): Technical documents that describe the composition and operation of individual hatchery programs. Under Limit 5 of the 4(d) rule, NMFS uses information in HGMPs to evaluate impacts on salmon and steelhead listed under the ESA.
Hatchery facility: A facility (e.g., hatchery, rearing pond, net pen) that supports one or more hatchery programs.
Hatchery-influenced selection: The process whereby genetic characteristics of hatchery populations become different from their source populations as a result of selection in hatchery environments (also referred to as domestication).
Hatchery operator: A Federal agency, state agency, or Native American tribe that operates a hatchery program.
Hatchery-origin fish: A fish that originated from a hatchery facility.
Hatchery-origin spawner: A hatchery-origin fish that spawns naturally.

Hatchery program: A program that artificially propagates fish. Most hatchery programs for salmon and steelhead spawn adults in captivity, raise the resulting progeny for a few months or longer, and then release the fish into the natural environment where they will mature.
Incidental: Unintentional, but not unexpected.
Incidental fishing effects: Fish, marine birds, or mammals unintentionally captured during fisheries using any of a variety of gear types.
Integrated hatchery program: A hatchery program that intends for the natural environment to drive the adaptation and fitness of a composite population of fish that spawns both in a hatchery and in the natural environment. Differences between hatchery-origin and natural-origin fish are minimized, and hatchery-origin fish are integrated with the local populations included in an ESU or DPS.
Isolated hatchery program: A hatchery program that intends for the hatchery-origin population to be reproductively segregated from the natural-origin population. These programs produce fish that are different from local populations. They do not contribute to conservation or recovery of populations included in an ESU or DPS.
Limit 5: Under section 4(d) of the ESA (see **Section 4(d) Rule**), a limit on "take" prohibitions that applies to Hatchery and Genetics Management Plans developed by a state and/or federal agency.
Limiting factor: A physical, chemical, or biological feature that impedes species and their independent populations from reaching a viable status.
National Environmental Policy Act (NEPA): A United States environmental law that established national policy promoting the enhancement of the environment and established the President's Council on Environmental Quality (CEQ).
National Marine Fisheries Service (NMFS): A United States agency within the National Oceanic and Atmospheric Administration and under the Department of Commerce charged with the stewardship of living marine resources through science-based conservation and management, and the promotion of healthy ecosystems.
National Pollutant Discharge Elimination System (NPDES): A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by the Environmental Protection Agency, a state, or, where delegated, a tribal government on an Indian reservation.
Native fish: Fish that are endemic to or limited to a specific region.
Natural-origin: A term used to describe fish that are offspring of parents that spawned in the natural environment rather than the hatchery environment, unless specifically explained otherwise in the text. "Naturally spawning" and similar terms refer to fish spawning in the natural environment.
Pathogen: An infectious microorganism that can cause disease (e.g., virus, bacteria, fungus) in its host.
Population: A group of fish of the same species that spawns in a particular locality at a particular season and does not interbreed substantially with fish from any other group.
Preferred alternative: The alternative selected or developed from an evaluation of alternatives. Under NEPA, the preferred alternative is the alternative an agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical, and other factors.
Productivity: The rate at which a population is able to produce reproductive offspring. It is one of the four parameters used to describe the viability of natural-origin fish populations (McElhany et al. 2000).
Project area: Geographic area where the Proposed Action will take place. See also **Proposed Action**.
Proportion of hatchery-origin spawners (pHOS): The proportion of naturally spawning salmon or steelhead that are hatchery-origin fish.

Proposed Action: NMFS's review and approval under Limit 5 of the 4(d) rules of the hatchery and genetic management plans (and operation of the hatchery facilities) submitted by the Corps of Engineers and Oregon Department of Fish and Wildlife for hatcheries in the Upper Willamette River Basin.
Record of Decision (ROD): The formal NEPA decision document that is recorded for the public. It is announced in a Notice of Availability in the Federal Register.
Recovery: Defined in the ESA as the process by which the decline of an endangered or threatened species is stopped or reversed, or threats to its survival neutralized so that its long-term survival in the wild can be ensured, and it can be removed from the list of threatened and endangered species.
Recovery plan: Under the ESA, a formal plan from NMFS (for listed salmon and steelhead) outlining the goals and objectives, management actions, likely costs, and estimated timeline to recover the listed species.
Recreational harvest: The activity of catching fish for non-commercial reasons (e.g., sport or recreation).
Redd: The spawning site or "nest" in stream and river gravels in which salmon and steelhead lay their eggs.
Residuals: Hatchery-origin fish that out-migrate slowly, if at all, after they are released. Residualism occurs when such fish residualize rather than out-migrate as most of their counterparts do.
Run: The migration of salmon or steelhead from the ocean to fresh water to spawn. Defined by the season they return as adults to the mouths of their home rivers.
Run size: The number of adult salmon or steelhead (i.e., harvest plus escapement) returning to their natal areas.
Salmonid: A fish of the taxonomic family Salmonidae, which includes salmon, steelhead, and trout.
Scoping: In NEPA, an early and open process for determining the extent and variety of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).
Section 4(d) Rule: A special regulation developed by NMFS under authority of section 4(d) of the ESA, modifying the normal protective regulations for a particular threatened species when it is determined that such a rule is necessary and advisable to provide for the conservation of that species.
Section 7 consultation: Federal agency consultation with NMFS or USFWS (dependent on agency jurisdiction) on any actions that may affect listed species, as required under section 7 of the ESA.
Section 10 permit: A permit for direct take of listed species for scientific purposes or to enhance the propagation or survival of listed species, or for incidental take of listed species during otherwise lawful activities. Issued by NMFS or USFWS (dependent on agency jurisdiction) as authorized under section 10(a)(1) of the ESA.
Smolts: Juvenile salmon and steelhead that have left their natal streams, are out-migrating downstream, and are physiologically adapting to live in salt water.
Spatial structure: The spatial structure of a population refers both to the spatial distributions of individuals in the population and the processes that generate that distribution. It is one of the four parameters used to describe the viability of natural-origin fish populations (McElhany et al. 2000).
Stock: A group of fish of the same species that spawns in a particular lake or stream (or portion thereof) at a particular season and which, to a substantial degree, does not interbreed with fish from any other group spawning in a different place or in the same place in a different season.
Straying (of hatchery-origin fish): A term used to describe when hatchery-origin fish return to and/or spawn in areas where they are not intended to return/spawn.

Supplementation: Release of fish into the natural environment to increase the abundance of naturally reproducing fish populations.

Take: Under the ESA, the term "take" means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Take for hatchery activities includes, for example, the collection of listed fish (adults and juveniles) for hatchery broodstock, the collection of listed hatchery-origin fish to prevent them from spawning naturally, and the collection of listed fish (juvenile and adult fish) for scientific purposes.

Threat: A human action or natural event that causes or contributes to limiting factors; threats may be caused by past, present, or future actions or events.

Threatened species: As defined by section 4 of the ESA, any species that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

Tributary: A stream or river that flows into a larger stream or river.

Upper Willamette River Basin: The geographic area upstream of Willamette Falls, including the entire watershed upstream including tributaries such as Molalla, North Santiam, South Santiam, Calapooia, McKenzie, Middle Fork Willamette rivers.

Viability: As used in this EIS, a measure of the status of listed salmon and steelhead that uses four criteria: abundance, productivity, spatial distribution, and diversity.

Viable salmonid population (VSP): An independent population of salmon or steelhead that has a negligible risk of extinction over a 100-year timeframe (McElhany et al. 2000).

Water intake screen: A screen used to prevent entrainment of salmonids into a water diversion or intake. See also **Diversion screen**.

Watershed: An area of land where all of the water that is under it or drains off of it goes into the same place, e.g. Rogue River watershed or Umpqua River watershed.

Weir: An adjustable dam placed across a river to regulate the flow of water downstream; a fence placed across a river to catch fish.

Yearling: Juvenile salmon or steelhead that has reared at least one year in the hatchery.

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1. Purpose of and Need for the Proposed Action

1.1. Background

Spring Chinook salmon (*Oncorhynchus tshawytscha*), winter steelhead (*O. mykiss*), and Columbia River bull trout (*Salvelinus confluentus*) (see Subsection 3.4)(64 FR 14308, March 24, 1999; 64 FR 14517, March 25, 1999; 63 FR 31647, June 10, 1998) are fish species listed as threatened under the Endangered Species Act (ESA) in the Upper Willamette River Basin. Therefore, actions taken by co-managers that affect ESA-listed species are required to have their hatchery programs evaluated by NMFS to ensure the programs are not jeopardizing ESA-listed salmon and steelhead.

The existing hatchery programs are continually being evaluated and adaptively managed to ensure impacts are acceptable to ESA-listed species. The first evaluation of the hatchery programs occurred in 2000 when NMFS issued a Biological Opinion under section 7 of the ESA directing hatchery reforms to reduce impacts on spring Chinook salmon and winter steelhead. Another Biological Opinion was issued in 2008 and directed the co-managers to pursue new plans to incorporate natural-origin fish into hatchery broodstocks. RPA #6.2 of the Biological Opinion directed the co-managers to develop new Hatchery and Genetic Management Plans (HGMPs) with specific protocols for incorporating natural-origin fish into hatchery broodstocks. These new HGMPs were submitted to NMFS in 2016 for evaluation under the ESA. Since then, NMFS has been reviewing the HGMPs under the ESA and NEPA.

Before these HGMPs can be approved under the ESA, NEPA requires NMFS to evaluate how proposed determination on the submitted HGMPs may affect the natural and physical environment and the relationship of people with that environment. The NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with wise use of affected resources and other legal and policy mandates.

1.2. Description of the Proposed Action

Below is a description of the proposed action categorized by species.

Spring Chinook Salmon

The hatchery co-managers (ODFW and USACE) have jointly submitted four HGMPs for all spring Chinook salmon hatchery programs in the Upper Willamette River Basin for approval under the ESA limit 5 of the 4(d) Rule. These latest HGMPs specifically include actions that purposefully collect

natural-origin salmon for broodstock purposes and can only be authorized under limit 5 of the ESA In addition, the hatchery summer steelhead and rainbow trout program are also included in this evaluation using the latest HGMPs submitted for these programs (Appendix A). The steelhead and trout programs only result in incidental take (not direct take) and will be authorized through the section 7 consultation, if that consultation results in an incidental take statement which includes the take from these programs. All of the hatchery programs and associated facilities are currently in operation. No new facilities or changes to current production release levels are proposed in the four HGMPs. The existing hatchery facilities are considered part of current conditions existing in the environment at this point in time because the hatchery facilities have been operating for many decades (Table 1). Under the Proposed Action, NMFS would issue a letter to co-managers approving the implementation of the submitted HGMPs under limit 5 of the 4(d) Rule and associated Incidental Take Statement of the section 7 Biological Opinion. NMFS approval of the spring Chinook salmon HGMPs would authorize the following activities:

- Continued collection of spring Chinook salmon for broodstock at existing fish collection facilities at Minto, Foster, Dexter dams, and McKenzie Hatchery. The new action in the HGMPs would be to use natural-origin fish collected at facilities for broodstock.
- Continued collection, transport, and release of adult spring Chinook salmon above the USACE dams (Detroit, Foster, Green Peter, Cougar, Blue River, Lookout Point, Fall Creek, Hills Creek) for reintroduction of salmon back into historical habitats.
- Holding of adult broodstock fish at the specific hatchery facilities if appropriate
- Spawning, incubation, and juvenile rearing at the specific hatchery facilities
- Continued release of juvenile hatchery spring Chinook salmon from the various hatchery release facilities, according to the production levels specified in the HGMPs
- Research, monitoring, and evaluation activities associated with the hatchery programs

All four of the hatchery spring Chinook salmon programs are funded by the USACE and ODFW. The Bonneville Power Administration funds a portion of the USACE mitigation costs for the Willamette Project (the specific amount depends upon the dam project and power generation). The ODFW operates the hatchery facilities and associated traps at Minto fish collection facility, Marion Forks Hatchery, Foster Dam fish collection facility, South Santiam Hatchery, Dexter fish

collection facility, Willamette Hatchery, and McKenzie Hatchery. The USACE operates the fish collection facilities at Fall Creek and Cougar dams.

Table 1. Operations of the fish collection facilities and hatchery facilities associated with the HGMPs and reintroductions above federal dams in the Upper Willamette River Basin.

Activity	Facility	Location	Does Facility Exist under Current Conditions?	Is Facility Operated under Current Conditions?
1) Trap and haul for reintroduction above federal dams, 2) Broodstock collection	Minto Fish Collection Facility	North Santiam; RM 42	Yes	Yes
	Foster Fish Collection Facility	South Santiam River; RM 38.5	Yes	Yes
	Dexter Fish Collection Facility	Middle Fork Willamette River; RM 17	Yes	Yes
	Fall Creek Fish Collection Facility	Fall Creek (MF Willamette); RM 7.2	Yes	Yes
	Cougar Fish Collection Facility	South Fork McKenzie River; RM 4.5	Yes	Yes
	McKenzie Hatchery	McKenzie River; RM 37	Yes	Yes
	Leaburg Hatchery	McKenzie River; RM 38.5	Yes	Yes
3) Incubation and rearing of juvenile hatchery salmon, steelhead, and rainbow trout	Marion Forks Hatchery	North Santiam River; RM 73	Yes	Yes
	South Santiam Hatchery	South Santiam River; RM 38.5	Yes	Yes
	McKenzie Hatchery	McKenzie River; RM 37	Yes	Yes
	Leaburg Hatchery	McKenzie River; RM 38.5	Yes	Yes

Activity	Facility	Location	Does Facility Exist under Current Conditions?	Is Facility Operated under Current Conditions?
	Oak Springs Hatchery	Deschutes River; RM 47	Yes	Yes
	Roaring River Hatchery	Crabtree Creek; RM 1.2	Yes	Yes
	Willamette Hatchery	Middle Fork Willamette River; RM 42	Yes	Yes
4) Release of juvenile hatchery salmon, steelhead, and rainbow trout	Minto Fish Collection Facility	North Santiam; RM 42	Yes	Yes
	South Santiam Hatchery	South Santiam River; RM 38.5	Yes	Yes
	McKenzie Hatchery	McKenzie River; RM 37	Yes	Yes
	Leaburg Hatchery	McKenzie River; RM 38.5	Yes	Yes
	Dexter Fish Collection Facility	Middle Fork Willamette River; RM 17	Yes	Yes
	Willamette River	Eugene area		
	SAFE	Lower Columbia River (Chinook salmon)	Yes	Yes
	Willamette River basin	throughout basin (rainbow trout)		
5) Research, Monitoring,	RME specified in HGMPs	varies	Yes	Yes

Activity	Facility	Location	Does Facility Exist under Current Conditions?	Is Facility Operated under Current Conditions?
and Evaluation	Watershed areas accessible to hatchery and natural salmon migration, spawning, and rearing		N/A	N/A

Summer Steelhead

The hatchery summer steelhead program propagates hatchery fish using many of the same collection facilities and hatcheries as for spring Chinook salmon described above (Table 1). The one exception is Roaring River Hatchery which raises summer steelhead and rainbow trout. The summer steelhead program proposed here reflects the management changes implemented in accordance with NMFS 2008 Biological Opinion and RPA actions.

Rainbow Trout

The rainbow trout program propagates hatchery fish for release into closed waterbodies (reservoirs, lakes, ponds) throughout the basin and in select rivers and streams outside of the winter steelhead DPS (e.g. McKenzie River). Rainbow trout are raised at the Roaring River, Leaburg, and Willamette hatcheries (Table 1). The rainbow trout program proposed here reflects management changes since 2008 (issuance of Biological Opinion) to the hatchery program, including funding and private firms producing these fish.

1.3. Purpose of and Need for the Action

The Reasonable and Prudent Alternative (RPA) 6.2 of the Willamette Project Biological Opinion (NMFS 2008) directed the co-managers to develop protocols for taking natural-origin fish for hatchery

broodstock. New HGMPs were required to be submitted by the co-managers to NMFS for evaluation under the ESA. These new HGMPs were submitted to NMFS in 2016. NMFS must then review these HGMPs to determine whether they meet the applicable standards for an exemption from section 9 of the ESA, pursuant to Limit 5 of NMFS' ESA section 4(d) regulations, which apply to the operation of hatchery programs. The purpose of the Proposed Action from NMFS' perspective is to evaluate the submitted HGMPs for ESA compliance. The need for the Proposed Action is to ensure the hatchery programs are being managed for the conservation and recovery of listed spring Chinook salmon and winter steelhead occurring in the Upper Willamette River Basin, so that the Willamette Project (NMFS 2008) does not jeopardize these threatened salmonid species. If approved, NMFS' evaluation and potential approval of the new HGMPs would fulfill NMFS' role and satisfy RPA 6.2 of the Willamette Project Biological Opinion (NMFS 2008) for these ESA-listed species.

1.4. Project Area and Analysis Area

The project area is the geographic area where the Proposed Action would take place. The project area consists of the geographic areas where the hatchery facilities are located and the stream and river reaches downstream of the facilities where hatchery fish are present as they emigrate to the ocean. The project area specifically includes hatchery areas where fish are spawned, incubated, reared, acclimated, released, or harvested. Within the project area, seven hatcheries are used to propagate the hatchery fish: Marion Forks Hatchery, South Santiam Hatchery, McKenzie Hatchery, Leaburg Hatchery, Oak Springs Hatchery, Roaring River Hatchery, and Willamette Hatchery (Table 1). Additional fish collection facilities are located at Minto, Foster, Dexter, Fall Creek, and Cougar (Table 1; Figure 1).

Figure 1. Location of the fish collection facilities and hatcheries in the Upper Willamette River Basin.

The "analysis area" is the geographic extent that is being evaluated for a particular resource. For some resources, the analysis area may be larger than the project area, since some of the effects of the alternatives may occur outside the project area. For example, some socioeconomic effects of the hatchery programs are evaluated at the project area level (the streams and rivers where hatchery fish are released),

but others are evaluated within a larger geographic scope (fisheries occurring in the ocean off the coasts of Washington and Oregon where hatchery fish are also caught).The analysis area for each resource is described in Chapter 3, Affected Environment. Direct and indirect effects on various resources within the project and analysis areas are analyzed in Chapter 4, Environmental Consequences.

In addition, a larger analysis area was defined to consider actions with effects that are potentially cumulative with the Proposed Action and thus, require evaluation of effects throughout the entire Washington/Oregon Coast Region (including areas where no hatchery facilities exist and no hatchery fish are released). The evaluation of this larger analysis area for cumulative effects is described in Chapter 5, Cumulative Effects.

1.5. Decisions to be Made

NMFS must decide on the following before the Proposed Action can be implemented:

- The preferred alternative following an analysis of all alternatives in this FEIS and review of public comments
- Whether the Proposed Action complies with ESA criteria under the section 4(d) Rule

1.5.1. Record of Decision

This NEPA process will culminate in a Record of Decision (ROD) that will record the selected alternative after public comment on this EIS, revision, and publication of the final EIS. The ROD will identify the environmentally preferred alternative; describe the preferred alternative and the selected alternative; and summarize the impacts expected to result from implementation of the selected alternative.

1.5.2. NMFS's Determination as to Compliance with the 4(d) Rule

Discussions between the co-managers and NMFS during development of the HGMPs are conducted with the knowledge and understanding that the specific criteria under Limit 5 of the 4(d) Rule must be met before a 4(d) limit can be issued. HGMPs submitted under Limit 5 (Artificial Propagation) must meet the following criteria:

1. Specify the goals and objectives for the hatchery program.
2. Specify the donor population's critical and viable threshold levels.
3. Prioritize broodstock collection programs to benefit listed fish.

4. Specify the protocols that will be used for spawning and raising the hatchery-origin fish.
5. Determine the genetic and ecological effects arising from the hatchery program.
6. Describe how the hatchery operation relates to fishery management.
7. Ensure that the hatchery facility can adequately accommodate listed fish if collected for the program.
8. Monitor and evaluate the management plan to ensure that it accomplishes its objective.
9. Be consistent with tribal trust obligations (65 Fed. Reg. 42422, July 10, 2000).

NMFS has a limited role (i.e., approve or deny) under Limit 5 of the 4(d) Rule. The decision as to whether the ESA 4(d) Rule Limit 5 have been met will be documented in NMFS's ESA decision documents at the end of the ESA evaluation process. Included with the ESA decision documents will be responses to comments on the HGMPs received during public review as required by the 4(d) Rule.

1.5.3. Biological Opinion on NMFS's Determination as to Compliance with the 4(d) Rule

ESA section 7(a)(2) provides that any action authorized, funded, or carried out by a Federal agency shall not jeopardize the continued existence of any endangered or threatened species or result in the adverse modification or destruction of designated critical habitat. NMFS's actions under section 4(d) require compliance with section 7(a)(2), and in this case NMFS plans to prepare a biological opinion on the effects of the action. NMFS's consultations under section 7 on those actions may be informed by this NEPA analysis. The results of these consultations are documented in the Biological Opinion developed by NMFS for the species under their jurisdiction. Biological Opinions are produced near the end of the ESA evaluation and determination process, providing the NMFS conclusions regarding the likelihood that the proposed hatchery actions will jeopardize the continued existence of any listed species or adversely modify designated critical habitat for any listed species.

1.6. Scoping and Relevant Issues

The first step in preparing an EIS is to conduct scoping of the issues that may be associated with the Proposed Action. This occurs first through internal agency reviews. The purpose of that scoping is to identify the relevant human environmental issues, to eliminate insignificant issues from detailed study, and to identify the alternatives to be analyzed in the EIS. Scoping can also help determine the level of analysis and the types of data required for analysis.

1.6.1. Scoping Process

This FEIS is a culmination of activities that included both internal, Tribal, and public scoping that are described in the following paragraphs.

1.6.2. Tribal Government Scoping

In January, 2017, NMFS sent letters to the following Tribal Governments who have expressed interest in the Upper Willamette River Basin:

- Burns Paiute Tribe
- Columbia River Inter-Tribal Fish Commission
- The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
- The Confederated Tribes of Grand Ronde
- Confederated Tribes of Siletz Indians
- Confederated Tribes of the Umatilla Indian Reservation
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Coquille Indian Tribe
- Cow Creek Band of Umpqua Tribe of Indians
- The Klamath Tribe

The purpose of the letters was to inform the Tribes of NMFS' review of the HGMPs under the ESA and NEPA and to identify any specific interests and/or issues from the Tribe's perspectives. The Burns Paiute Tribe was the only Tribal government to respond back to NMFS from this request.

1.6.3. Notices of Public Scoping and Public Review and Comment

Public scoping for this EIS commenced with publication of a Notice of Intent in the Federal Register on December 15, 2016 (81 FR 90787). The comment period was open for 45 days to gather information on the scope of the issues and the range of alternatives to be analyzed in the EIS. At the same time, all of the spring Chinook salmon HGMPs were available for public review and comment for 60 days. The HGMPs provided information to help inform the public of the upcoming DEIS. Public review of the HGMPs is also required under limit 5 of the ESA 4(d) Rule**.**

On March 23, 2018, the DEIS was released and made available for public review and comment for 45 days (83 FR 12753, March 23, 2018). NMFS received a request to extend the public review. The extension was granted and the public comment period closed on May 29, 2018 (83 FR 18554, April 27, 2018).

NMFS developed a website for the EIS and associated HGMPs at:

https://www.westcoast.fisheries.noaa.gov/hatcheries/salmon_and_steelhead_hatcheries.html

The website was available during the scoping period, DEIS public review and comment, FEIS public review, and will be updated and available throughout the project duration.

1.6.4. Written Comments

Written comments received on the DEIS during the public scoping process included:

- 1 from non-governmental organizations
- 1 from individual citizen
- 3 from non-governmental organizations

Written comments received on the DEIS during public review included:

- 1 from government agencies
- 5 from non-governmental organizations
- 4 from individual citizens

1.6.5. Issues Identified During Scoping

- In the McKenzie River, many details of the reintroduction effort above Cougar Dam using the hatchery program need to be further explained in the HGMP. Further details on the guidelines and protocols for integrating natural-origin salmon into the McKenzie spring Chinook salmon hatchery broodstock needs to be clarified. The scientific basis for the hatchery program need to be further elaborated. The hatchery program has two primary purposes: recover the wild population and provide harvest mitigation opportunities on hatchery salmon.
- The HGMPs are not stand alone management plans in isolation of other mandates. Hatchery management must take into account the Biological Opinion for the Willamette Project and the federal recovery plan for salmon and steelhead in the Upper Willamette River.
- Consideration should be given to initiating a conservation hatchery salmon program for the Calapooia River, where natural-origin spring Chinook are nearly extinct. Since the removal of barrier dams, salmon have not recovered and need artificial intervention to boost abundances.

1.6.6. Future Public Review and Comment

NMFS has reviewed all public comments received on the DEIS. This FEIS is revised based upon this public review. The final draft of the EIS will be available for review via a federal register notice. After

this, any public comments will again be considered. After this, a Record of Decision (ROD) will be completed describing the alternative chosen by NMFS for this project.

1.7. Relationship to Other Plans and Policies

In addition to NEPA and ESA for hatchery authorizations, other plans and policies also affect hatchery management in the Upper Willamette River Basin. They are summarized below to provide additional context for the hatchery programs in the UWR.

1.7.1. Recovery Plans for Upper Willamette Salmon and Steelhead

For ESA species, a Federal recovery plan must be developed by the lead Federal agency. For UWR salmon and steelhead, NMFS finalized this recovery plan in 2011. This recovery plan specifies the key limiting factors/threats for each population in the UWR ESU and DPS. For hatcheries, the recovery plan describes the actions needed in order to reduce the impacts of hatchery fish on the conservation and recovery of UWR salmon and steelhead.

1.7.2. Native Fish Conservation Policy

Oregon's Native Fish Conservation Policy helps guide the management of hatcheries and fishery harvest as it relates to conserving and recovering wild fish species (ODFW 2002). This policy was enacted in 2002 and replaced the former Wild Fish Policy. One of the requirements of this policy is to develop and implement conservation plans for fish species. In areas where ESA listed salmon and steelhead occur, a federal recovery plan meets this need. For other non-listed salmonids, Oregon develops the state conservation plan. The HGMPs under evaluation reflect decisions made by ODFW under this policy..

1.7.3. Clean Water Act

The Clean Water Act (33 USC 1251, 1977, as amended in 1987), administered by the U.S. Environmental Protection Agency and state water quality agencies, is the principal Federal legislation directed at protecting water quality. Each state implements and carries forth Federal provisions, as well as approving and reviewing National Pollutant Discharge Elimination System (NPDES) applications, and establishing total maximum daily loads for rivers, lakes, and streams. The states are responsible for setting the water quality standards needed to support all beneficial uses, including protection of public health, recreational activities, aquatic life, and water supplies.

The Oregon Department of Environmental Quality (ODEQ) is the agency responsible for carrying out the provisions of the Federal Clean Water Act within Oregon. The agency is responsible for establishing water quality standards, making and enforcing water quality rules, and operating waste discharge permit programs. Hatchery operations are required to comply with the Clean Water Act and governed by NPDES permits.

1.7.4. Bald Eagle and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 USC. 668-668c), enacted in 1940 and amended several times since then, prohibits the taking of bald eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." The U.S. Fish and Wildlife Service, who is responsible for carrying out provisions of this Act, define "disturb" to include a "decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." Changes in hatchery production have the potential to affect eagle productivity through changes in its prey source (salmon and steelhead).

1.7.5. Marine Mammal Protection Act

The Marine Mammal Protection Act (MMPA) of 1972 (16 USC 1361), as amended, establishes a national policy designated to protect and conserve wild marine mammals and their habitats. This policy was established so as not to diminish such species or populations beyond the point at which they cease to be a key functioning element in the ecosystem, nor to diminish such species below their optimum sustainable population. All marine mammals are protected under the MMPA.

NMFS is responsible for reviewing Federal actions for compliance with the MMPA. Changes in fish production can indirectly affect marine mammals by altering the number of available prey (salmon and steelhead). In addition, separately from the proposed action, NMFS is currently reviewing an application to lethally remove sea lions at Willamette Falls because of excessive predation of winter steelhead in accordance with the MMPA (82 FR 52038)

1.7.6. Executive Order 12898

In 1994, the President issued Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority and Low-income Populations*. The objectives of the Executive Order include developing Federal agency implementation strategies, identifying minority and low-income populations where

proposed Federal actions could have disproportionately high and adverse human health and environmental effects, and encouraging the participation of minority and low-income populations in the NEPA process. Changes in hatchery production have the potential to affect the extent of harvest available for minority and low-income populations.

1.7.7. Secretarial Order 3206

Secretarial Order 3206 (*American Indian Tribal Rights, Federal-Tribal Trust Responsibilities and the ESA*) issued by the Secretaries of the Departments of Interior and Commerce, clarifies the responsibilities of the agencies, bureaus, and offices of the departments when actions taken under the ESA and its implementing regulations affect, or may affect, Indian lands, tribal trust resources, or the exercise of American Indian tribal rights as they are defined in the order. Secretarial Order 3206 acknowledges the trust responsibility and treaty obligations of the United States toward tribes and tribal members, as well as its government-to-government relationship when corresponding with tribes. Under the order, NMFS and the U.S. Fish and Wildlife Service (Services) "will carry out their responsibilities under the [ESA] in a manner that harmonizes the Federal trust responsibility to tribes, tribal sovereignty, and statutory missions of the [Services], and that strives to ensure that Indian tribes do not bear a disproportionate burden for the conservation of listed species, so as to avoid or minimize the potential for conflict and confrontation."

More specifically, the Services shall, among other things, do the following:

- Work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems (Section 5, Principle 1)
- Recognize that Indian lands are not subject to the same controls as Federal public lands (Section 5, Principle 2)
- Assist Indian tribes in developing and expanding tribal programs so that healthy ecosystems are promoted and conservation restrictions are unnecessary (Section 5, Principle 3)
- Be sensitive to Indian culture, religion, and spirituality (Section 5, Principle 4)

1.7.8. The Federal Trust Responsibility

The United States government has a trust or special relationship with Indian tribes. The unique and distinctive political relationship between the United States and Indian Tribes is defined by statutes, executive orders, judicial decisions, and agreements and differentiates tribes from other entities that deal with, or are affected by the Federal government. Executive Order 13175, Consultation and Coordination

with Indian Tribal Governments, states that the United States has recognized Indian tribes as domestic dependent nations under its protection. The Federal government has enacted numerous statutes and promulgated numerous regulations that establish and define a trust relationship with Indian tribes. The relationship has been compared to one existing under common law trust, with the United States as trustee, the Indian tribes or individuals as beneficiaries, and the property and natural resources of the United States as the trust corpus (Cohen 2005). The trust responsibility has been interpreted to require Federal agencies to carry out their activities in a manner that is protective of Indian treaty rights. This policy is also reflected in the March 30, 1995, document, Department of Commerce - American Indian and Alaska Native Policy (U. S. Department of Commerce 1995).

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Five alternatives are evaluated in this EIS: (1) status quo hatchery programs with no integration of natural-origin fish into hatchery broodstocks (No-action), (2) allow integration of natural-origin fish into hatchery broodstocks, (3) reduce hatchery production to conservation (reintroduction) needs (no fishery mitigation), (4) terminate the existing hatchery programs in the Upper Willamette River Basin, and (5) increase hatchery production to support fisheries consistent with ESA impact limits. No other alternatives that would meet the purpose and need were identified that would be appreciably different from the five alternatives described below (see Subsection 2.5, Alternatives Considered But Not Analyzed in Detail, for further description of alternatives considered but not analyzed in detail).

Current Hatchery Programs

Currently in the UWR, spring Chinook salmon, summer steelhead, and rainbow trout are released into various subbasins (Table 2). For the spring Chinook salmon hatchery program, over 5 million juvenile fish are currently released into the Molalla, North Santiam, South Santiam, McKenzie, Middle Fork Willamette and Coastal Fork Willamette river basins (Table 2). Summer steelhead are not native to the UWR, but are released to increase harvest opportunities as discussed in greater detail below. Over 500,000 hatchery juvenile summer steelhead are released into the North Santiam, South Santiam, McKenzie, Middle Fork Willamette, and mainstem Willamette rivers (Table 2). Rainbow trout (non-native Cape Cod stock) are sterilized prior to release and nearly 1 million hatchery fish are released throughout the UWR (Table 2).

Additional details of the hatchery programs, including past releases, are summarized in Section 3.4 below.

Table 2. Release of hatchery fish in the Upper Willamette River Basin under the various alternatives considered in this EIS.

Alternative	Species	Number of fish released							
		Molalla	**North Santiam**	**South Santiam**	**McKenzie**	**Middle Fork Willamette**	**Coastal Fork Willamette**	**Mainstem Willamette**	**Total**
1 and 2	Spring Chinook	100,000	704,000	1,021,000	787,000	2,300,000[1]	267,000	0	**5,179,000**
	Steelhead[2]	0	121,000	161,500	108,000	88,428	0	68,572	**547,500**
	Rainbow[3] trout	Reservoirs throughout Upper Willamette River Basin and McKenzie River							**963,517**
3	Spring Chinook	100,000	630,000	350,000	604,750	1,672,000	0	0	**3,356,750**
	Steelhead[4]	0	121,000	161,500	0	0	0	0	**282,500**
	Rainbow trout								0
4	Spring Chinook	0	0	0	0	0	0	0	0
	Steelhead	0	0	0	0	0	0	0	0
	Rainbow trout								0
5	Spring Chinook	150,000	1,060,000	1,500,000	1,200,000	3,500,000	400,000	0	**7,780,000**
	Steelhead	0	180,000	242,000	162,000	132,000	0	103,000	**822,000**
	Rainbow trout	Rainbow trout same as Alternatives 1 and 2.							**963,517**

Source: Submitted HGMPs, Hatchery operation plans, and this EIS.
[1] Includes 100,000 sub-yearlings released into Hills Creek Reservoir in the fall.
[2] Summer steelhead
[3] Rainbow trout are released in numerous locations (see Table 12below)
[4] Winter steelhead (new program)
[5] Assume summer steelhead

2.1. Alternative 1 (No-action): Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under this alternative, NMFS would not approve the four HGMPs recently submitted by the co-managers under limit 5 of the ESA 4(d) Rule. The hatchery programs would continue to operate in accordance with the Biological Opinion on the Willamette Project (NMFS 2008), except for RPA 6.2.2 related to genetically integrated broodstocks. The co-managers would not have authorization under the Incidental Take Statement of the Biological Opinion to incorporate natural-origin spring Chinook salmon and/or winter steelhead into the hatchery broodstocks (an additional ESA authorization is needed to purposefully take natural-origin fish for broodstock). The existing ESA coverage provided by NMFS (2008) (except for broodstock integration) would continue to be in effect. This consultation only authorizes the incidental take associated with the hatchery programs. The intentional, purposeful take of natural-origin fish for broodstock is considered direct take, and would not be allowed under this alternative.

The co-managers could choose to continue to operate the existing hatchery programs under status quo conditions and not incorporate natural-origin fish into the hatchery broodstocks. There would be some risks and benefits from not incorporating natural-origin fish into the broodstocks. For purposes of this analysis, NMFS has defined the No-action Alternative 1 as the choice by the co-managers to continue to operate the existing hatchery programs in compliance with NMFS (2008) except for RPA 6.2.2 that directs the incorporation of natural-origin salmon into the hatchery broodstocks. All of the activities associated with the existing hatchery programs and covered by NMFS (2008) would continue: salmon and steelhead would be collected at the fish collection facilities, adult salmon would be reintroduced above the Federal dams, hatchery salmon would be collected for broodstock (no natural-origin fish), progeny would be incubated, reared and released, the hatchery facilities would use water for operation, and the hatcheries would discharge hatchery water effluent.

NMFS's No-action Alternative 1 represents the best estimate of what would happen in the absence of the new proposed Federal action.

2.2. Alternative 2 (Proposed Action/Preferred Alternative): Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under this alternative, NMFS would approve the recently submitted HGMPs for spring Chinook salmon by issuing an approval letter to the co-managers under limit 5 of the 4(d) Rule. The HGMPs would be

authorized in entirety and grant new ESA coverage for incidental and direct take associated with the spring Chinook hatchery programs in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers. The hatchery production levels, collection and rearing protocols, use of hatchery fish for supplementation above the Federal dams would all be authorized under this Alternative 2. The Best Management Practices (BMPs) used by ODFW for hatchery management would also continue as described in the submitted HGMPs.

The collection of natural-origin salmon for use in the hatchery broodstocks would occur at existing hatchery facilities and fish ladders associated with dams as under Alternative 1. No new facilities are proposed in the submitted HGMPs. In most cases, sufficient numbers of natural-origin broodstock can be collected at these facilities during the course of the salmon run and collection of hatchery fish. This includes activities at Leaburg Dam, where hatchery fish may be trapped and removed, in order to reduce pHOS in the McKenzie River.

In addition, there are three other potential actions being evaluated as part of the proposed action: 1) initiation of a supplementation program for spring Chinook in the Calapooia River using adult hatchery spring Chinook salmon, 2) outplanting of adult winter steelhead above Mercer Dam on Rickreal Creek, and 3) initiation of a conservation hatchery program for winter steelhead in the North and South Santiam rivers for reintroduction above Corps dams, using natural-origin steelhead. These additional actions are being evaluated because the co-managers and other stakeholders have expressed interest in pursuing these actions in the future. These actions are further described below.

During the public scoping for this EIS, comments were received to consider a hatchery supplementation program for spring Chinook salmon in the Calapooia River due to very low returns of salmon observed over the last decade. Significant habitat restoration actions have occurred in the Calapooia River in recent years, including the removal of dams that impeded passage of salmon and steelhead in the Calapooia River. However, recovery of spring Chinook salmon has not occurred to date. Therefore, several stakeholders requested a possible supplementation program be evaluated for spring Chinook salmon in the Calapooia River. NMFS is considering this possible action as part of the proposed action and evaluating the impacts on the human environment of implementing this hatchery supplementation action for salmon in the Calapooia River.

Rickreal Creek, a tributary entering the Willamette River on the west side of the UWR Basin, has a run of winter steelhead, but the area is not considered essential for the recovery of the DPS (the four populations

on the eastside of the Willamette are the "core" populations for recovery; ODFW and NMFS (2011)). Mercer Dam currently blocks all passage of upstream migrating fish. Several stakeholders have been interested in passing fish above Mercer Dam into historical habitat upstream of the dam. To date, no winter steelhead have been passed above the dam due to uncertainties of fish survival through the reservoir and dam and lack of ESA authorization. Coho salmon, a non-native species to Rickreal Creek, have been passed upstream with success. In the future, there may be the possibility of also passing winter steelhead above Mercer Dam if stakeholders decide it is appropriate. NMFS is considering this possible action and evaluating the impacts on the human environment of implementing the action of passing winter steelhead above Mercer Dam.

Efforts to recover winter steelhead above Corps dams in the South Santiam and North Santiam rivers are underway in accordance with the improvements specified for passage and improved temperature control in the Biological Opinion for the Willamette Project (NMFS 2008). In the event insufficient returns of natural-origin winter steelhead are available in the future for reintroduction, a conservation hatchery program may be initiated (using natural-origin fish) for the sole purpose of reintroducing winter steelhead above the Corps dams in the North and South Santiam rivers (similar to current efforts for spring Chinook salmon). NMFS is assessing this possibility for winter steelhead in the North and South Santiam rivers in Alternative 2.

Best management practices (BMPs) are protocols for the operation of hatchery facilities and hatchery programs to appropriately meet the objectives of the hatchery program, including minimizing impacts on ESA-listed fish (IHOT 1995; HSRG 2004; Mobrand et al. 2005). The BMPs in these HGMPs include:

(1) providing specific-pathogen free water source for adult and juvenile fish holding
(2) ensuring adequate alarm systems are in operation to protect rearing fish from flow disruptions
(3) ensuring that water supplies have back-up power generation in case of an electrical outage to protect rearing fish
(4) requiring appropriate disinfection procedures to prevent pathogen transmission between stocks of fish onsite
(5) providing the correct amount and type of food to achieve desired growth rates
(6) adequately screening hatchery intake water supplies to prevent fish loss
(7) ensuring that the hatchery is operated in compliance with its NPDES permit
(8) documenting the survival and production of hatchery fish at each life stage while in the hatchery.

(9) outplanting surplus carcasses from the hatchery for nutrient enhancement in the ecosystem, if appropriate according to pathology guidelines.

For the purpose of this analysis, NMFS treats the Proposed Action Alternative as implementing the hatchery production of salmon and steelhead as proposed in the HGMPs provided in 2016 and 2018 for spring Chinook salmon and steelhead. For hatchery rainbow trout, NMFS did not consider using natural-origin rainbow trout for this program. All of the following activities would occur: broodstock collection; spawning, rearing, and release of hatchery fish; and facility operation including water intake and discharge.

2.3. Alternative 3: Reduce Hatchery Production to Reintroduction Needs

Under this alternative, the co-managers would produce only enough hatchery fish for reintroduction of adult salmon and steelhead above the Corps dams (and other areas as deemed appropriate). The hatchery programs would be managed solely for conservation and recovery purposes and providing enough returning adult salmon and steelhead for outplanting in under-utilized historical habitats. This alternative would reduce hatchery smolt releases compared to the No-action alternative (Table 2).

This alternative was crafted based on the proposed Chinook HGMPs, which identify hatchery production levels needed for reintroduction purposes above the Corps dams. NMFS is using these production levels for this alternative. The production numbers are shown in Table 2. The purpose of analyzing a reduced production alternative is that most hatchery-related impacts vary with the number of smolts released.

The proposed HGMPs for spring Chinook salmon specify a total maximum production of 5.179 million smolts annually (Alternatives 1 and 2; Table 2). The above production levels equate to 3.357 million smolts annually. Therefore, Alternative 3 would reduce hatchery Chinook production by 32% compared to Alternative 2 (Proposed Action/Preferred Alternative; Table 2). In all other respects (e.g., facility operations, monitoring, etc.), the proposed action would remain the same; except broodstock integration rates using natural-origin fish would be higher because fewer returning adult fish would require the program to incorporate more natural-origin fish into the hatchery production.

For steelhead, presently the only hatchery program propagates out-of-DPS summer steelhead. This stock is produced solely for fishery mitigation and has no conservation or recovery benefits for the DPS. For this alternative, all of the existing hatchery production for summer steelhead in the North Santiam and

South Santiam (282,500 smolts/year) is evaluated as being transferred over to winter steelhead production solely for conservation/reintroduction purposes. Returning hatchery winter steelhead would be available for outplanting above the Corps dams in the North and South Santiam, similar to spring Chinook salmon.

- North Santiam winter steelhead production level: 121,000 smolts/year
- South Santiam winter steelhead production level: 161,500 smolts/year

For the rainbow trout hatchery program, there are no conservation/reintroduction benefits that could be used from the rainbow trout hatchery program using non-local, Cape Cod stock. Therefore, under Alternative 3, there would be no rainbow trout hatchery program. The hatchery programs for spring Chinook and winter steelhead, as described above, would fulfill the reintroduction needs specified for this alternative.

NMFS's 4(d) regulations do not provide NMFS with the authority to order changes of this magnitude as a condition of approval of the HGMPs. NMFS's 4(d) regulations require NMFS to make a determination that the HGMPs, as submitted by the USACE, either meet or do not meet the standards prescribed in limit 5 of the 4(d) Rule. Nonetheless, NMFS supports analysis of this alternative to assist with a full understanding of potential effects on the human environment under various hatchery management scenarios.

2.4. Alternative 4: Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under this alternative, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. All of the activities associated with the hatchery programs would be terminated: no hatchery fish would be released, no broodstock would be collected at trapping locations, trapping facilities would be removed, no returning hatchery fish would be removed from various locations, the hatchery facilities would not use water for operation, and the hatcheries would not discharge hatchery water effluent. All salmon and steelhead currently being raised in hatchery facilities would be released or killed, and no additional broodstock would be collected. The existing fish collection facilities (i.e. Minto Dam FF, Foster Dam FF, Dexter Dam FF) would continue to be used to collect only natural-origin salmon for reintroduction above the federal dams. No hatchery salmon or steelhead would be available for reintroduction because the program would be terminated.

This alternative would not be expected to meet the purpose and need for action because termination of the spring Chinook salmon hatchery programs is not supported by NMFS (2008) Biological Opinion for the Willamette Project. However, NMFS will describe the effects of this action in Alternative 3 in order to gain a better understanding of the potential effects on the human environment under various management scenarios ranging from termination of the hatchery programs (this Alternative) to increased hatchery production (Alternative 5).

2.5. Alternative 5: Increase hatchery production to support fisheries consistent with ESA impact limits

Under this alternative, the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. The increased hatchery production would allow for increased fishery harvest opportunities on hatchery produced fish in recreational and commercial fisheries in the ocean and freshwater. NMFS has approved Fisheries Management and Evaluation Plans (FMEPs; NMFS 2001a; NMFS 2001b) that specify the allowable fishery impacts on UWR spring Chinook salmon and winter steelhead when in freshwater. Since there are unused fishery impacts that are below the maximum authorized by the FMEPs, the additional hatchery production under Alternative 5 could be targeted in fisheries while still being within the confines of the ESA-approved FMEPs.

For this alternative, NMFS evaluated a total hatchery production level of 8.6 million salmon and steelhead smolts (900,000 pounds/year) produced annually from UWR hatchery facilities. This production level has been produced in the past using existing water rights and existing hatchery facilities. This alternative therefore represents a reasonable alternative that includes approximately 33% greater hatchery production than Alternatives 1 and 2.

2.6. Alternatives Considered But Not Analyzed in Detail

The following alternatives will not be evaluated in detail. These alternatives are eliminated because (1) they do not meet the purpose and need for the action, and/or (2) they are not meaningfully different from the five alternatives described above and would not supply additional information that would inform the decision-making process.

2.6.1. Change Locations of the Hatchery Programs Releases

Under this possible alternative, changes to the locations where hatchery fish are currently being released would be implemented. Such a modification might be considered in an attempt to reduce hatchery effects in the natural population areas for spring Chinook salmon and winter steelhead. This potential alternative was eliminated from further analysis because changes to hatchery fish release locations are not substantially different than the scope of alternatives being considered and would not result in meaningfully different impacts on the human environment, , such as genetic effects or competition and predation impacts associated with hatchery operations. Any changes to release locations would not substantively alter the range of impacts already being considered in the identified alternatives.

2.6.2. Attaining Hatchery Program Goals by Alternative Actions and Reforms

In each of the HGMP's, section 1.16 describes alternative actions and reforms that were considered by the co-managers that could be implemented to meet hatchery program goals and objectives. These alternative actions would change hatchery fish release locations, modify adult collection techniques and infrastructure, and/or make necessary improvements to the hatchery facilities if funding was available, while still meeting the original goals and objectives of the hatchery program. These identified alternative actions in the HGMPs were not further considered because the actions were not meaningfully different than the proposed actions in the HGMPs and do not provide additional information on the scale of effects to further inform decision making within the Willamette River Basin.

2.6.3. Evaluate the HGMPs under Section 10(a)(1)(A) of the ESA, instead of Limit 5 of the 4(d) Rule

Under this possible alternative, NMFS would determine that the hatchery programs, as described in the HGMPs, meet the requirements for a section 10(a)(1)(A) enhancement take permit. Under this possible alternative, the only change from the Proposed Action would be a difference in which process mechanism ESA compliance is obtained for these hatchery programs. Consequently, this potential alternative would not be meaningfully different from the Proposed Action and will not be analyzed in detail.

3. AFFECTED ENVIRONMENT

3.1. Introduction

Chapter 3, Affected Environment, describes current conditions for seven resources that may be affected by implementation of the alternatives:

- Water quantity (Subsection 3.2)
- Water quality (Subsection 3.3)
- Salmon and Steelhead and Their Habitats (Subsection 3.4)
- Other Fish and Their Habitats (Subsection 3.5)
- Wildlife (Subsection 3.6)
- Socioeconomics (Subsection 3.7)
- Environmental justice (Subsection 3.8)

No other resources were identified during internal scoping that would potentially be impacted by the Proposed Action or alternatives. Current conditions include effects of the past operation of Chinook salmon, summer steelhead, and rainbow trout hatchery programs in the Upper Willamette River Basin.

The project area is the geographic area where the Proposed Action would take place. It includes the watersheds where fish would be spawned, incubated, reared, acclimated, released, or harvested under the proposed hatchery programs (Subsection 1.4, Project Area). Each resource's analysis area includes the project area as a minimum area, but may include locations beyond the project area if effects would be expected to occur outside the project area (Subsection 1.4, Project Area).

3.2. Water Quantity

Hatchery programs can affect water quantity when they take water from a well (groundwater) or a neighboring tributary streams (surface water) to use in the hatchery facility for broodstock holding, egg incubation, juvenile rearing, and juvenile acclimation. All water, minus evaporation, that is diverted from a river or taken from a well is discharged to the adjacent river from which the water was appropriated after it circulates through the hatchery facility (non-consumptive use)(Table 3). When hatchery programs use groundwater, they may reduce the amount of water for other users in the same aquifer. When hatchery programs use surface water, they may lead to dewatering of the stream between the water intake and discharge structures, which may impact fish and wildlife if migration is impeded or dewatering leads to reduced habitat areas and/or increased water temperatures. Generally, water intake and discharge

structures are located as close together as possible to minimize the area of the stream that may be impacted by a water withdrawal for the hatchery facility.

A water right permit is required for all groundwater withdrawal except those supporting single-family homes. All hatchery wells used by hatchery facilities supporting hatchery programs in the Upper Willamette River Basin are permitted by the Oregon Department of Water Resources (OWRD 2013). No hatchery facilities are located in areas designated by Oregon as Critical Groundwater Areas (OWRD 2013). For surface water use, each hatchery facility has a designated water right (Table 3) issued by the State of Oregon.

Streamflows within the watersheds where the hatchery facilities are located in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers is driven predominantly by rain (PNERC 2016). All of these watersheds drain the Cascade Mountain Range. The quantity of water within the streams and rivers is typically greatest from November through March and tapers off to the lowest streamflow conditions in August through October (PNERC 2016). Snow melt and groundwater discharge into streams and river depends upon elevation and variation in snowpack. Management of the dams and reservoirs in each of the watersheds controls discharge in the mainstem rivers below the Federal dams. In general, discharge is greater than natural conditions in the summertime and lower than natural conditions during certain periods of the wintertime (floodcontrol).Water diversions for agricultural and municipal purposes occur in each of the watersheds.

Ten main hatchery facilities are currently used to support the hatchery programs within the Upper Willamette River Basin (Figure 1). All of the hatchery facilities use surface water as their primary water source (Table 3). The South Santiam and Willamette hatcheries also use a very small amount of groundwater during specific time periods for incubating eggs in the hatchery. The length of stream affected by the hatchery's water withdrawal (from the inlet to outlet) ranges from 370 to 7,339 feet in length for the ten hatchery facilities (Table 3). The longest distance between intake and outlet occurs at the Willamette Hatchery which uses water from Salmon Creek and empties into the Middle Fork Willamette River. While this does reduce the flow of water in Salmon Creek, it should be noted that salmon do not currently have access into the creek.

The maximum allowable water use permitted by the hatchery's surface water right ranges from 32 to 100 cubic feet per second (cfs; Table 3). However, most of the hatchery facilities do not use their full water right throughout the entire year. Water use depends upon fish production levels and the capacity of the

hatchery facility. During the lowest streamflow periods throughout the year (typically August through October), each hatchery facility uses only a small fraction of their full water right (Table 3).

Table 3. Water source and use by hatchery facility. See Appendix 1 for HGMP citations.

Hatchery Facility	Maximum Surface Water Use Permitted by Water Right (cfs)	Maximum Groundwater Use Permitted by Water Right (cfs)	Surface Water Source	Minimum Mean Monthly Surface Water Flows during Facility Operation cfs (month)	Actual Surface Water Use (cfs) by Hatchery Facility During Minimum Mean Monthly Surface Flows (previous column)[1]	Maximum length of stream affected by hatchery water withdrawal (feet)[2]	Discharge Location
Marion Forks Hatchery	34	0	Marion Creek	438 (NF Santiam upstream of Detroit Dam; September)	18.5	4,840	Horn Creek
Marion Forks Hatchery	32	0	Horn Creek		3.01	790	Horn Creek
Minto Dam FF	60	0	North Santiam River	1,010 (August)	40.5	370	North Santiam River
Roaring River Hatchery	25	0	Roaring River	NA[3](October)	5.93	1,500	Roaring River
South Santiam Hatchery	NA[3]	0.11	South Santiam River	759 (August)	25.9	NA[3] (reservoir withdrawal)	South Santiam River
Foster Dam FF	NA[3]	0	South Santiam River	759 (August)	NA[3]	NA[3] (reservoir withdrawal)	South Santiam River
Leaburg Hatchery	0.33	NA[3]	Spring	NA[3]	0	NA[3]	McKenzie River
	100	NA[3]	McKenzie River	2,200 (Vida gage) (September)	85.6	2,632	McKenzie River
McKenzie Hatchery	50	0	McKenzie River		50	NA[3] (canal withdrawal)	McKenzie River
	201	0	Cogswell Creek	NA (September)	2.2	1,892	McKenzie River

Hatchery Facility	Maximum Surface Water Use Permitted by Water Right (cfs)	Maximum Groundwater Use Permitted by Water Right (cfs)	Surface Water Source	Minimum Mean Monthly Surface Water Flows during Facility Operation cfs (month)	Actual Surface Water Use (cfs) by Hatchery Facility During Minimum Mean Monthly Surface Flows (previous column)[1]	Maximum length of stream affected by hatchery water withdrawal (feet)[2]	Discharge Location
Willamette Hatchery	87.5	0.92	Salmon Creek	1,050 (MF Willamette near Oakridge; August)	80.6	7,339	Salmon Creek
Dexter dam FF	35	0	MF Willamette River	1,740 (July)	35	NA[3] (reservoir withdrawal)	Middle Fork Willamette

[1]Monthly hatchery facility water use data reported by ODFW for Water Year 2015-16.

[2]Reported values are the maximum distance from intake of water supply to discharge point at the outfall of the hatchery facility. Some hatchery facilities have two water intake sources and the farthest intake from the facility is reported here to represent the maximum stream reach affected. Lengths were estimated visually using Google Earth.

[3]Not available or applicable.

3.3. Water Quality

Hatchery programs can affect the water quality of the adjacent stream or river from the discharge of effluent from the hatchery facility. There are potentially seven rivers or streams within the UWR affected by the operation of the hatchery facilities. The seven rivers are shown in Table 3 and Figure 1. Each of the hatchery facilities is required to have a National Pollutant Discharge Elimination System (NPDES) permit administered by the Oregon Department of Environmental Quality under the Clean Water Act. Monitoring and compliance with the permits is verified on a regular basis by testing the water quality below the hatchery to determine if discharge is within the specified limits. The most common substances found in the effluent of UWR hatcheries are ammonia, nitrogen, phosphorus, and antibiotics. Bacteria, parasites, and viruses can also be transmitted from the hatchery fish to the effluent. These substances and organisms are a byproduct of hatchery fish rearing and treating the fish to ensure high survival while being grown at very high densities.

The affected environment from the discharge of effluent from the hatchery facilities occurs from the point of discharge downstream until thorough mixing occurs in the adjacent stream or river. Even though the discharges are within the criteria of the hatchery facilities NPDES permit administered by the Oregon Department of Environmental Quality, the effluent may affect water quality, and disease and pathogen load below the hatchery facility. Bartholomew (2013) showed the effluent discharge effects to be short-lived and extending downstream for less than 200 meters before it became undetectable. Each of the hatchery facilities are required by their NPDES to circulate the effluent through an abatement pond to settle out uneaten food, fish waste, and any other substances not in solution. The South Santiam Hatchery is an exception because it does not have an effluent settlement pond, so current practices restrict the number of ponds to be cleaned at a given time in order to comply with the NPDES permits. After this, the effluent is then discharged into the adjacent stream or river to help reduce the effects on the adjacent stream or river near the hatchery facility.

The release of hatchery fish from the facilities are exposed to the broader range of water quality conditions throughout the watershed as smolts, jacks, and adults migrating to and from the ocean. Hatchery fish can contribute marine-derived nutrients to the watershed if they spawn naturally or die before being collected at the hatchery facility or harvested. The current condition of most streams and rivers within the UWR are in violation of one or more of the Federal Clean Water Act 303(d) standards (Figure 2). Dissolved oxygen, lead, mercury, temperature, weeds and algae are the current 303(d) listings for the UWR. Lack of riparian shade, effects of dams, and poor agricultural and forestry practices

are some of the causes for the 303(d) listings. The hatchery facilities are not identified as a cause for any of the current 303(d) listings within the UWR. Most of the streams and rivers have 303(d) listings and are not affected in any way by the operation of the hatchery programs.

3.4. Salmon and Steelhead and Their Habitats

This section describes the salmon and steelhead affected by the proposed action, the current status of these populations in the UWR, and past and present hatchery fish releases. This information informs the comparison of alternatives in Chapter 4, Environmental Consequences.

Within the UWR, natural populations of spring Chinook salmon and winter steelhead are present. Both species are listed under the ESA (79FR 20802, April 14, 2014) and critical habitat is designated for both species. The specific distribution, abundance, and habitat of each species are further described below.

Status of ESA-listed Salmon and Steelhead

3.4.1. Upper Willamette Spring Chinook Salmon

The Upper Willamette River Chinook salmon ESU, listed as threatened under the ESA on March 24, 1999 (64 FR 14308) and reaffirmed on June 28, 2005 (70 FR 37160) and April 14, 2014 (79 FR 20802), includes all naturally spawned populations of spring-run Chinook salmon upstream from Willamette Falls and in the Clackamas River. Natural populations include Chinook salmon in the North Santiam, the South Santiam, the McKenzie, the Middle Fork Willamette, and the Clackamas River basins. Hatchery Chinook salmon released from hatcheries located on the Clackamas, North Santiam, South Santiam, McKenzie, and Middle Fork Willamette Rivers are also part of the ESU.

The current threatened status of the Upper Willamette spring Chinook salmon ESU is a result of numerous factors affecting their health. Most of the historical habitat available to spring Chinook salmon is currently blocked by impassable dams in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette rivers, operated by the Corps of Engineers as part of the Willamette Project. Efforts to reintroduce salmon and steelhead to their historical habitat above the dams are currently ongoing, with the success of these efforts dependent upon effective downstream passage of juvenile fish through the reservoirs and dams. The Biological Opinion for the Willamette Project (NMFS 2008) identifies the improvements necessary to reduce the effects of these dams on spring Chinook salmon.

Table 4. Water source and use by hatchery facility and applicable 303(d) listings.

Hatchery Facility	Stream or River Adjacent to Hatchery Facility	Compliant with NPDES Permit	Discharges Effluent into a 303(d) Listed Water Body	Impaired Parameters	Cause of Impairment as identified by NMFS (2008) and ODEQ (2009)
Marion Forks	Horn and Marion creeks (near confluence with N Santiam R)	Yes	No	None	Not applicable
Minto Ponds	North Santiam River	Yes	Yes	Temperature, Dissolved oxygen	Riparian disturbance, canopy cover, riparian vegetation, dams
South Santiam	South Santiam River	Yes	Yes	Temperature	Riparian disturbance, canopy cover, riparian vegetation, dams
Roaring River	Roaring River	Yes	Yes	Temperature. Biological criteria	Riparian disturbance, canopy cover, riparian vegetation, forest and agriculture land management
Leaburg	McKenzie River	Yes	Yes	Temperature, Lead, Mercury	Riparian disturbance, canopy cover, riparian vegetation, natural and man-made sources
McKenzie	McKenzie River	Yes	Yes	Temperature, Lead, Mercury	Riparian disturbance, canopy cover, riparian vegetation, natural and man-made sources
Willamette	Salmon Creek	Yes	No	None	Not applicable
Dexter Ponds	Middle Fork Willamette River	Yes	Yes	Temperature, Aquatic weeds or algae	Riparian disturbance, canopy cover, riparian vegetation, dams

Source: ODEQ (2013).

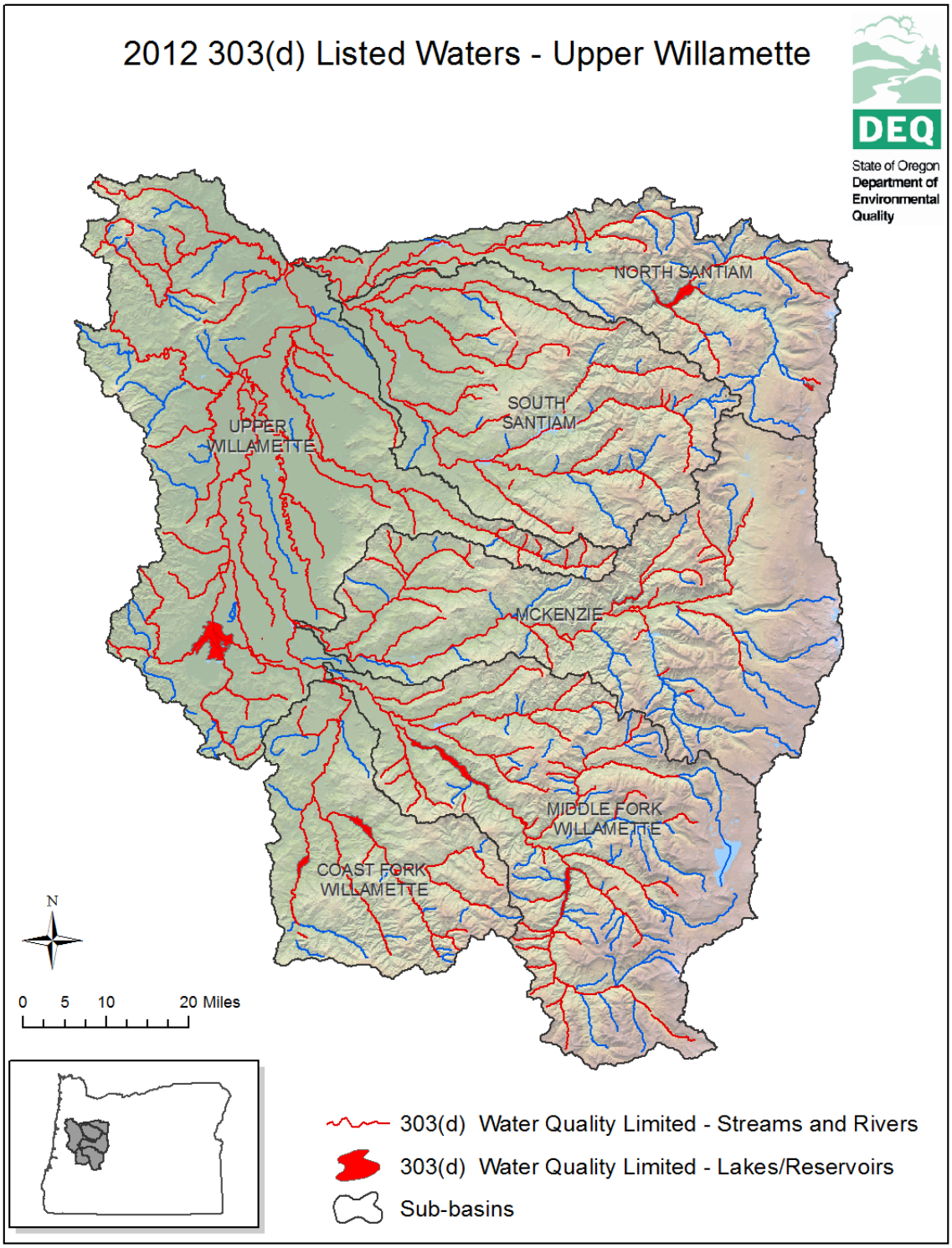

Figure 2. EPA 303(d) water-quality-impaired waters for the Upper Willamette River spring Chinook salmon ESU and winter steelhead DPS. Figure provided by ODEQ, P. Woolverton, personal communication, November, 2017.

Habitat degradation, particularly in the lowland areas of the Willamette Valley and lower Columbia River, has also reduced the quantity and quality of habitats used by both juvenile and adult spring Chinook salmon (ODFW and NMFS 2011). Mortality of adult spring Chinook salmon migrating back to spawning areas has been particularly troublesome, with some populations experiencing over 80% loss of adults prior to spawning (Figure 3). Poor water conditions and disease outbreaks for overcrowding below the dams has been the primary cause of the excessive mortality rates of adult UWR spring Chinook salmon (Bowerman et al. 2018). When spring Chinook have natural access to headwater habitat areas where the fish can over-summer in natural habitat, mortality rates have been very low (see McKenzie River in Figure 3). Fishery harvest rates have been reduced substantially since ESA listing and is no longer a key limiting factor for the ESU (ODFW and NMFS 2011). The generalized life history traits of UWR Chinook are summarized in Table 5. Today, adult UWR spring Chinook salmon begin appearing in the lower Willamette River in January, with fish entering the Clackamas River as early as March. The majority of the run ascends Willamette Falls from late April through May, with the run extending into mid-August (Myers et al. 2006). Chinook migration past the falls generally coincides with a rise in river temperatures above 50°F (Mattson 1948; Howell et al. 1985; Nicholas 1995).

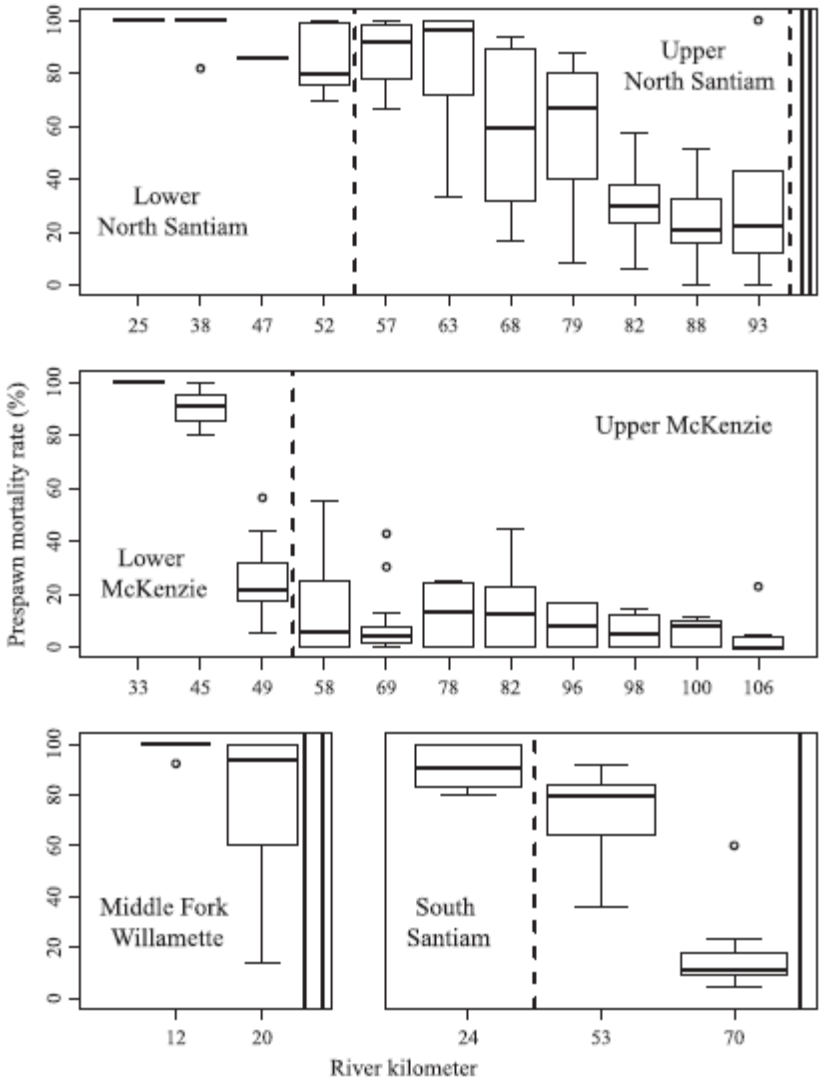

Figure 3. Mortality rates of adult spring Chinook salmon prior to spawning in populations of the UWR ESU. Figure from Bowerman et al. (2018).

Table 5. A summary of the general life history characteristics and timing of UWR Chinook salmon. Data are from numerous sources.

Life History Trait	Characteristic
Willamette River entry timing	January-April; ascending Willamette Falls April-August
Spawn timing	August-October, peaking in September
Spawning habitat type	Large headwater streams
Emergence timing	December-March
Rearing habitat	Rears in larger tributaries and mainstem Willamette
Duration in freshwater	12-14 months; sometimes 2-5 months
Estuarine use	Days to several weeks
Life history type	Stream
Ocean migration	Predominantly north, as far as southeast Alaska
Age at return	3-6 years, primarily 4-5

The following information was assembled from the most recent status review (NWFSC 2015), and focuses on the main four independent populations of spring Chinook salmon upstream from Willamette Falls; North Santiam, South Santiam, McKenzie, and Middle Fork Willamette River basins.

Chinook salmon counts at Willamette Falls have been undertaken since 1946, when 53,000 Chinook salmon were counted; however, not until 2002 with the return of nearly 100% marked hatchery-reared fish was it possible to inventory naturally-produced spring Chinook salmon with any accuracy. Fish returning in2002 benefitted from very good ocean conditions and the calculated trend since then (nearly -10%annually) is influenced by that peak; in any event, the last five years (2010-2014) have also seen a downward trend in natural-origin adult returns, with an overall geometric mean of 9,269 fish (Figure 4,).

Adult natural-origin spring Chinook salmon returns to the North Santiam River, as measured at Bennett Dam and through redd and carcass surveys, have exhibited an increase in abundance in contrast to many of the other populations in the ESU and the combined count at Willamette Falls (Figure 4). This may be related to improved fish passage at Bennett Dam, resulting in a decrease in subsequent pre-spawning mortality, or it may be related to temperature-control operations at Detroit Dam that have resulted in a more “normal” incubation temperature regime for Chinook salmon. Estimates of NORs at Bennett Dam

from 2001-2005 ranged from 217 to 721, geometric mean of 514. Furthermore, of those fish that passed Bennett Dam from 2001-2005 some 63.2% were estimated to have died prior to spawning (in NWFSC (2016)). The current 5-year geometric mean of spring-run Chinook salmon ascending Bennett Dam is 1,372 (2010-2014), and the observed prespawning mortality during this period was only30.5% (**Table 6**).[2] Spawner abundance, based on redd count, is noticeably less than the Bennett Dam counts, 412 (2010-2014)[3], but exhibits a similar recent positive trend. Genetic analysis of returning adults suggests that there is some contribution to escapement by the progeny of hatchery-origin spawners transported above Detroit Dam. Presently, natural-origin fish that reach the fish handling facilities at Minto are transported above the fish barrier to spawn in the North Santiam reach between Minto and Big Cliff Dam. While this "sanctuary" reach is solely populated with unmarked adult Chinook salmon, temperature and dissolved gas conditions may contribute to elevated prespawning mortality levels.

Spring-run Chinook salmon adults returning to the South Santiam River are monitored via redd counts and carcass recoveries in the mainstem South Santiam. Carcass recoveries are used to estimate the proportion of NOR and HOR spawners. In addition, direct counts of returning adults are made at the Foster fish collection facility at Foster Dam, where only NORs are passed above the dam. Foster Dam counts may be biased by conditions at the adult trap below Foster Dam, because not all fish produced upstream of the dam are attracted to the trap. Additionally, some of the NORS that enter the trap may be the offspring of spawners from reaches below the dam.

For the available Foster Dam time series (2007-2014) the abundance of NOR spawners has exhibited a positive trend, although not significantly (due in part to the limited number of years) and ocean conditions during the initial years of the trend may have biased the trend; however, given the overall negative NOR abundance trend at Willamette Falls the South Santiam should be viewed in a more positive light. Prespawning mortality below and above Foster Dam averages 26.3%±5.4% and 33.3%±11.3%, respectively. Above Foster Dam PSM levels may be affected by past adult trap and haul handling protocols. Geometric mean abundance for natural-origin adults in the South Santiam River from 2010-2014 was 575. In addition, it appears that there is a very small number of Chinook salmon in Green Peter Reservoir that exhibit an adfluvial life history (Romer and Monzyk 2014); residing in freshwater their whole life and spawning above the reservoir in small tributary streams. Fish in the Green Peter Reservoir

[2] Table data reflects Bennett Dam counts to 2013.

[3]Differences between the Bennett Dam counts and redd-based spawner estimates suggest that prespawning mortality counts and redd counts and expansions contain considerable uncertainty.

are most likely the descendants of hatchery-origin fish released in the reservoir over the course of several years. Some juveniles may be able to migrate downstream to Foster Reservoir, although the contribution to the total population is likely negligible. While the presence of these fish confirms the continued suitability of the Middle Santiam River above Green Peter Dam for spawning and rearing, adaptation to the adfluvial life history may impact the productivity of the anadromous portion of the population if there is a high occurrence of this life history.

It appears that juvenile passage through Foster Dam is sufficiently high to sustain a naturally-spawning aggregation above the Dam, although total abundance is still quite low. Genetic analysis indicates that the replacement rates for the 2007 and 2008 brood years were 0.96 and 1.16,respectively(O'Malley et al. 2014). Efforts are currently underway to improve both adult collection and juvenile downstream passage at Foster Dam.

The status of spring-run Chinook salmon in the McKenzie River is monitored through both dam counts at Leaburg and Cougar dams, and through extensive spawner surveys (redd and carcass counts) throughout the basin. Genetic pedigree analysis of transported adults provides further information on the productivity of stream reaches above Cougar Dam. Numerous long-term abundance and life-history data sets exist for this population. Prior to the initiation of mass-marking for hatchery releases, hatchery contribution to spawning abundance was estimated through scale analysis, so it is possible to estimate NOR abundance prior to the 2002 return year.

Overall, McKenzie River spring-run Chinook salmon natural-origin abundance has declined to levels not seen since the time of listing. This decline has occurred despite the restoration of access to spawning habitat in the South Fork McKenzie River above Cougar Dam through a trap and haul program. Genetic pedigree based estimates of cohort replacement rate for the 2007 and 2008broodyears from hatchery adults released above the dam were both below replacement, 0.41 and0.31, respectively(Banks et al. 2014). Juvenile tagging studies suggest that total survival through Cougar Reservoir and Dam project has been poor (Beeman et al. 2013). While the effort to restore access to spawning habitat above Cougar Dam has resulted in the natural production of juveniles and returning adults, at the current levels for juvenile downstream passage and adult return there appears to be little net improvement in productivity. Overall, redd counts for the entire McKenzie River have declined over the last five years, suggesting a more systematic limiting factor. Both short-term and long-term trends for the entire population are negative (Figure 4, Table 6).

Chinook salmon in the Middle Fork Willamette River are monitored through redd and carcass surveys throughout much of the basin. In addition, fish are enumerated at both the Dexter Trap and at the Fall Creek trap below Fall Creek Dam. Presently, unmarked fish are transported above Fall Creek Dam. From 2006-2014, the pHOS for fish transported above Fall Creek Dam has averaged4.6% (±1.5%), while predominately marked hatchery fish are transported above Dexter Dam to the North Fork Middle Fork Willamette River and Hills Creek (above Hills Creek Dam). Fish transported above Dexter Dam are part of an experimental program to assess the potential for a sustained trap and haul process around the dams.[4] Although the transported hatchery-origin adults successfully reproduce, in the absence of adequate downstream juvenile fish passage facilities it is unlikely that this program currently provides any substantial direct benefit to population abundance or productivity. Alternatively, the progeny of fish passed above Fall Creek Dam have a much higher likelihood of successful downstream passage via the complete drawdown of Fall Creek Reservoir every fall. Based on returns to Fall Creek Dam, adult-to-adult return rates[5] have averaged 0.97 from 2010-2014. With the exception of spawning reaches above Fall Creek Dam, the remainder of the currently accessible portion of the Middle Fork Willamette Basin, below Dexter Dam and Fall Creek Dam, is subject to conditions that result in a very high prespawning mortality and very poor incubation and juvenile survival. Natural-origin spawners above Fall Creek averaged 138±40 fish from 2002-2014, with a slightly positive long-term trend. Estimates of prespawning mortality can be quite high in some years for the fish transported above Fall Creek Dam.[6] Of the hatchery-origin adults transported above Dexter Dam, prespawning mortalities have been high for fish transported to Hills Creek above Hills Creek Dam (49.3% 2012-14) compared to the North Fork Middle Fork Willamette River (39.0%, 2012-2014). Longer transportation times to Hills Creek are thought to be partially responsible for these differences (Naughton et al. 2015).

[4]As a secondary benefit, the progeny of transported fish provide forage for Bull Trout.

[5]Adult to adult rates calculated as NOR adults returning to Fall Creek Dam divided by the average number of adults (NOR and HOR) passed above Fall Creek Dam four and five years previously.

[6]Prespawning mortality is estimated from recovered carcasses and may be biased depending on the number and timing of surveys, the number of carcasses recovered, and the seasonal river conditions.

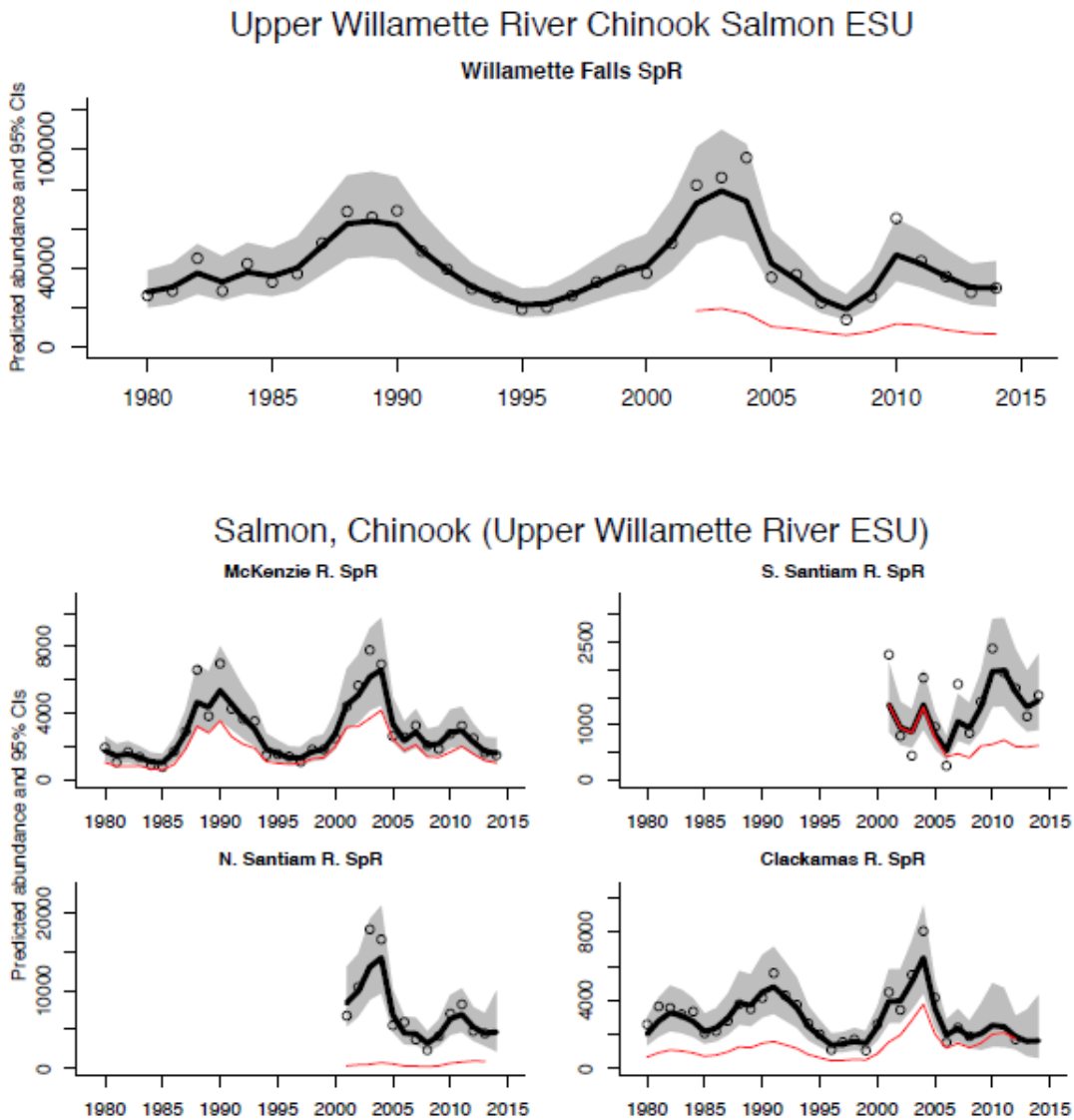

Figure 4. Smoothed trend in estimated total (thick black line) and natural (thin red line) Willamette Falls counts and population spawning abundance. Points show the annual raw spawning abundance estimates. Clackamas River data reflects counts at North Fork Dam. North Santiam River data reflect counts at Upper and Lower Bennett Dam. Figure 84 from NWFSC (2015).

Table 6. 5-year geometric mean of raw natural-origin spawner (NOS) counts. This is the raw total spawner count times the fraction NOS estimate, if available. In parentheses, 5-year geometric mean of raw total spawner counts is shown. A value only in parentheses means that a total spawner count was available but no or only one estimate of NOS available. North Santiam River data reflect counts at Upper and Lower Bennett Dam to 2013. The geometric mean was computed as the product of counts raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-year periods is shown on the far right. Based on Table 50 from NWFSC (2015).

Population	1990-94	1995-99	2000-04	2005-09	2010-14	% Change
Willamette Falls Spring Chinook	(39,891)	(26,608)	20,900 (66,906)	7,567 (25,547)	9,269 (38,630)	22 (51)
McKenzie	2,134 (3,583)	1,118 (1,539)	3,241 (5,100)	1793 (2,457)	1,446 (2,254)	-19 (-8)
N. Santiam			408 (12,064)	290 (4,136)	852 (5,963)	194 (44)
S. Santiam			1,108 (1,108)	450 (883)	575 (1,686)	28 (91)

Pre-spawning mortality levels are generally high in the lower tributary reaches where water temperatures and fish densities[7] are generally the highest. Areas immediately downstream of high head dams may also be subject to high levels of total dissolved gas (TDG). While the relationship between TDG levels and mortality is related to a complex interaction of fish species, age, depth, and history of exposure(Beeman and Maule 2006), the relative risks are quite high in some reaches. For example, natural-origin Chinook salmon and steelhead are passed above the barrier dam at the Minto fish facility into a short reach immediately below the Detroit/Big Cliff Dam complex. At certain times of the year, water spilled over Detroit and Big Cliff dams has the potential to produce high levels of TDG, which could affect a significant portion of the incubating embryos, in-stream juveniles, and adults in the basin, although the effect of this impact has not been quantified.

[7]Reaches downstream of fish hatcheries contain relatively large numbers of hatchery fish, which may also be more susceptible to pre-spawning mortality.

The apparent decline in the status of the McKenzie River spring Chinook salmon population in the last 10 years is a source of concern given that this population was previously seen as a stronghold of natural production in the ESU. In contrast to most of the other populations in this ESU, McKenzie River Chinook salmon have access to much of their historical spawning habitat, although access to historically high quality habitat above Cougar Dam (South Fork McKenzie River) is still limited by poor downstream juvenile passage. Additionally, the installation of a temperature control structure in Cougar Dam in 2008 was thought to benefit downstream spawning, incubation, and rearing success. Natural-origin spawners in the Middle Fork Willamette River consisted solely of adults returning to Fall Creek. While these fish contribute to the population and ESU, at best the contribution will be minor. Finally, improvements were noted in the North and South Santiam populations. The increase in abundance in both populations was in contrast to the other populations and the counts at Willamette Falls. While spring-run Chinook salmon in the South Santiam population have access to some of their historical spawning habitat, natural-origin spawners in the North Santiam are still confined to below Detroit Dam and subject to relatively high pre-spawning mortality rates.

3.4.2. Upper Willamette Winter Steelhead

The Upper Willamette River steelhead DPS (listed as threatened under the ESA on March 24, 1999 and reaffirmed January 05, 2006 (71 FR 834) and April 14, 2014 (79 FR 20802)), includes native winter-run populations from Willamette Falls upstream to and including the Calapooia River. Core populations of winter steelhead occur in the North Santiam, South Santiam, Molalla, and Calapooia rivers. Smaller natural populations occur in several West Valley tributaries (Tualatin, Yamhill, Luckiamute rivers; Rickreal Creek). There are no winter steelhead hatchery programs included in this DPS (NMFS 2006).

The run timing of UWR steelhead is a legacy of the fact that, before construction of a fish ladder at Willamette Falls in the early 1900s, flow conditions allowed steelhead to ascend Willamette Falls only during the late winter and spring. As a result, the majority of the UWR winter steelhead run return to freshwater in January through April, pass Willamette Falls from mid-February to mid-May, and spawn in March through June, with peak spawning in late April and early May. Compared to spring Chinook salmon, UWR steelhead typically migrate further upstream and can spawn in smaller, higher gradient streams and side channels. Table 7 summarizes the generalized life history traits for UWR steelhead. UWR steelhead may spawn more than once, although the frequency of repeat spawning is relatively low. Repeat spawners are predominantly females and usually spend one year post spawning in the ocean and spawn again the following spring.

Juvenile steelhead rear in headwater tributaries and upper portions of the subbasins for one to four years (most often two years), then as smoltification proceeds in April through May, migrate quickly downstream through the mainstem Willamette River and Columbia River estuary and into the ocean. The downstream migration speed depends to some extent on river flow, with faster migration occurring at higher river flows. UWR steelhead typically forage in the ocean for one to four years (most often two years) and during this time are thought to migrate north to Canada and Alaska and into the North Pacific including the Alaska Gyre (Myers et al. 2006).

Table 7. A summary of the general life history characteristics and timing of UWR Steelhead. Data are from numerous sources.

Life History Trait	**Characteristic**
Willamette River entry timing	February-May
Spawn timing	March-June
Spawning habitat type	Headwater streams
Emergence timing	8-9 weeks after spawning; June-August
Rearing habitat	Headwater streams
Duration in freshwater	1-4 years (mostly 2). Smolt in April-May
Estuarine use	Briefly in spring, peak in May
Ocean migration	North to Canada and Alaska, and into the North Pacific
Age at return	3-6 years, primarily 4 years

Winter steelhead counts at Willamette Falls provide a complete count of fish returning to the DPS. In the last 10 years (2008-2017), returns to Willamette Falls have averaged 5,152 winter steelhead, of those an average of 3,396 returned after February 15th.[8] Of these fish, if one apportions the late winter fish to the four eastside tributaries that historically supported late-winter steelhead based on the results of the radio-tagging work from 2012-2014 (Jepson et al. 2013; Jepson et al. 2014; Jepson et al. 2015), the 10-year average for returning adults would be an average 3,409. Based on the three years of radio-tag data, an

[8]February 15th marked the estimated demarcation between early run timing and late run timing winter steelhead. All natural-origin winter steelhead are listed.

average of 59.3±3.1% (SE) of the winter-run steelhead ascending Willamette Falls enter the four primary steelhead population basins.

Trend analysis using the last 10 years of return data indicates 2.9% annual increase using the post-February 15th data and a slight 0.6% annual increase using the total winter count. Long-term abundance (1971 to present) is negative for both post-February 15th (-3.2%) and total winter-run counts (-3.5%), although the hatchery-origin winter steelhead are included in the counts from 1971through the 1990s. In general, overall abundance for the Upper Willamette River winter steelhead DPS remains low with recent trends being stable.

Population abundance estimates based on spawner (redd) surveys are only available for the Molalla and associated tributaries (Pudding River, Abiqua Creek) through 2006. These estimates relied on a proportional apportionment of winter-run steelhead counts at Willamette Falls based on index redd counts in the four winter-run steelhead populations. Recent estimates, based on the proportional migration of winter-run steelhead tagged at Willamette Falls (Jepson et al. 2013; Jepson et al. 2014),indicate that a significantly smaller portion of the steelhead arriving at Willamette Falls are destined for the Molalla River. Based on radio-tag detections and the total winter-run steelhead count at the Willamette Falls, the estimated escapement (95% CI) to the Molalla for 2012-2014 was 976 (660-1,406), 903(651-1,223), and 757 (540-1,042), respectively. As indicated by the broad confidence intervals, these estimates give only general indicator of steelhead abundance. Previous escapement estimates (1980 to 2006) had a geometric mean of 1,237 ranging from 97 to 4,658, long term trend show an annual 3.7% decline, although this decline is likely an overestimate due to the inclusion of hatchery fish in the early years. Estimated declines (Figure 6 and Table 8) in the Molalla River are based correlations with observed trends in the North and South Santiam Rivers. Given that the Molalla River has no major migration barriers, limiting factors in the Molalla River are more likely related to habitat degradation. Abundance is likely relatively stable, but at a depressed level.

Late-winter steelhead spawn throughout the North Santiam Basin except for reaches above the Big Cliff/Detroit Dam complex. [As discussed above, the Willamette Project is a major limiting factor in the status of UWR steelhead and Chinook.] Currently, the best measure of steelhead abundance is the count of returning winter-run adults to Upper and Lower Bennett Dam. Recent passage improvements at the dams and an upgraded video counting system have contributed to a higher level of certainty in adult estimates. While there are steelhead spawning below Bennett, it is likely that these dam counts approximate the population run size. The Bennett Dam counts may also approximate spawner counts,

given that post-dam prespawning mortality is thought to be low for winter steelhead. Unfortunately, steelhead were not counted at Bennett Dam from 2006 to 2010. The most recent average count for unmarked (presumed native) winter steelhead (2010-1014) is 1,195 ± 194. Longer term trends 1999-2014 are negative, -5 ±3%. Radio-tagging studies (Jepson et al. 2013; Jepson et al. 2014; Jepson et al. 2015) provided additional estimates of abundance that were similar to the Bennett Dam counts (Figure 6), with an average abundance of 1,154.

Survey data (index redd counts) is available for a number of tributaries to the South Santiam River; in addition, live counts are available for winter steelhead transported above Foster Dam. Temporal differences in the index reaches surveyed and the conditions under which surveys were undertaken make the standardization of data among tributaries very difficult. For the Foster Dam time series, the most recent 5-year average (2010-2014) has been 304±34, with a negative trend in the abundance over those years (recognizing that the 2010 return reflected good ocean conditions). Longer time series are less meaningful, in that abundance estimates before 2009 were developed using different methodologies. Expanding the radio-tag tracking data (Jepson et al. 2013; Jepson et al. 2014; Jepson et al. 2015) for 2012-2014 yields South Santiam abundances of 1,226 (875-1,693), 1,134 (853-1,474), and 1,312 (1,010-1,758), respectively. In addition to steelhead spawning in the mainstem South Santiam River, annual spawning surveys of tributaries below Foster Dam (Thomas, Crabtree, and Wiley creeks) indicate the consistent presence of low numbers of spawning steelhead, primarily in the headwater areas of the tributaries (Figure 5).

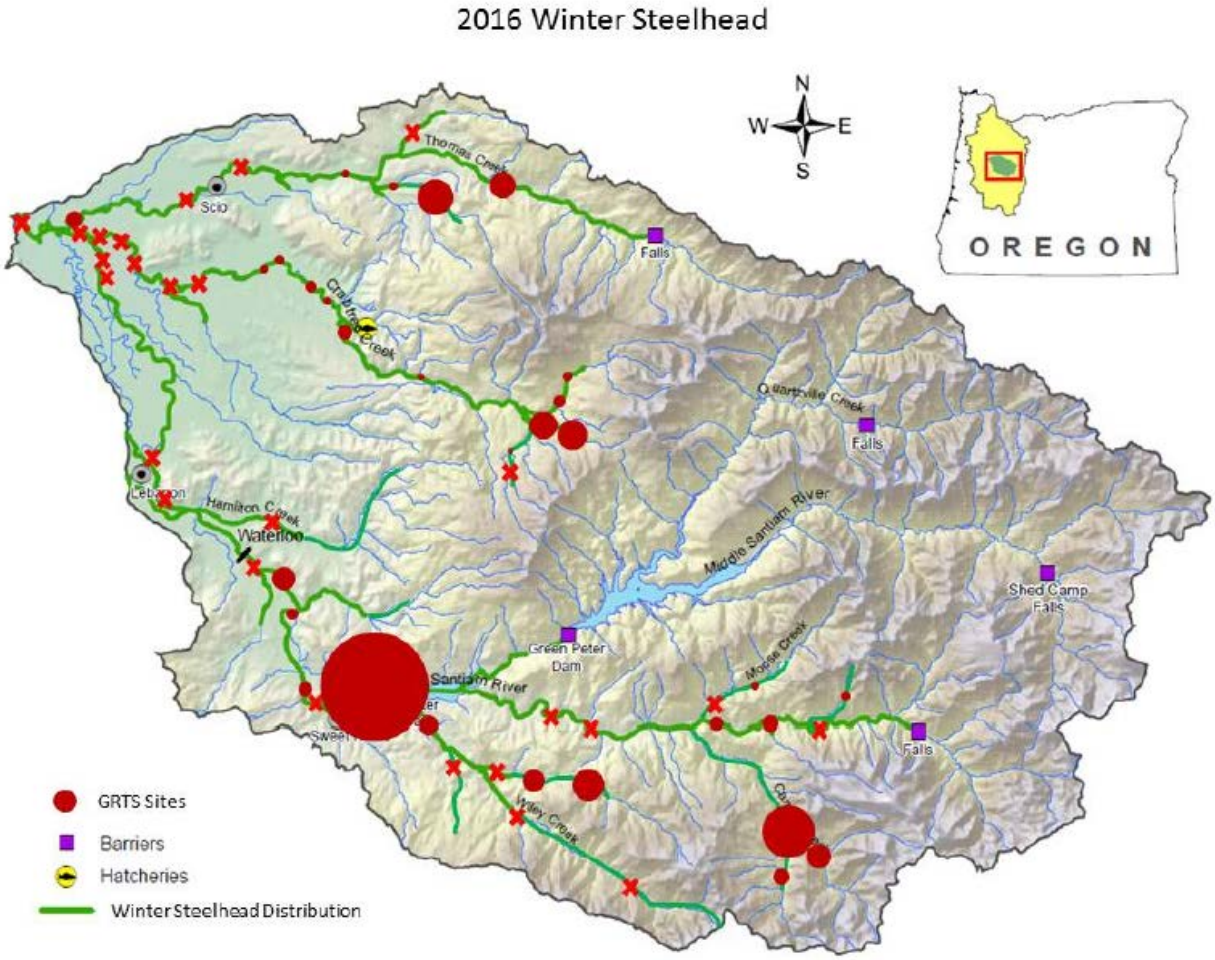

Figure 5. Spawning distribution and density of winter steelhead redds observed in the South Santiam River Basin, 2016. Figure taken from Mapes et al. (2017).

There is a nearly complete and consistent time series for index reach redd counts in the Calapooia River dating back to 1985. While there is not an expansion available from index reach to population spawner abundance, the trend in redds/mile is generally negative, although this is due in part to the time series beginning at a time of good ocean conditions. The redds/mile trend generally reflects good ocean conditions in the late 1980s and early 2000s, in addition to a period of poor ocean conditions in the mid-1990s. Abundance is thought to be rather low, population estimates (95% CI) based on radio tagged winter steelhead (Jepson et al. 2013; Jepson et al. 2014; Jepson et al. 2015) for 2012, 2013, and2014 are 127 (43-366), 204 (99-408), and 126 (54-289) respectively. These numbers would suggest that abundances have been fairly stable, albeit at a depressed level.

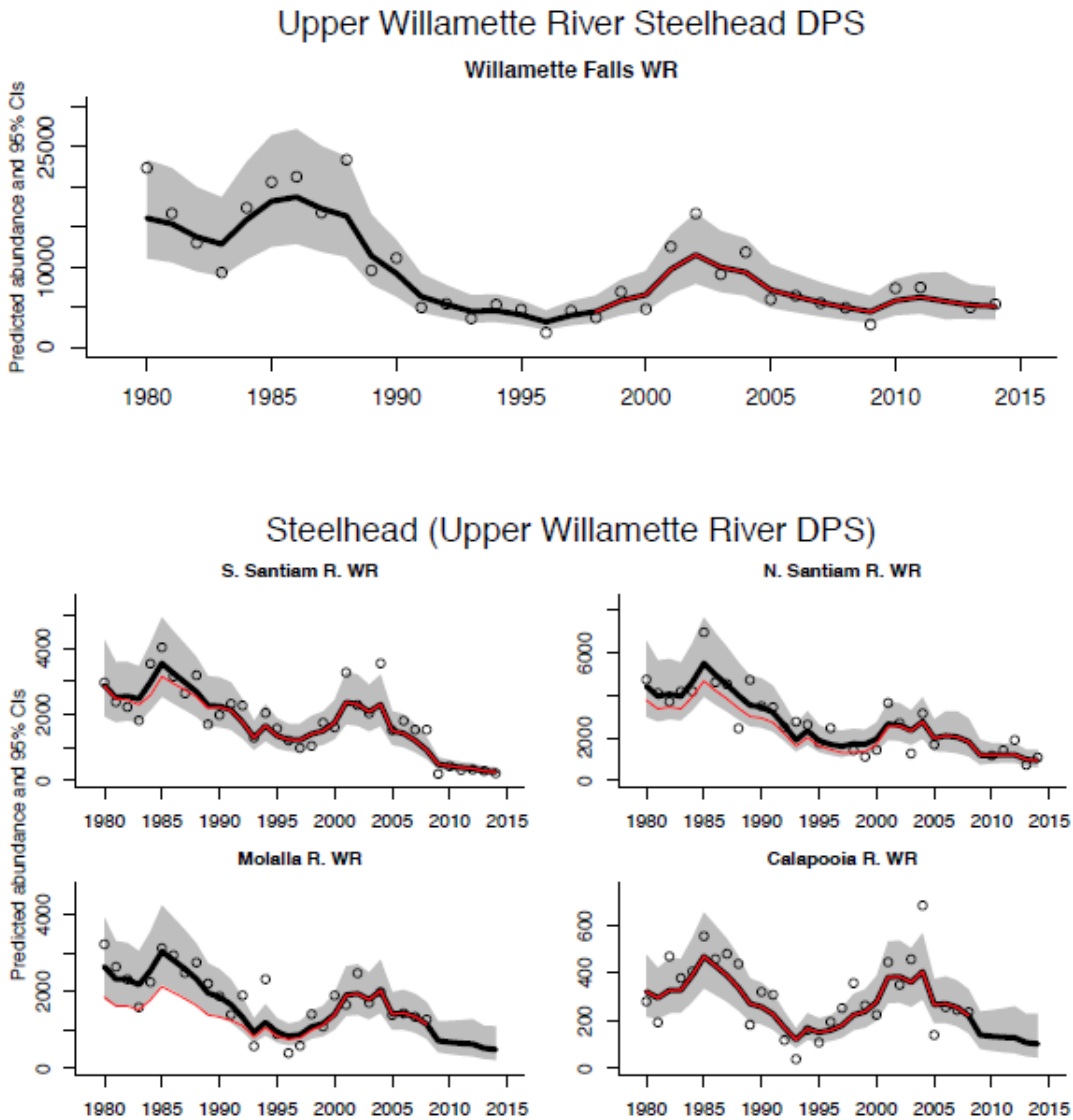

Figure 6. Smoothed trend in estimated total (thick black line) and natural (thin red line) population spawning abundance of winter steelhead. Points show the annual raw spawning abundance estimates. Figure taken from NWFSC (2015).

Table 8. 5-year geometric mean of raw natural origin spawner counts of winter steelhead. This is the raw total spawner count times the fraction natural origin estimate, if available. In parentheses, 5-year geometric mean of raw total spawner counts is shown. A value only in parentheses means that a total spawner count was available but no or only one estimate of natural origin spawners available. The geometric mean was computed as the product of counts raised to the power 1 over the number of counts available (2 to 5). A minimum of 2 values were used to compute the geometric mean. Percent change between the most recent two 5-yearperiods is shown on the far right. Based on Table 53 of NWFSC (2015).

Population	1990-94	1995-99	2000-04	2005-09	2010-14	% Change
Willamette Falls	(5619)	5039 (3961)	10135 (10135)	4926 (4926)	6164 (6164)	25 (25)
S. Santiam	1940 (1940)	1277 (1277)	2440 (2440)	1044 (1044)	306 (306)	-71 (-71)
N. Santiam	2494 (2928)	1285 (1611)	2178 (2234)		1195 (1195)	
Molalla	1182 (1462)	726 (798)	1924 (1924)	1357 (1357)		
Calapooia	149 (149)	219 (219)	406 (406)	214 (214)		

Populations in this DPS have experienced long-term declines in spawner abundance. The underlying cause(s) of these declines is not well understood. Returning winter steelhead do not experience the same deleterious water temperatures as the spring-run Chinook salmon. Although the recent magnitude of these declines is relatively moderate, continued declines would be a cause for concern. Improvements to Bennett Dam fish passage and operational temperature control at Detroit Dam maybe providing some stability in abundance in the North Santiam River population. It is unclear if sufficient high quality habitat is available below Detroit Dam to support the population reaching its VSP recovery goal, or if some form of access to the upper watershed is necessary to sustain a “recovered” population. Similarly, the South Santiam Basin may not be able to achieve its recovery goal status without access to historical spawning and rearing habitat above Green Peter Dam (Quartzville Creek and Middle Santiam River) and/or improved juvenile downstream passage at Foster Dam.

Past and Present Hatchery Fish Releases

Spring Chinook Salmon

The past (since 1990) and present releases of hatchery spring Chinook salmon fish from UWR hatcheries is shown in Figure 7. Total releases of spring Chinook salmon have remained relatively constant since

about 2000, and have fluctuated between approximately 3 million to 4.5 million smolts per year. Releases of spring Chinook salmon have remained fairly constant from the Willamette and North Santiam hatcheries and have recently (since 2010) been reduced at the South Santiam and McKenzie hatcheries (Figure 7). The location of hatchery fish releases have varied over time. Most of the hatchery fish releases occur at the hatchery facilities (Table 2; Figure 1 (page 7)).All of the current hatchery facilities (Figure 1 (page 7)) have been in operation for at least the last 20 years.

Hatchery spring Chinook salmon are primarily released in the early spring through late spring as yearlings (smolts; Table 9), although a small proportion are released as sub-yearlings in the fall. This two-pronged strategy mimics the life history of natural-origin juvenile spring Chinook salmon, that appear in rotary screw traps in the fall and very early spring as sub-yearlings and as yearlings later in the spring and summer (Romer et al. 2017). The size of hatchery fish is generally larger than their natural-origin fish (Table 9).

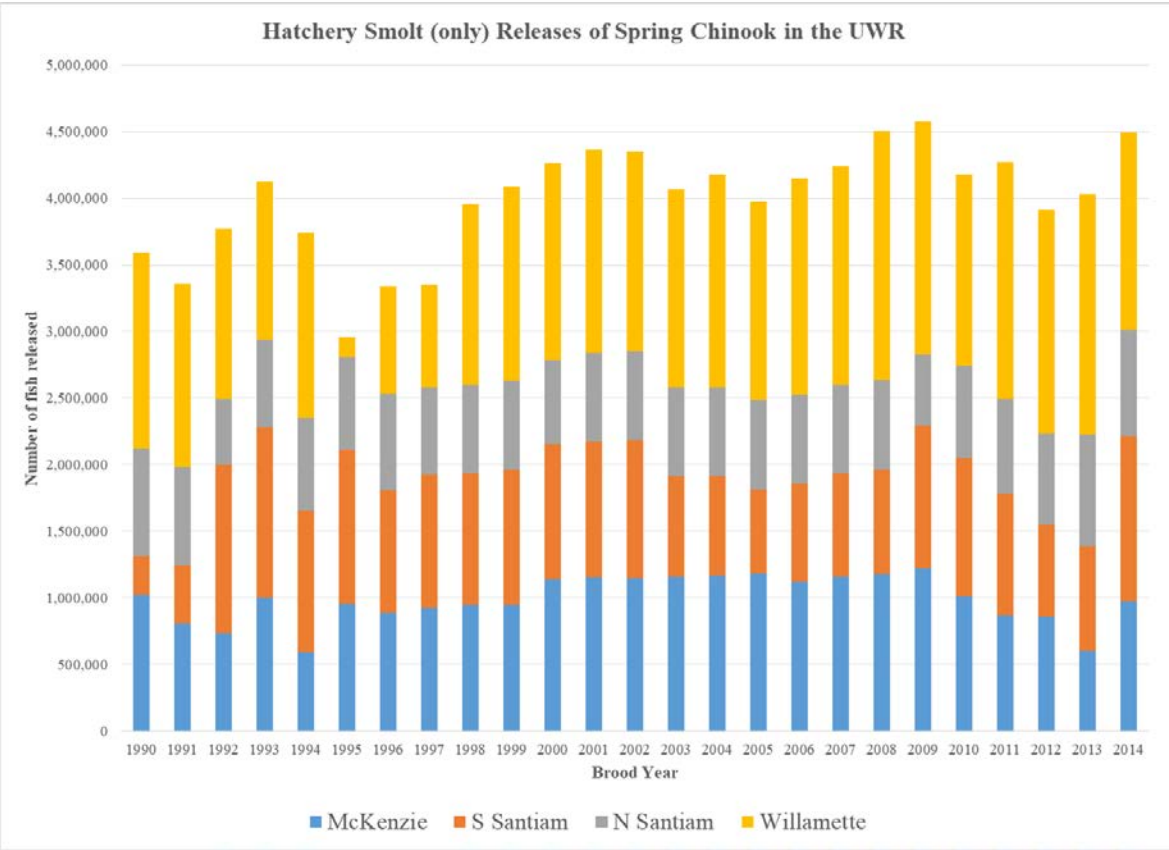

Figure 7. Smolt releases of spring Chinook salmon between 1990 and 2014 by ODFW from the McKenzie, South Santiam, North Santiam, and Willamette Hatcheries. The numbers do not include releases of unfed fry and fingerling life stages. Data from HGMPs (see Appendix 1) and ODFW's fish propagation reports (http://www.dfw.state.or.us/fish/hatchery/).

Table 9. Comparative individual sizes and freshwater occurrence timings for rearing and/or emigrating natural-origin salmon and steelhead juveniles by species and life stage, and hatchery-origin fish released from UWR hatchery programs.

Species/Origin	Life Stage	Individual Size average fork length (range; mm)	Predominant Occurrence or Release Timing
Chinook salmon (wild)	Fry	<40 (~30-60)	February - May
Chinook salmon (wild)	Parr-Subyrlg.	>60 (~40-100)	May – June and September-December
Chinook salmon (wild)	Yearling	>100 (~75-180)	Mid-March – mid-May
Chinook salmon (hatchery)	Sub-yearling	120 (60 -200)	May - November
Chinook salmon (hatchery)	Yearling	170 (150-200)	January - March
Steelhead (wild)	Fry	60 (23-100)	June - Oct.
Steelhead (wild)	Parr	96 (65-131)	Oct.- mid-May
Steelhead (wild)	Smolt	165 (109-215)	Late-April - June
Steelhead (hatchery)	Smolt	195 (180-220)	March - April
Rainbow trout (hatchery)	Fingerling	100 (50-150)	Spring, fall
Rainbow trout (hatchery)	Legal	>200 (200-400)	Spring, summer, fall

Notes and sources:

- Wild Chinook salmon data from Romer et al. (2017).
- Wild steelhead individual size data and occurrence estimates from Shapovalov and Taft (1954) and WDFW juvenile out-migrant trapping reports (Volkhardt et al., 2006a, 2006b; Kinsel et al., 2007).
- Hatchery-origin fish release size and timing data are average individual fish size and standard release timing targets as cited in ODFW's Hatchery Operation Plans for 2017and submitted HGMPs.

The proposed number of spring Chinook salmon to be released in the UWR is over 5 million fish (Table 2). The number of fish released per sub-basin ranges from near 700,000 (McKenzie Hatchery) to potentially over 2,000,000 from the Willamette Hatchery in the Middle Fork Willamette River (Table 2).

Summer-run Steelhead

Summer-run steelhead are not native to the UWR. The hatchery program was initially started in the UWR in the late 1960s as mitigation for lost winter steelhead production caused by the construction of the

Foster and Green Peters dams. Native winter steelhead had not been providing the angling opportunity desired by sportsmen and fisheries managers, because they spawned and were essentially gone from the system by late May. High water through the late winter and spring often impacted, and sometimes substantially reduced, sport angling efforts for winter steelhead. In addition to mitigating for the construction and effects of operation of the dams, the creation of a summer run of steelhead was intended to expand the duration of the steelhead angling season through the summer and fall.

The facilities that are used to raise and release hatchery summer-run steelhead into the North Santiam, South Santiam, McKenzie, Middle Fork Willamette rivers, and the mainstem Willamette River, are summarized in Table 10 and shown in Figure 1. Eight different facilities are used for incubation, rearing, acclimation and release for the summer-run steelhead program (Table 10).

Hatchery summer-run steelhead are released in the spring as yearlings (smolts; Table 9). While natural-origin steelhead generally spend at least two years in freshwater before emigrating to the ocean, hatchery-origin steelhead are released as yearlings after accelerated growth in the hatchery. The size of hatchery fish are generally larger than their natural-origin counterparts (Table 9).

Table 10. Summary of facilities and locations for the production of summer steelhead in the Willamette River Basin. Based on information provided in the most recent hatchery operating plans (http://www.dfw.state.or.us/fish/hatchery/).

Production Phase	Facility	Location
Broodstock collection, adult holding, and spawning	Foster Dam Fish Facility (South Santiam FH)	South Santiam River; RM 38.5
Incubation	South Santiam FH	South Santiam River; RM 38.5
	Oak Springs FH	Deschutes River; RM 47
Rearing	South Santiam FH	South Santiam River; RM 38.5
	Oak Springs FH	Deschutes River; RM 47
	Willamette FH	MF Willamette River; RM 42
	Roaring River FH	Crabtree Creek; RM 1.2
	Leaburg FH	McKenzie River; RM 39
	Dexter FH	Middle Fork Willamette River; RM 17

Production Phase	Facility	Location
Release	Minto Ponds	North Santiam; RM 42
	South Santiam FH	South Santiam River; RM 38.5
	Roaring River FH	Main stem Willamette River
	Dexter Ponds	Middle Fork Willamette River; RM 17
	Leaburg FH	McKenzie River; RM 39

FH = fish hatchery; RM = river mile

The proposed fish release goal for the summer-run steelhead program is nearly 550,000 (**Table 2**, Table 11). Since 2003, the average release of summer-run steelhead in the UWR has been approximately 584,000, ranging between 500,000 to about 670,000 (Figure 8).

Table 11. Hatchery facilities used to raise summer-run steelhead, release subbasin, and the number of fish released within the Upper Willamette River Basin.

Hatchery Facilities	Release sub-basin	Number
South Santiam/Willamette/Minto	North Santiam	66,000
South Santiam/Minto	North Santiam	55,000
Total for Sub-basin		**121,000**
South Santiam	South Santiam	161,500
Total for Sub-basin		**161,500**
South Santiam/Oak Springs/Leaburg	McKenzie	108,000
Total for Sub-basin		**108,000**
South Santiam/Willamette/Dexter	MF Willamette	61,000
South Santiam/Willamette/Roaring River	MF Willamette	27,428
Total for Sub-basin		**88,428**
South Santiam/Willamette/Roaring River	Main stem Willamette	68,572
Total for Sub-basin		**68,572**
Grand Total for UWR Basin		**547,500**

Source: Data from annual hatchery operations plans: http://www.dfw.state.or.us/fish/hatchery/
Note: All releases are smolts (yearlings).

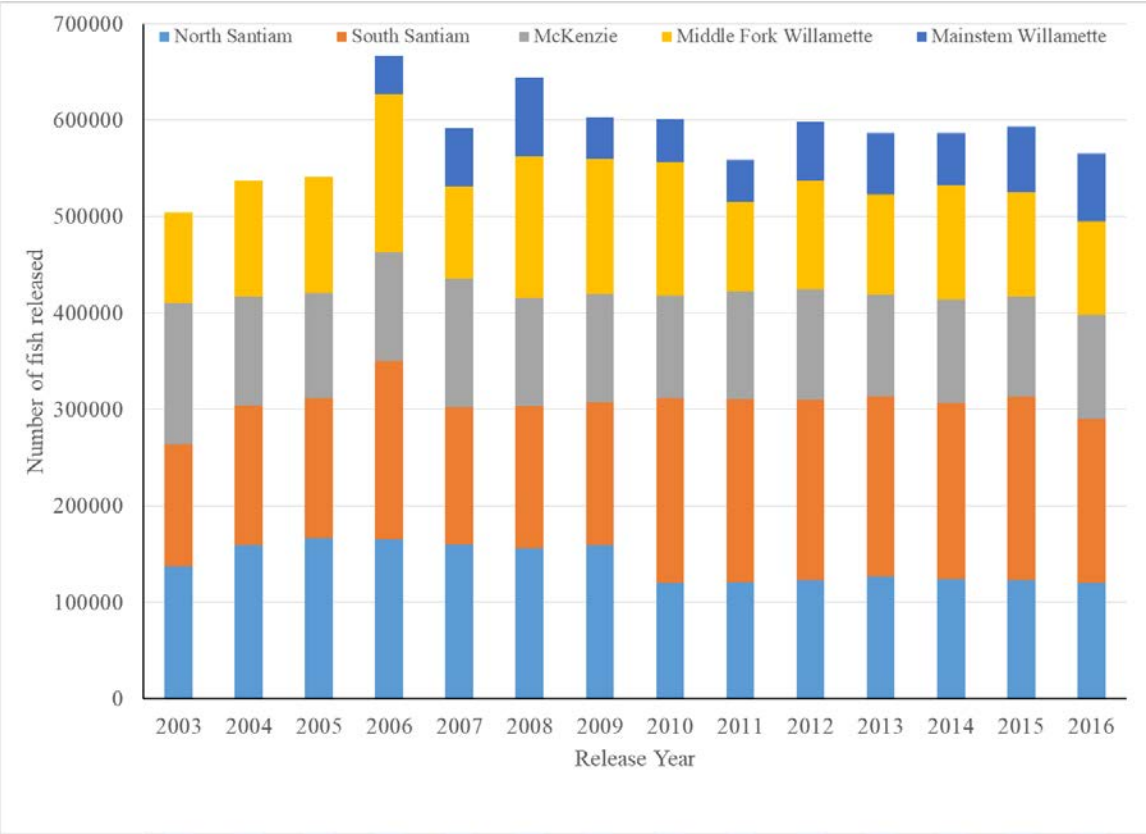

Figure 8. Releases of summer-run steelhead smolts in the Upper Willamette River Basin between 2003 and 2016. Data from ODFW (http://www.dfw.state.or.us/fish/hatchery/) accessed November 6, 2017.

Rainbow Trout

The goal of the rainbow trout hatchery program is to mitigate for trout harvest opportunities lost as a result of the construction and operation of Big Cliff, Detroit, Green Peter and Foster dams in the Santiam River subbasin, Fern Ridge Dam in the Long Tom River subbasin, Blue River and Cougar dams in the McKenzie River subbasin, and Fall Creek, Lookout Point, Dexter, Dorena, Cottage Grove and Hills Creek dams in the Middle Fork and upper Willamette River subbasin.

Broodstock for the program is maintained and spawned at the Roaring River Hatchery (Figure 1). The eggs are stocked shortly after fertilization to make the fish sterile, so that they cannot reproduce in the wild. For the portion of rainbow trout that are eventually released in the UWR, 1.5 million eyed eggs are transported to Willamette Hatchery in January. In addition, 250,000 fingerlings (about 50 fish per pound) are released into Detroit Reservoir in late June from Roaring River Hatchery.

Different sizes of fish are released in the numerous water bodies that receive hatchery rainbow trout (Table 12). In sum total, approximately 960,000 hatchery rainbow trout are released into the Willamette River Basin from this hatchery program (Table 12).

Table 12. Annual production goals for the Upper Willamette River rainbow trout hatchery program.

Hatchery	Release location	Number	Size (fish per pound)	Release timing
Roaring River	Mid-Willamette District; 16 waterbodies	5,400	75.0	March-July
		250,000	50.0	
		82,503	3.0	
		835	1.5	
		400	0.5	
Leaburg	Mid-Willamette District; 7 waterbodies	148,800	3.0	January-December
		7,725	1.5	
		700	1.0	
		275	0.5	
	Upper Willamette District; 3 waterbodies	234,135	3.0	February-September
		27,855	1.5	
Willamette	Mid-Willamette District; 4 waterbodies	88,900	3.0	May-October
		6,000	1.5	
	Upper Willamette District; 9 waterbodies	30,000	20.0	March-October
		5,000	3.0	
		74,989	2.0	
Grand total		**963,517**		

Source: ODFW hatchery operating plans; http://www.dfw.state.or.us/fish/hatchery/ accessed November 7, 2017

The average number of rainbow trout released from the three hatchery facilities since 2003 is just over 1 million fish, and has fluctuated between approximately 755,000 and 1,300,000 (Figure 9).

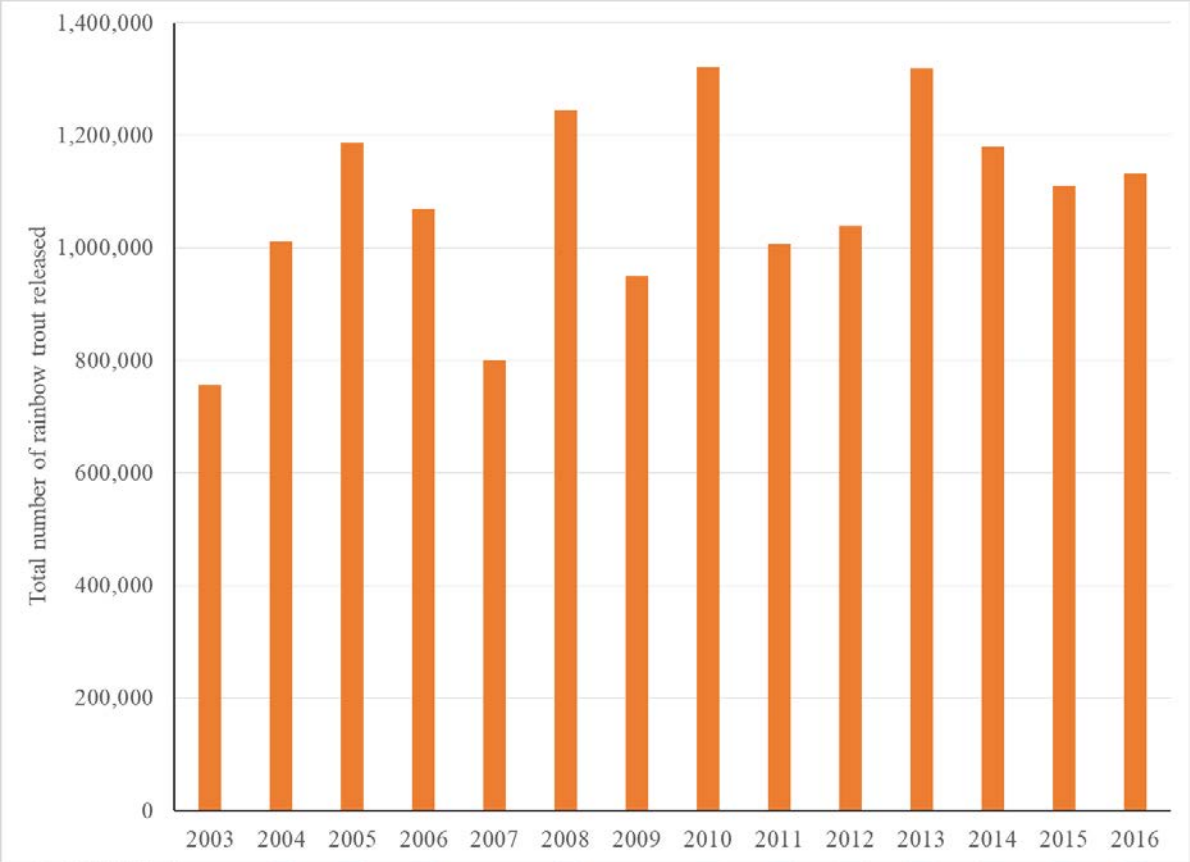

Figure 9. Total number of rainbow trout released from the Leaburg, Roaring River, and Willamette fish hatcheries between 2003 and 2016. Data from ODFW annual fish propagation reports (http://www.dfw.state.or.us/fish/hatchery/).

3.5. Other Fish and Their Habitats

This section includes other fish species (not salmon and steelhead) within the UWR that have a relationship with hatchery fish either as prey, predators, or competitors (Table 13). Generally, interactions among resident fish and hatchery fish would occur (1) through competition for space or food used by hatchery fish, and other fish in the analysis area, or (2) if hatchery fish are prey for other fish species or vice-versa. In the UWR, all resident fish species may compete with, be predators of, and/or serve as prey for hatchery fish depending upon the life stage and time of year (Table 13).

Resident hatchery rainbow trout are stocked into many reservoirs, lakes, and ponds throughout the UWR. Hatchery trout are stocked as fingerlings and legal-sized fish (>8 inches in length). Hatchery trout that are stocked into free-flowing rivers and streams where anadromous salmon and steelhead are currently sterilized (triploidy) prior to being released.

Pacific lamprey, river lamprey, Western Brook lamprey, coastal cutthroat troutare Federal “species of concern” (Table 13). Lamprey and cutthroat trout are widespread throughout the UWR. All of these fish species may prey or are preyed upon certain life stages of salmon and steelhead.

In the analysis area, all of the hatchery facilities may intercept and/or attract these fish species because water is used during operation. The inlet and outlet water discharge for the 10 hatchery facilities are screened to prevent fish from entering the facilities. During collection of returning hatchery salmon and steelhead, any other fish species that are incidentally collected are returned back to the river unharmed. For other broodstock collection and smolt release locations, the standard protocol is to release all other fish unharmed. Rainbow and cutthroat trout, pikeminnow, dace, sculpin, and sucker are the most common fish species incidentally captured and released within the UWR. The hatchery collection facilities are designed specifically to capture and collect adult salmon and steelhead. Most of the non-salmonid species commonly occurring in the Affected Environment are smaller-sized fish and thus freely pass through the facilities unimpeded and are not captured. Non-target species typically are less than five percent of the total catch.

Table 13. Range and status of other fish species that may interact with UWR spring Chinook salmon and steelhead. This is not an exhaustive list of fish species, but includes the fish most abundant and widespread in the analysis area.

Species	Range within the Willamette River Basin	Federal/State Listing Status	Type of Interaction with Hatchery Fish in Analysis Area
Bull trout	McKenzie and Middle Fork Willamette River basins	Federally listed as threatened	• May benefit by preying on releases of juvenile hatchery fish • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
White sturgeon	Mainstem Willamette River downstream of Willamette Falls	Not listed	• Predator of juvenile and adult salmon and steelhead. • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Pacific, river, and brook lamprey	Common in main river channel, sloughs, and tributaries. Occasionally found in seasonal watercourses not far from permanent watercourses.	Not listed. Pacific lamprey and river lamprey are Federal species of concern. Pacific lamprey are Oregon sensitive species	• Potential prey item for adult salmon and steelhead • May compete with salmon and steelhead for food and space • May be a parasite on salmon and steelhead while in marine waters • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Rainbow trout	Common in the main river channel and in sloughs and tributaries. Mostly the juveniles of this species are present in seasonal watercourses.	Not listed	• Predator of salmon and steelhead eggs and fry • Potential prey item for adult salmon and steelhead • May compete with salmon and steelhead for food and space • May interbreed with steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Coastal cutthroat trout	Common in the main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed. Federal species of concern	• Predator of salmon and steelhead eggs and fry • Potential prey item for adult salmon and steelhead • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Speckled dace	Common in the main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed	• Predator of salmon and steelhead eggs and fry • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish

Redside shiner	Common in the main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed	• May compete with salmon and steelhead for food and space • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Sculpin (genus *Cottus* and *Leptocottus spp.*)	Common in main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed	• Predator of salmon and steelhead eggs and fry • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Largescale sucker	Common in main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed	• Predator of salmon and steelhead eggs and fry • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Northern pikeminnow	Common in the main river channel and in sloughs, tributaries, and seasonal watercourses	Not listed	• Freshwater predator on salmon and steelhead eggs and juveniles • May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients
Oregon Chub	Rare in sloughs and seasonal watercourses	Not listed. Recovered and delisted in 2015.	• May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Walleye	Mainstem and lower portions of major tributaries	Non-native species	• Freshwater predator of salmon and steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Smallmouth bass	Common in the main river channel and sloughs, occasional in seasonal watercourses of the lower Willamette Valley	Non-native species	• Freshwater predator of salmon and steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Largemouth bass	Occasionally found in the main river channel, but common in sloughs, tributaries, and seasonal watercourses	Non-native species	• Freshwater predator of salmon and steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Other centrarchids (bluegill, crappie, pumpkinseed)	Common in sloughs, tributaries, and seasonal watercourses	Non-native species	• Freshwater predator of salmon and steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish

Yellow perch	Common in the main river channel and in sloughs and tributaries; rarely in seasonal watercourses	Non-native species	• Freshwater predator of salmon and steelhead • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Common carp	Common throughout the main river channel and in sloughs and tributaries. Occasionally found in seasonal watercourses.	Non-native species	• Carp have a strong negative impact on aquatic ecosystems. Their feeding behavior uproots plants, which disturbs habitat for invertebrates, fish, and waterfowl and increases water turbidity
American shad	Main river channel	Non-native species	• May compete with salmon and steelhead for food • May benefit from additional marine-derived nutrients provided by hatchery-origin fish

Sources: Tinus and Beamesderfer (1994), NMFS (2013), ODFW (2005), USFWS (2013), Pribyl et al. (2005), and Williams et al. (2014).

3.6. Wildlife

Within the analysis area, many species occur and potentially interact with hatchery salmon and steelhead within the UWR (Table 14). Many species are listed under the ESA including: yellow-billed cuckoo, streaked horned lark, northern spotted owl, marbled murrelet, and the red tree vole is a candidate species (Table 14). However, most of these ESA-listed species do not interact with hatchery salmon and steelhead because of their habitat and food preferences and distribution. No interaction is expected to occur between salmon and steelhead and northern spotted owl, gray wolf, yellow-billed cuckoo, or streaked horned lark because they are not likely to be found in the analysis area or do not feed upon aquatic species (Table 14). Other ESA-listed species, such as the green sturgeon, eulachon, southern killer whale, humpback whale, Stellar sea lion have been analyzed in NMFS (2014) or NMFS (2017).

There are several species of birds that feed on juvenile salmon including Caspian terns and cormorants. During the spring when salmon and steelhead juvenile out-migrate to the Pacific Ocean, they may be a major food source for these bird populations within the UWR, but more so once the fish enter the lower Columbia River and estuary. Hatchery-produced fish appear to be more vulnerable to bird predation than natural-origin fish(Collis et al. 2001).

Finally, fishing in the analysis area has created fishery access points, roads, boat launches, and campsites that result in ongoing, but likely minor, habitat disruptions to terrestrial wildlife.

Table 14. Range and status of wildlife species that may interact with Upper Willamette River hatchery salmon and steelhead.

Species	Range within the Willamette River Valley	Federal Listing Status	Type of Interaction with Salmon and Steelhead in Analysis Area
Northern spotted owl	Forest habitat Cascade Mountains	Threatened	• No interaction
Marbled murrelet	Potential forest habitat primarily west of crest of Coast Range Mountains (in general), but may occur east of the crest of the Coast Range in the western tributaries of the Willamette River valley	Threatened	• Potential predator of juvenile salmon and steelhead in freshwater and saltwater areas • May consume similar prey items in the ocean
Yellow-billed cuckoo	Dense willow and cottonwood stands in river floodplains	Threatened	• No interaction
Streaked horned lark	Throughout region	Threatened	• No interaction
Other bird species dependent upon aquatic environment (osprey, heron, cormorant, bald eagle, dipper, gull, Caspian tern, duck, geese)	Throughout region	Not listed	• Predators of juvenile and adult salmon and steelhead in freshwater and saltwater areas
Small mammals (river otter, mink, raccoon, weasel, fisher)	Throughout region. Typically riparian areas	Not listed. Fisher is a candidate species	• Predators of juvenile and adult salmon and steelhead in freshwater areas
Red tree vole	Potentially higher elevations	Candidate species	• No interaction
Grey wolf, Canada lynx	Not currently present	Wolf-endangered. Lynx-threatened	• Not applicable.

Species	Range within the Willamette River Valley	Federal Listing Status	Type of Interaction with Salmon and Steelhead in Analysis Area
Other reptile species dependent upon aquatic environment (e.g.,snakes, lizards)	Coastwide	Not Federally listed, although California mountain kingsnake, Northern sagebrush lizard, common kingsnake are species of concern (USFWS 2013)	• Predators of juvenile and adult salmon and steelhead in freshwater areas
Amphibians (e.g.,tree frog, red-legged frog, western toad, northwestern salamander)	Coastwide	Not Federally listed, although many of these species are species of concern	• Potential predator of eggs, fry, carcasses in freshwater areas

Sources: NMFS (2013), USFWS (2013), and http://pages.uoregon.edu/titus/herp/ (accessed April 8, 2014).

3.7. Socioeconomics

Socioeconomics is defined as the study of the relationship between economics and social interactions with affected regions, communities, and user groups. In addition to providing fish for harvest, hatchery programs directly affect socioeconomic conditions in the economic impact regions where the hatchery facilities operate and where hatchery fish are released. Hatchery facilities generate economic activity by providing employment opportunities and through local procurement of goods and services for hatchery operations.

The focus of this socioeconomic analysis area is the Willamette River Basin, Lower Columbia River downstream of the confluence, and the Pacific Ocean(Figure 10).Issues addressed in this section include socioeconomic effects related to hatchery operations, gross and net economic values derived from production and harvest of hatchery-origin fish produced from Willamette hatcheries (where estimates are available), and the ways hatcheries and the fish produced in Willamette River Basin hatcheries affect personal income and employment. The analysis area includes sites outside the project area because

salmon that are produced within the project area can migrate outside the project area (e.g., Pacific Ocean) and contribute to fisheries in these other areas. Changes in salmon fisheries may lead to socioeconomic effects. Willamette River Basin steelhead are typically only caught in freshwater fisheries and not in ocean fisheries. Information on socioeconomic conditions related to tribal harvests is provided in Section 3.8, Environmental Justice.

This section describes recent trends and baseline conditions for hatchery program costs, harvest, economic values associated with commercial and recreational fisheries, and regional economic conditions. For an historical overview of salmon and steelhead harvest, please see NMFS(2014).

Figure 10. Analysis areas for socioeconomic impact region. The focus areas are the Willamette Basin, lower Columbia, and Pacific Ocean off British Columbia and Southeast Alaska. Figure 3-1 from NMFS (2014).

Hatchery Program Costs

Salmon and steelhead hatchery programs have operated in the states of Oregon and Washington for more than 100 years. Currently, 176 salmon and steelhead hatchery programs operate at 80 hatcheries and associated artificial production facilities in the Columbia River Basin (NMFS 2014).

Between 2005 and 2014, an average of 4.2 million spring Chinook salmon and nearly 600,000 summer steelhead have been released from UWR hatcheries (Table 15).

Table 15. Hatchery production (number of fish) of salmon and steelhead released from Upper Willamette River Basin hatcheries between 2005 and 2014.

Release year	Spring Chinook	Summer Steelhead
2005	3,976,218	541,057
2006	4,148,974	666,557
2007	4,239,837	591,635
2008	4,505,156	643,951
2009	4,572,201	602,930
2010	4,178,153	600,650
2011	4,271,248	558,564
2012	3,913,528	597,914
2013	4,028,916	586,925
2014	4,496,135	586,445
Avg.	4,233,037	597,663

Hatchery program expenses include production, headquarters administrative and management, acclimation and liberation, and hatchery facility and other fixed costs. Information pertinent to estimating hatchery facility costs was developed by TRG (2009) and includes the following:

- **Hatchery production costs:** Hatchery production costs include expenses accrued at the primary hatchery facility, as well as other hatchery facilities where the fish might be taken for rearing. Unit cost information includes the following:
    - Time spent in the hatchery facility affects production costs. The size of most released smolts ranges from 10 to 15 smolts per pound for spring Chinook salmon and steelhead. The spring Chinook salmon and steelhead spend about 18 months in the hatchery system.
    - Feed costs range from $0.40 to $0.80 per pound of feed.

- Marking hatchery-origin fish is a Federal directive for federally operated, administered, or funded programs that produce fish for harvest. The two most common methods to mark hatchery-origin fish are with an adipose fin clip and/or a coded wire tag (CWT). Marking costs are about $0.05 per smolt, depending on the proportion of smolts receiving CWT inserts, which are about $0.20 per smolt.
- Labor costs (excluding labor overhead) are the largest component of production costs, usually comprising about 50 percent of production costs.

- **Headquarters administrative and management costs:** Headquarters administrative and management costs include indirect expenses for central office overhead, with management and administration, that can range from about $0.03 to $0.40 per smolt produced.
- **Acclimation and liberation costs:** Some hatchery programs produce fish at a hatchery facility and then move the fish to a different location before release. Fish are then acclimated to the water at the new site before release. There are additional costs associated with this process.
- **Hatchery facility and other fixed costs:** This includes the cost of maintaining and/or improving hatchery facilities.

Average cost information from Table 16 was used, along with the number of fish released, to estimate the total cost of fish production at all hatchery facilities in the Upper Willamette River Basin. The cost to operate the 80 hatcheries and associated facilities in the Columbia River Basin varies by the operating agency. Production cost information for hatcheries for each operating agency is presented in Table 16.

Using the average number of fish released (Table 15) and the average costs associated with rearing Chinook and steelhead from Table 16, the cost of raising the number of spring Chinook and steelhead released in the UWR is approximately $5.7 million ($4.1 million for spring Chinook and $1.6 million for steelhead). The hatcheries in the UWR employ 37 FTE jobs and two seasonal positions (information from submitted HGMPs).

Table 16. Average cost per smolt from Mitchell Act-funded hatchery programs.Based on Table 3-12 from NMFS (2014).

Agency	Species	Average Cost per Smolt ($)[1,2]
ODFW	Chinook Salmon	0.743
	Steelhead	2.147
USFWS	Chinook Salmon	1.174
	Steelhead	3.260
WDFW	Chinook Salmon	1.095
	Steelhead	2.696
Yakama Nation	Chinook Salmon	0.829
Average for Chinook		0.960
Average for steelhead		2.701

Source: Compiled by TCW Economics (Appendix J of NMFS (2014)).

[1] All dollar values are expressed in 2007 dollars, as presented in the source document identified in Appendix J in NMFS (2014). The computation of total costs for smolt production were adjusted to 2009 dollars for estimating regional economic effects of the alternatives.

[2] Includes operation costs, headquarters' overhead costs, amortized capital costs, and acclimation and transport costs, where applicable.

Commercial Harvest and Economic Value

This section contains reports on recent historical levels of commercial harvest of salmon and steelhead in the following fisheries: Columbia River Basin salmon fisheries; Oregon and Washington coastal salmon fisheries, British Columbia salmon fisheries, and Southeast Alaska salmon fisheries.

Columbia River Basin[9]

The Columbia River mainstem commercial salmon fishery is currently divided into a non-tribal and a tribal fishery. The non-tribal commercial fishery is located downstream of Bonneville Dam, as well as in the Select Areas (i.e., off channel areas of the lower Columbia River). This fishery intercepts UWR natural- and hatchery-origin fish. The tribal in-river commercial fishery is upstream of Bonneville Dam and will not be analyzed in this EIS because UWR fish are harvested in negligible numbers upstream of Bonneville Dam. There are no non-tribal steelhead commercial fisheries in the Columbia River.

[9] There are currently no commercial fisheries for salmon or steelhead in the Willamette River Basin.

Visual stock identification (VSI) and coded-wire tag (CWT) recoveries indicate that spring Chinook salmon destined for the Willamette River typically comprised a large percentage of the spring Chinook salmon caught during past winter commercial seasons and during March in Columbia River recreational fisheries (Table 17).

In the lower Columbia River fisheries, commercial fishermen have harvested an annual average of approximately 2,400 fish between 2000 and 2016 (Table 17). Using the annual harvest value (known as the ex-vessel value, which is the price received for the product at the dock; $31.82 per fish) of Chinook salmon caught in the non-tribal commercial fisheries in the lower Columbia River economic impact region from the Mitchell Act FEIS (NMFS 2014), the annual commercial harvest value between 2000 and 2016 averaged $75,431 (these values are in 2009 dollars).

Table 17. Commercial and sport catch of Willamette Spring Chinook Salmon in the Lower Columbia River (downstream of the Willamette River) and Lower Willamette River (downstream of Willamette Falls).

	Lower Columbia River Mainstem		**Lower Willamette River**
Catch year	**Commercial[1]**	**Sport[2]**	**Sport[3]**
2000	1,100	200	9,000
2001	3,500	3,800	7,600
2002	7,400	5,200	10,800
2003	1,800	7,200	13,500
2004	7,200	5,900	12,000
2005	300	2,800	5,800
2006	2,700	2,000	7,200
2007	1,300	1,600	5,700
2008	100	200	4,600
2009	300	1,400	4,500
2010	3,300	5,400	22,700
2011	2,300	2,100	22,800
2012	2,300	3,200	15,800
2013	1,800	1,700	7,400
2014	1,300	2,300	8,100
2015	2,600	3,500	13,600
2016	1,000	1,400	6,000
Average	**2,371**	**2,935**	**10,418**

Source: Based on Table 3 from Joint Columbia River Management Staff (2017).

[1]Includes spring Chinook destined for the Willamette River landed in Select Area commercial fisheries of Youngs Bay (since 1992), Tongue Point (since 1998), and Blind Slough (since 1998). Also, includes estimated release mortalities from Lower Columbia mainstem commercial selective fisheries since 2001.

[2] Includes spring Chinook destined for the Willamette River landed in Columbia River boat and/or bank fisheries. Also includes estimated hook and release mortalities in the Lower Columbia mainstem selective recreational fishery since 2001.

[3] Includes estimated hook and release mortalities in the Lower Willamette selective recreational fishery since 2000.4Includes estimated hook and release mortalities in the Lower Willamette selective recreational fishery since 2000.

Pacific Ocean

Columbia River stocks of Chinook salmon contribute to commercial fisheries in the Pacific Ocean. This section describes economic values for commercial salmon fisheries in the Pacific Ocean where Columbia River (including UWR) are intercepted. This summary of the economic impacts relies on the analysis and the conclusions from the Mitchell Act FEIS (NMFS 2014). Catch values and associated economic values presented in this section are for all salmon stocks, not just salmon stocks from the Columbia (and UWR) River Basin. About 32 percent of the Chinook salmon in non-tribal commercial fisheries and 22 percent of the Chinook salmon harvested in tribal commercial fisheries north of Cape Falcon consist of Columbia River stocks(NMFS 2014). Stocks of Columbia River Chinook salmon do not substantially contribute to the salmon fisheries south of Cape Falcon; however, Columbia River stocks of Chinook salmon do contribute to Chinook salmon commercial fisheries in the Astoria area of northern Oregon. Columbia River stocks also account for about 28 percent of Chinook salmon harvested in the Southeast Alaska commercial fishery and about 7 percent of the commercial harvest of Chinook salmon harvested in British Columbia marine waters(NMFS 2014).

In terms of economic value, the average annual harvest value (ex-vessel value) of Chinook salmon caught along the Washington Coast by tribal commercial fishers was $1,201,946, and by non-tribal commercial fishers was $1,457,827. The average annual non-tribal commercial catch of Columbia River Chinook salmon for the Oregon Coast (near Astoria) was $361,859, and $13,798,782 and $13,003,266 for British Columbia and Southeast Alaska, respectively (Table 18).

Table 18. Average Annual (2002 through 2009) Chinook Catch and Commercial Ex-vessel Value for Tribal and Non-tribal Commercial Fisheries for the Pacific Ocean. Based on Table 3-18 from NMFS (2014).

Economic Impact Region	Tribal		Non-tribal Commercial	
	Average Catch (number of fish)1	**Ex-vessel Value ($)2**	**Average Catch (number of fish)1**	**Ex-vessel Value ($)2**
Oregon Coast (Astoria3)			6,808	361,859
Washington Coast	28,470	1,201,946	29,056	1,457,827
British Columbia			234,375	13,798,782
Southeast Alaska			268,398	13,003,266
TOTAL	**28,470**	**1,201,946**	**538,637**	**28,621,734**

Recreational Harvest and Economic Value

Columbia River Basin (Lower Columbia and Lower Willamette Rivers)

The recreational fishery on the mainstem Columbia River below Bonneville Dam includes two main management areas: the mainstem Columbia River extending from Bonneville Dam downstream to the Tongue Point/Rocky Point line, and the Buoy 10 area extending from below the Tongue Point/Rocky Point line to Buoy 10, which marks the ocean/in-river boundary. In the Lower Columbia River, sport fishermen have averaged nearly 3,000 UWR spring Chinook salmon per year (Table 17). In the lower Willamette River (downstream of Willamette Falls), sport fishermen have harvested an annual average of nearly 10,500 between 2000 and 2016 (Table 17).

Upper Willamette River Basin

In the Upper Willamette River Basin, there are recreational fisheries for spring Chinook salmon and summer-run steelhead. The average catch of spring Chinook salmon has decreased from about 6,500 to 4,300, while harvest of summer-run steelhead stayed approximately the same (10,427 to 10,144) between the periods of 1995 to 2005 and 2006 to 2016 (Figure 11). Part of the reason for the decline of spring Chinook salmon is that returning hatchery fish were not differentially marked from natural-origin fish until 2002, so some portion of the fish harvested from 1995 through 2001 were natural-origin fish. Once externally marked hatchery spring Chinook salmon began returning, all natural-origin (non-marked) fish had to be released upon capture. The fishery for hatchery-origin summer-run steelhead has remained relatively constant (Figure 11).

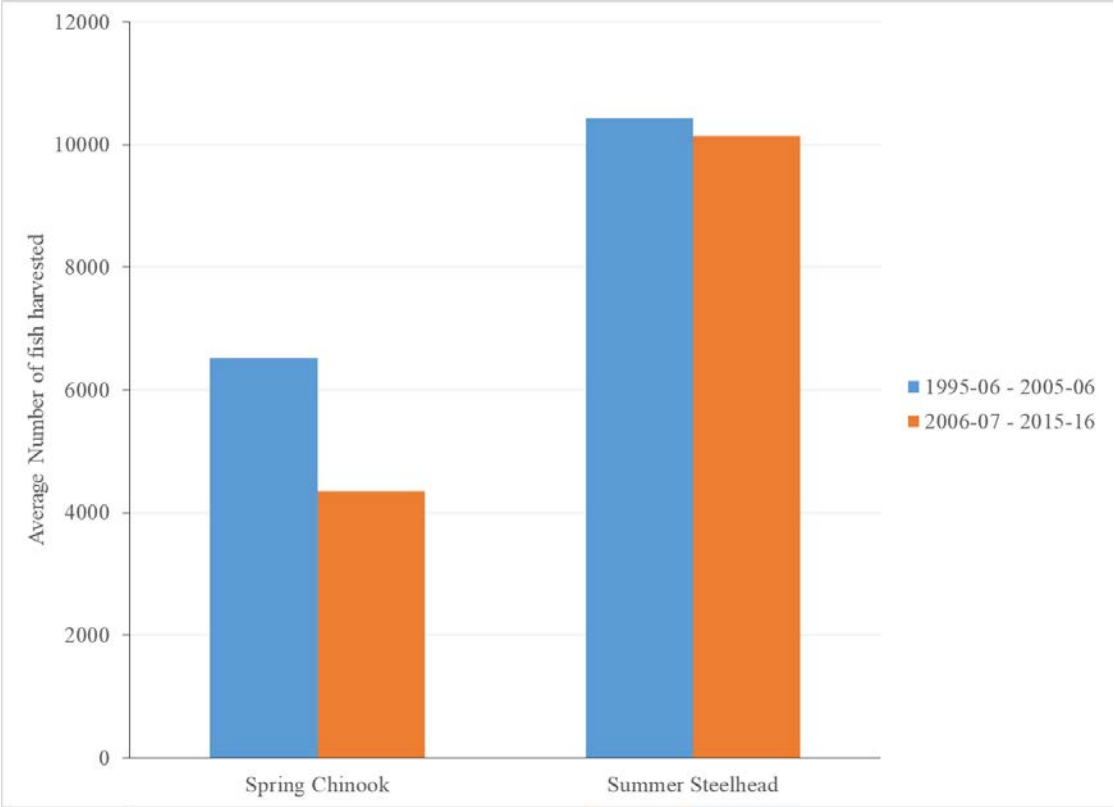

Figure 11. Comparison of the average recreational harvest of spring Chinook salmon and summer steelhead in the Upper Willamette River Basin between 1995-05 and 2006-16, excluding harvest in the mainstem Willamette River downstream of Willamette Falls. Source: ODFW: **http://www.dfw.state.or.us/resources/fishing/sportcatch.asp**, accessed on October 25, 2017.

NMFS (2014) estimated that between 2002 and 2009, there was an annual average of over 584,000 fishing trips in the Lower Columbia River economic impact region, which includes the Willamette River valley, and recreational anglers spent nearly $48 million annually (Table 19).

Table 19. Average annual (2002 through 2009) catch, number of trips, and trip expenditures for recreational Chinook salmon and steelhead fisheries for the lower Columbia River Basin. Based on Table 3-19 from NMFS (2014).

Economic Impact Region/Species	**Average Catch (number of fish)**	**Number of trips**	**Trip Expenditures ($)[1]**
Lower Columbia River			
Chinook Salmon	77,497	373,089	30,604,491
Steelhead	40,187	211,511	17,350,247
TOTAL	**117,684**	**584,600**	**47,954,738**

Sources: Average catch estimates are based on 2002 through 2009 historical averages and modeled harvest estimates developed by the Mitchell Act Fishery Modeling Team. See Appendix J of NMFS (2014) for how the number of trips and trip expenditures was derived.

[1] All dollar values are expressed in 2009 dollars.

Pacific Ocean

Recreational fishing for Chinook salmon[10] in Pacific Coast waters is limited to hook-and-line gear and is conducted mostly from privately owned pleasure craft and charter boats. There is little shore-based (e.g., piers and jetties) angling in the ocean for salmon.

Recreational anglers caught an average of 1,725, 24,984, 105,995, and 60,147 Chinook salmon in fisheries off the coasts of Oregon, Washington, British Columbia, and Southeast Alaska, respectively between 2002 and 2009 (Table 20). This accounts for an annual average of just under 200,000 Chinook salmon caught (Table 20). These fisheries are supported by fish released from hatcheries in the Columbia River (and UWR) basins.

Based on an estimated range in effort of 0.8 to 1.2 fishing days per fish caught and average spending estimates ranging from $119.70 to $147.52 per day (TRG 2009), anglers incurred an estimated $3,272,724 in trip-related expenditures to catch Chinook salmon (26,709 fish) in recreational fisheries along the Washington and Oregon coasts (Table 21). For British Columbia and Southeast Alaska, the

[10] It is important to understand that most of the Chinook salmon caught in the ocean are not spring-run.

average recreational catch for Chinook salmon was 136,182 fish and trip-related expenditures were $26,118,339 (Table 21).

Table 20. Historical (2002 through 2009) Chinook salmon catch in recreational Pacific ocean supported by Columbia River Stocks. Based on Table 3-21 from NMFS (2014).

Economic Impact Region	Number of fish[1]								
	2002	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**Annual Average**
Oregon Coast	2,754	2,330	2,183	3,635	509	594	817	980	1,725
Washington Coast	57,821	34,183	24,907	36,369	10,667	8,944	14,635	12,351	24,984
British Columbia	107,089	114,172	129,902	106,599	88,493	107,229	94,056	100,426	105,995
Southeast Alaska	64,683	68,852	78,505	70,040	63,500	61,851	25,662	48,089	60,147
TOTAL	**232,347**	**219,537**	**235,497**	**216,643**	**163,169**	**178,618**	**135,170**	**161,846**	**192,851**

Sources: Catch data for the California, Oregon, and Washington Coasts are from PFMC (2003, 2004, 2005, 2006, 2007, and 2011 in NMFS (2014)). Catch data for Puget Sound/Strait of Juan de Fuca are from WDFW (2008; in NMFS (2014)). Catch data for British Columbia and Southeast Alaska are from PSC (2003, 2004, 2005, 2006, 2007, 2008, 2009, and 2011 in NMFS (2014)).

[1] Catch values reported in this table are for all stocks, not just Columbia River Basin stocks.

[3] Includes salmon fisheries in the Astoria area of northern Oregon only; potential effects of the EIS alternatives on Chinook salmon ocean fisheries south of the Astoria area would be expected to be negligible. Refer to the Socioeconomics Impact Methods Appendix (Appendix J) in NMFS (2014)for additional details pertaining to this assumption.

Table 21. Average annual (2002 through 2009) catch, number of trips, and trip expenditures for Chinook salmon recreational fisheries for the Pacific Ocean. Based on Table 3-22 from NMFS (2014).

Economic Impact Region	Average Catch (number of fish)[1]	Number of Trips	Trip Expenditures ($)[2]
Oregon Coast (Astoria3)	1,725	2,104	251,829
Washington Coast	24,984	20,478	3,020,895
British Columbia	105,995	86,881	16,662,935
Southeast Alaska	60,147	49,301	9,455,404
Total	192,851	158,764	29,391,063

Source: Average catch estimates are 2002 through 2009 historical averages. See Appendix J in NMFS (2014) for a description of how number of trips and trip expenditures were derived.
[1] Catch values reported in this table are for all stocks, not just Columbia River Basin stocks
[2] All dollar values are expressed in 2009 dollars.
[3] Includes salmon fisheries in the Astoria area of northern Oregon only.

Regional Economic Conditions

Lower Columbia River Economic Impact Zone

Commercial and recreational fisheries generate personal income and support jobs in regional and local economies throughout the Lower Columbia River economic impact zone. Commercial landings of salmon and steelhead are frequently sold directly, or after processing, to persons or businesses located outside the region. The transfer of money to businesses within the region supports payments of wages and other forms of compensation, and that money is then re-spent regionally (i.e., the multiplier effect). Similarly, non-local recreational anglers (i.e., anglers who live outside the local area) spend money on guide services, lodging, and other goods and services within the Lower Columbia River economic impact zone that generate income for local and non-local communities. Last, money spent on hatchery operations and management, which often comes from state or Federal sources located outside the local area, provides an additional infusion of income to local economies.

The estimated amount of personal income and the number of jobs supported in Lower Columbia River economic impact zone (both hatchery-origin and natural-origin salmon and steelhead) is based on the analysis that was done for the Lower Columbia River impact zone from NMFS (2014). These estimates

are based on average annual harvest conditions for all salmon and steelhead caught in the economic impact region. The lower Columbia River economic impact region generates $52,577,674 in personal income and supports about 1,333 jobs (39 for just hatchery personnel).

Hatchery operations (including related ongoing weir operations) in the Columbia River Basin also generate direct, indirect, and induced economic effects within the basin's four economic impact regions, as shown in Table 22. Hatchery production spending on labor and procurement of goods and services is estimated to generate a total of $64,088,521 in personal income and about 1,282 jobs in the basin (Table 22). Hatchery-generated economic activity is greatest in the lower Snake River economic impact region, where $24,009,550 in personal income and 480 jobs are estimated to be supported by hatchery operations (Table 22). Economic activity is similar in the lower Columbia River economic impact region, where $22,728,721 in personal income and 455 jobs are estimated to be supported by hatchery operations (Table 22).

Table 22. Economic Effects of the Lower Columbia River Economic Impact Zone Hatchery Operations and Associated Harvest. Based on Table 3-23 from NMFS (2014).

	Hatchery Operations[1]			**Harvest-related Effects1**	
Sector	**Operating Costs ($)[2]**	**Personal Income ($)[2]**	**Number of Jobs[3]**	**Personal Income ($)[2]**	**Number of Jobs[3]**
Tribal	- [4]	-	-	0	0
Non-tribal commercial	-	-	-	6,232,855	158
Recreational	-	-	-	46,344,819	1,174.50
TOTAL	**29,500,000**	22,728,721	**455**	**52,577,674**	**1,332.50**

[1] Source: Hatchery operation costs, which include related weir operation costs, are from Table 4-85 in NMFS (2014), and the number of jobs was estimated using jobs per million dollars of production cost factors described in Appendix J of NMFS (2014). Harvest-related effects on personal income and jobs are based on average annual harvest estimates and on application of personal income and jobs factors identified in Appendix J of NMFS (2014).

[2] All dollar values are expressed in 2009 dollars.

[3] Jobs are expressed in full- and part-time jobs.

[4] Dashes mean unknown because funding for hatchery operations is not allocated among user groups.

Pacific Ocean

Columbia River stocks support fisheries that generate personal income and support jobs in affected economic impact regions and local economies throughout the Columbia River Basin and Pacific Coast. However, unlike the Columbia River Basin, economic impact regions and local economies outside the Columbia River Basin (that are within the Pacific Ocean) are generally more dependent on fish originating from their local river systems, even though Columbia River stocks contribute to the fisheries. Fisheries that affect the Oregon and Washington Coasts, however, are exceptions. Fisheries in these areas depend substantially on Columbia River Basin stocks. The amount of personal income and the number of jobs supported in these economic impact regions by all salmon and steelhead stocks (not just Columbia River Basin stocks) is as follows (from NMFS 2014):

- Average annual harvest of salmon in commercial and recreational fisheries along the Washington coast generates $13,199,490 in personal income and supports an estimated 389 jobs.
- Commercial and recreational salmon fisheries along the Oregon coast generate $4,231,696 in personal income and 126 jobs.

These reported values for personal income and jobs on the Washington and Oregon coasts represent average annual conditions over the 2002 through 2009 period(NMFS 2014). Additional socioeconomic and demographic information for western U.S. coast fishing communities can be found on the NMFS Northwest Fisheries Science Center website at: http://www.nwfsc.noaa.gov/research/divisions/sd/communityprofiles/index.cfm.

3.8. Environmental Justice

This section was prepared in compliance with Presidential Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations* (EO 12898), dated February 11, 1994, and Title VI of the Civil Rights Act of 1964. The EPA defines environmental justice as “the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.” See the following website for more information on environmental justice: (http://www.epa.gov/compliance/basics/ejbackground.html).

In Executive Order 12898 (59 FR 7629), *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, EPA states that “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately

high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations." While there are many economic, social, and cultural elements that influence the viability and location of such populations and their communities, the development, implementation and enforcement of environmental laws, regulations and policies can have impacts. Therefore, Federal agencies, including NMFS, must ensure fair treatment, equal protection, and meaningful involvement for minority populations and low-income populations as they develop and apply the laws under their jurisdiction.

Both EO 12898 and Title VI address persons belonging to the following target populations:

- Minority – all people of the following origins: Black, Asian, American Indian and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic[11]
- Low income – persons whose household income is at or below the U.S. Department of Health and Human Services poverty guidelines.

Definitions of minority and low income areas were established on the basis of the Council on Environmental Quality's (CEQ's) *Environmental Justice Guidance under the National Environmental Policy Act* of December 10, 1997. CEQ's *Guidance* states that "minority populations should be identified where either (a) the minority population of the affected area exceeds 50 percent or (b) the population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographical analysis." The CEQ further adds that "[t]he selection of the appropriate unit of geographical analysis may be a governing body's jurisdiction, a neighborhood, a census tract, or other similar unit that is chosen so as not to artificially dilute or inflate the affected minority population."

The CEQ guidelines do not specifically state the percentage considered meaningful in the case of low-income populations. For this environmental impact statement, the assumptions set forth in the CEQ guidelines for identifying and evaluating impacts on minority populations are used to identify and evaluate impacts on low-income populations. More specifically, potential environmental justice impacts are assumed to occur in an area if the percentage of minority, lower per capita income, and percentage below poverty level are meaningfully greater than the percentage of minority, lower per capita income, and percentage below poverty level in the state of Oregon as a whole.

[11] "Hispanic" is an ethnic and cultural identity and is not the same as race.

The 10 hatchery facilities located in the UWR release hatchery Chinook salmon and steelhead into rivers which are located in the counties listed in Table 23.All of the counties in the analysis area are environmental justice communities of concern because they meaningfully exceed thresholds for low income or minority populations, with the exception of Clackamas County (Table 23).

Table 23. Demographic information regarding counties in the analysis area (USCB 2016).

County	Black (percent)	American Indian or Alaska Native (percent)	Hispanic or Latino (percent)	Poverty Rate (percent)	Per Capita Income (dollars)
Multnomah	5.8	1.5	11.4	15.7	31,544
Clackamas	1.1	1.1	8.4	9.4	34,047
Marion	1.4	2.5	26.2	16.8	22,490
Linn	0.7	1.6	8.8	15.8	21,706
Lane	1.1	1.3	7.6	17.4	24,105
Oregon (statewide average)	**2.1**	**1.8**	**12.8**	**13.3**	**27,684**

Note: Shaded cells represent values that were meaningfully different (in general, greater than 10 percent) than those of the reference population (which is treated here as the state of Oregon average values), making them an environmental justice community of concern.
Source: https://www.census.gov/quickfacts/fact/table/US/PST045216. Data accessed November 2, 2017.

EPA guidance regarding environmental justice extends beyond statistical threshold analyses to consider explicit environmental justice effects on Native American tribes (EPA 1998). Federal duties under the Environmental Justice Executive Order, the presidential directive on government-to-government relations, and the trust responsibility to Indian tribes may merge when the action proposed by another federal agency or the EPA potentially affects the natural or physical environment of a tribe. The natural or physical environment of a tribe may include resources reserved by treaty or lands held in trust; sites of special cultural, religious, or archaeological importance, such as sites protected under the National Historic Preservation Act or the Native American Graves Protection and Repatriation Act; and other areas reserved for hunting, fishing, and gathering (usual and accustomed, which may include “ceded” lands that are not within reservation boundaries). Potential effects of concern may include ecological, cultural, human health, economic, or social impacts when those impacts are interrelated to impacts on the natural or physical environment (EPA 1998).

Confederated Tribes of the Grand Ronde

The Confederated Tribes of the Grand Ronde include the Umpqua, Mololla, Rogue River, Kalapuya, and Chasta Tribes (as spelled by the Tribe). Their reservation is located in the coast range of Oregon (http://www.grandronde.org). When the tribes' Federal recognition was restored in 1983, there remained some potential conflicts with the state of Oregon regarding fishing rights (K. Dirksen, pers. comm., Tribal Fish and Wildlife Program Manager, Cowlitz Tribe, February 17, 2010, in NMFS (2014)). In 1986, the tribe and the state of Oregon signed a consent decree, which identified and explained, in part, how the tribe would manage and fish for salmon. Tribal members engage in ceremonial and subsistence fishing throughout original ceded lands. The tribe has participated in salmon recovery planning covering the reservation and ceded lands.

Burns Paiute Tribe

The Burns Paiute Tribe, located in southeast Oregon, is also a native American tribe involved and interested in the hatchery programs of the Upper Willamette River basin. In recent years, adult hatchery spring Chinook salmon from the Middle Fork Willamette River have been used for ceremonial fisheries in the Malheur River for tribal members. The Burns Paiute Tribe has expressed concern with continuing this program during public scoping for this EIS.

4. ENVIRONMENTAL CONSEQUENCES

4.1. Introduction

This section evaluates the potential impacts of the five alternatives (including the Proposed Action) on the human environment including the biological, physical, and human resources described in Subsection 3, Affected Environment. NMFS has defined the No-action Alternative (Alternative 1) as the continued operation of the hatchery programs without ESA authorization to use natural-origin fish for broodstock purposes. The Proposed Action Alternative (Alternative 2) is NMFS approval of the HGMPs under limit 5 of the 4(d) Rule, which includes authorization to use natural-origin fish for broodstock purposes. Alternative 3 is reducing hatchery production to levels producing hatchery fish for reintroduction purposes. Alternative 4 is terminating all hatchery programs in the Upper Willamette River Basin. Alternative 5 is increasing hatchery production to support enhanced fisheries up to ESA-approved fishery impact limits.

Where applicable, the relative magnitude of impacts is described using the following terms:

Undetectable:	The impact would not be detectable.
Negligible:	The impact would be at the lower levels of detection.
Low:	The impact would be slight, but detectable.
Medium:	The impact would be readily apparent.
High:	The impact would be severe or greatly beneficial.

In this chapter, there are two general aspects of impacts analyzed. First, is the effect from the operation of the hatchery facility (e.g., McKenzie Hatchery) on the affected environment. Second, is the effect from releasing hatchery fish from a particular program (e.g., McKenzie spring Chinook salmon program) on the affected environment. Many of the effects on resources evaluated in this section lend themselves more readily to either a discussion based on hatchery facility or discussion based on a specific program. To a large extent, it is most appropriate to consider effects on water quantity (Subsection 4.2, Effects on Water Quantity), water quality (Subsection 4.3, Effects on Water Quality), salmonid habitat (Subsection 4.4, Effects on Salmon and Steelhead and Their Habitats, and Subsection 4.5, Effects on Other Fish and Their Habitats), and wildlife (Subsection 4.6, Effects on Wildlife)largely in terms of the facilities, since facility operation and other associated structures are the primary, potential source of impact, though any effects of individual programs on such resources are also addressed. Conversely, effects that are more the result of interactions of an ecological nature with fish originating from the proposed programs are the

primary focus of the analyses on salmon and steelhead (Subsection 4.4, Effects on Salmon and Steelhead and Their Habitats) and other fish (Subsection 4.5, Effects on Other Fish and Their Habitats). Consequently, the analyses also addresses potential effects from individual programs. Effects on socioeconomics (Subsection 4.7, Effects on Socioeconomics), and environmental justice (Subsection 4.8, Effects on Environmental Justice) would also be expected to accrue more from the presence and/or exploitation of the proposed fish releases; therefore, analyses of these resources primarily addresses the effects of the individual programs.

4.2. Effects on Water Quantity

4.2.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under Alternative 1, the existing hatchery facilities in the UWR Basin would continue to operate in accordance with NMFS (2008) (see section 2.1Alternative 1 (No-action): Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks for more information see Appendix A). Consequently, short- and long-term surface water and groundwater use would be the same as current conditions (no changes are proposed to current hatchery operations). There would be no change in compliance with water permits or water rights at any of the hatchery facilities under Alternative 1 because the hatchery programs have existing permits and water rights to divert water as proposed in the submitted HGMPs. An analysis of the site-specific effects under Alternative 1 is provided below.

All of the facilities associated with the hatchery programs (Marion Forks Hatchery, Minto Dam FF, South Santiam Hatchery, Foster Dam FF, Roaring River Hatchery, McKenzie Hatchery, Leaburg Hatchery, Willamette Hatchery, and Dexter Dam FF) use surface water. All water diverted from the stream, river, or reservoir (minus evaporation) is returned after it circulates through each facility, so the only segment of the river that may be impacted by these hatchery facilities would be the area between the water intake and discharge structures (Subsection 3.2, Water Quantity). Willamette hatchery and South Santiam hatchery are permitted to use both surface and groundwater (Table 3). However, most of the water used is surface water because the groundwater water rights are low (0.11 to 0.3 cfs) (Table 3).

4.2.1.1 Amount of Water Used

Under Alternative 1, all of the hatchery facilities would continue to operate, and between 25 and 100.33 cfs of water could be used (by permitted water rights) from rivers, streams, reservoirs, and diversions between the water intake and discharge structures at the specific hatchery facility locations (Table 3).

For the UWR Basin, natural streamflows from August through October are typically the lowest throughout the year. The flows downstream of the dams are managed and can be greater than natural flows during this period depending upon water management. During this period of low streamflow, if the hatchery facility uses water up to the full water right this could result in low streamflows in the area affected by the hatchery's water withdrawal (the area affected is described below). For each hatchery facility, the actual water use by the facility was assessed for the time period of lowest streamflows in the stream or river where the hatchery facility is located (ODFW 2017). Streamflow information is available for every location (Table 3).

Surface water use by the hatchery facilities during the minimum mean monthly flows ranges from 2.2 to 85.6 cfs (Table 3). The percentage of streamflow affected during the lowest streamflows is reported in Table 3, and ranges from one to eight percent of the available streamflow during the lowest discharge periods of the year. There are essentially two categories of effect from the hatchery facilities using water from the adjacent streams and reservoirs: hatcheries that use water from natural, free-flowing streams, and hatcheries that take water from existing reservoirs and canals. Roaring River Hatchery, Marion Forks Hatchery, and Willamette Hatchery are located adjacent to free-flowing streams where water use ranges from 3.01 to 80.6 cfs during the lowest streamflows of the year (Table 3).

For all of the other hatchery facilities (Minto FF, South Santiam Hatchery, Foster FF, Leaburg Hatchery, McKenzie Hatchery, and Dexter FF), water is used from existing reservoirs and canals managed for other water purposes. The greatest use is for Leaburg Hatchery, where 85.6 cfs is used in September from the McKenzie River. It is important to note the Leaburg-Walterville diversion canal also withdraws water from the McKenzie River in this same reach (averages >1,000 cfs in September). Consequently, this reach of river is affected by two water withdrawals. Given the amount of water diverted down the Leaburg-Walterville canal, the effect of Leaburg hatchery's withdrawal is negligible on the affected reach of the McKenzie River.

For all of the hatchery facilities, the percent of the adjacent stream, river, reservoir, or diversion used during low streamflows ranges is relatively minor (Table 3). The hatchery facilities would not completely dewater the adjacent stream or river nor inhibit rearing and migration of any fish species. Therefore, under Alternative 1, if hatchery operations continue as proposed, there would continue to be negligible adverse impact from water withdrawal for the operation of the hatchery facilities (Table 3). The length of stream affected by the water diversion at the hatchery facilities is described below.

4.2.1.2 Length of Stream Affected by Water Use

Under Alternative 1, the length of stream or river impacted from having the water withdrawn for hatchery purposes would range from 370 to 7,339 feet in length (Table 3). This length of stream or river is the distance between the intake and outlet of the hatchery facility (the length of water diversion for hatchery purposes). For the hatchery facilities associated with a dam (i.e. Minto FF, South Santiam Hatchery, Foster FF, Leaburg Hatchery, McKenzie Hatchery, and Dexter FF) it is difficult to quantify impacts to the adjacent river because the water withdraw is located in the reservoir behind the dam. In every case, the water is taken upstream of the associated dam and discharged back into the river in the near vicinity of the tailrace of the dam. It is also difficult to quantify the effects of water withdrawal on fish migration because the dam is a complete barrier to fish passage unless the fish migrate into fish ladders, and water taken for the hatchery does not affect flow in the fish ladders. Given these circumstances, the effects of the hatchery's water use on affected stream reach is undetectable.

For the other hatchery facilities located adjacent to free-flowing streams (Roaring River Hatchery, Marion Forks Hatchery, and Willamette Hatchery), the maximum length of stream affected by water withdrawal ranges from 790 to 7,339 feet (Table 3). The greatest effect of water withdrawal is in Salmon Creek adjacent to Willamette Hatchery due to the length of stream affected and amount of water used during low streamflows. In no circumstance does the hatchery water withdrawals impede fish passage because most of the water is left in the affected stream from hatchery intake to effluent discharge. In terms of available habitat for aquatic species, the length of stream affected by hatchery water withdrawal is minor. Therefore, the amount of stream habitat affected by the hatchery facilities use of water before getting returned back to the stream under Alternative 1 would be low and only adversely affect the stream around the localized area of the hatchery.

Table 24. Total water use (cfs up to permit rights for ground and surface water) by alternative for all of the hatchery facilities cumulatively within each salmonid population area. For specific water uses, see Table 4 in Chapter 3.

Hatchery Facilities (by population area)	Alternative 1 (No-action)	Alternative 2 (Proposed Action)	Alternative 3 (Reduce production to reintroduction needs)[3]	Alternative 4 (Terminate the existing hatchery programs)	Alternative 5 (Increase hatchery production)	Maximum Percentage of Surface Water Diverted Under Alternatives 1,2, (percent)[1]	Maximum Percentage of Surface Water Diverted Under Alternative 5 (percent)[1]
North Santiam (Marion Forks hatchery & Minto Dam FF)	126	126	86	0	126	< 5%	< 15%
South Santiam (South Santiam hatchery, Roaring River hatchery, and Foster Dam FF[4])	31.94	31.94	22	0	31.94	< 4%	< 6%
McKenzie (McKenzie hatchery & Leaburg hatchery)	170.33	170.33	116	0	170.33	< 4%	< 11%
Middle Fork Willamette (Willamette hatchery & Dexter Dam FF)	122.5	122.5	83.3	0	122.5	< 8%	< 8%

Source: HGMPs (see Appendix 1 for citations), United States Geological Survey data sets (http://waterdata.usgs.gov), http://streamflow.engr.oregonstate.edu/links/gages_mainx.htm

[1] This calculation is the actual surface water use by the hatchery facility (column 6 of Table 5 in Section 3.2, Water Quantity) divided by the minimum mean surface water flows during lowest annual streamflows (column 5 of Table 5 in Section 3.2, Water Quantity).

[2] This metric is calculated as the total stream miles of designated critical habitat for winter steelhead and/or spring Chinook salmon in the population area where the hatchery facilities are located for the Upper Willamette ESU and DPS.

[3] Alternative 3 reduces hatchery production by 32% compared to No-action alternative. Therefore water use reduced by 32% for this alternative.

[4] No water allocated for Foster Fish Collection Facility in this calculation.

4.2.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, the effects on water quantity would be exactly the same as Alternative 1 (No-Action).The difference between Alternative 2 and the No-action alternative relate to how natural-origin fish are used in hatchery broodstocks, and therefore, does not change how water is used at the hatchery facilities. There would be no change in compliance with water permits or water rights at any of the hatchery facilities under Alternative 2 because the hatchery programs have existing permits and water rights to divert water as proposed in the submitted HGMPs. The analysis of the site-specific effects under Alternative 2 would be identical to effects analyzed under Alternative 1 (which result in negligible adverse impacts from water withdrawals at the hatcheries).

4.2.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, hatchery production levels would be reduced to produce only hatchery fish needed for reintroduction purposes throughout the UWR Basin. This equates to 32% less hatchery production compared to the No-action alternative. The number of fish targeted to be produced in a hatchery is in direct relationship to the amount of water needed to produce those fish. If fewer hatchery fish are produced in Alternative 3, compared to the No-action Alternative, then less water is going to be used at the hatchery to produce those fish. This is done by hatchery managers to optimize rearing densities and minimize costs associated with pumping water, etc. Therefore, since Alternative 3 is a production level 32% lower than the No-action alternative, the amount of water needed to produce those fish would be approximately 32% lower under Alternative 3. This assessment of impact focuses on the critical time period when natural streamflows are lowest throughout the year and the hatchery withdrawals would be of greatest impact. This represents the greatest impact on water resources. During other periods of the year (e.g. winter, early summer when natural streamflows are higher than in September through October), impacts from the hatchery facilities would be less because more water is flowing in adjacent streams and rivers.

Since the hatchery facilities would still need water to produce hatchery fish under Alternative 3, the length of stream affected between water intake and hatchery outfall would be the same for this alternative compared to the No-action Alternative 1.

4.2.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under Alternative 4 all hatchery production in the UWR Basin would be terminated. Three facilities (Roaring River Hatchery, Marion Forks Hatchery, and Willamette Hatchery) would not use any water for hatchery production. Therefore, the adjacent stream reaches at the hatchery facilities would no longer be affected by water withdrawals to raise hatchery fish compared to the No-action alternative 1. An additional one to eight percent of available streamflow during the lowest periods of the year would remain in the streams instead of being diverted for hatchery purposes. However, since the affected stream reaches are relatively short, and water use by the hatchery limited, the benefits of Alternative 4 on water quantity, compared to the no-action alternative, would be low.

For the water quantity impacts related to operation of the remaining hatchery facilities (Minto FF, South Santiam Hatchery, Foster FF, Leaburg Hatchery, McKenzie Hatchery, and Dexter FF), the effects under Alternative 4 would be mixed because several of the fish facilities would continue to be operated to collect natural-origin salmon and winter-run steelhead to pass upstream of the dams. Water would still be used at the same rate and during the same periods as the No-action alternative 1 in order to attract and collect natural-origin salmon and steelhead. The South Santiam Hatchery, Leaburg Hatchery, and McKenzie Hatchery facilities would not be in operation, but the benefits of not using water for the facility would be negligible because water for these facilities is taken from existing reservoirs and diversions that would continue to operate under Alternative 4.

4.2.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, hatchery production would be increased up to the available capacity of the existing hatchery facilities (an increase in production of approximately 33% compared to the No-action Alternative). For further information on this alternative, see Section 2.5, "Alternative 5: Increase hatchery production to support fisheries consistent with ESA impact limits". The effects of Alternative 5 on water quantity would be technically identical to the No-action alternative because existing water rights would not be increased. However, as evaluated in Alternative 1, there are periods of

time when the hatcheries do not use their full water right for hatchery production Table 3). Since this is the case, there is the possibility of increased water use for hatchery production within the existing limits of permitted water rights and hatchery capacity in order to produce the additional hatchery production under Alternative 5. For example, Willamette Hatchery currently uses 80.6 cfs during August under the No-action alternative, but the permitted water right is up to 87.5 cfs. Therefore, under Alternative 5 up to 87.5 cfs could be used for increased hatchery production during August. If it is assumed the hatchery facility would use the full water right legally available during the lowest streamflow period of the year, the amount of water used by the hatcheries ranges from 2% to 15% of the adjacent stream or river (Table 24). The greatest potential diversion from using the full water right under this alternative occurs in Marion and Horn creeks at Marion Forks hatchery on the North Santiam River (15% usage in Alternative 5 compared to 5% under the No-action alternative). Alternative 5 could result in greater use of water during the lowest streamflow periods in some locations, which would impact the adjacent stream reach from point of intake to point of discharge at the hatchery facility. However, the overall impacts on water quantity for this stretch of stream or river is low compared to the No-action alternative. The nature or character of the affected stream reach would not be changed in terms of aquatic organisms and stream habitat. The current water quality issues (e.g. 303(d) listings) identified for the streams would still exist under Alternative 5.

The length of stream affected by water withdrawals from the hatchery facilities would be the same for Alternative 5 compared to the No-action Alternative because the intake and outfall locations at each facility would be unchanged.

4.3. Effects on Water Quality

4.3.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under Alternative 1, the existing hatchery facilities in the UWR Basin would continue to operate in accordance with the Biological Opinion for the Willamette Project (NMFS 2008). See section 2.1, "Alternative 1 (No-action): Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks" for more information. Consequently, discharge of treated effluent (in compliance with the hatchery facility's NPDES permit) would continue as under current conditions. Levels of ammonia, nitrogen, phosphorus, and antibiotics (the most typical substances discharged)) would continue to be monitored at the hatchery facilities to ensure the effluent is within specified limits. The effect of the effluent discharge from the hatchery facility into adjacent streams and

rivers would be low and temporary because the effluent plume would mix with natural streamflows. There is likely some localized impacts from hatchery effluent at the point of discharge. The chemicals, bacteria, and viruses expelled from the hatchery may impact algae growth in the stream and aquatic insects until the discharge is diluted downstream. However, we have no information beyond this likely effect as to the impacts that have occurred previously or would transpire under any of the alternatives. Effluent discharge from the facilities is typically a low proportion of the overall flow in the adjacent stream or river making dilution quick from the discharge location. Table 24 shows the effluent discharge from the facilities and actual streamflows during the low flows periods throughout the year; making this the worst case for effluent dilution into adjacent streams. Aquatic organisms would be exposed to higher concentrations of chemicals, viruses, parasites, and bacteria within the outfall plume immediately below the hatchery facilities. However, the effect is likely to be undetectable farther than 200 meters downstream of the hatchery outfall (Bartholomew 2013).

Bartholomew (2013) found hatchery-related disease and pathogen transmission and outbreak in effluent of UWR hatchery facilities to be localized, with greatest mortality occurring at the hatchery and no mortality of fish observed in the receiving waters 400 feet downstream from the hatchery. Therefore, the potential adverse impacts are expected to be temporary and confined exclusively to the small area directly at the hatchery outfall. No impacts are expected on critical habitat and EFH as the effluent dilutes downstream (see Chapter 3, Affected Environment).

Alternative 1 would not be expected to change any of the Clean Water Act 303(d) listings because effluent resulting from the UWR hatchery facilities is included in the current conditions of the streams and rivers described in Subsection 3.3, Water Quality. In addition, the current 303(d) list violations related to temperature, dissolved oxygen, lead, and mercury of which hatchery effluent would not affect (Table 5). For example, the 303(d) listing for the North Santiam River is attributed to temperature and dissolved oxygen due to lack of riparian vegetation and upstream dams (Table 5); hatchery-related effluent parameters are not a factor in this listing. Also, the 303(d) listings apply to most of the streams and rivers in the UWR, of which many do not have any hatchery facility within the subbasin (e.g. Molalla, Calapooia, Coast Fork Willamette, Long Tom, Marys, Luckiamute, Yamhill, and Tualatin (Figure 2). Therefore, operation of hatchery facilities in the project area do not contribute to the Clean Water Act 303(d) list violations for the streams and rivers near the hatchery facilities, and do not contribute in any detectable manner to the existing water quality issues in the streams and rivers near the hatchery facilities. Thus, any impacts on existing water quality issues are expected to be undetectable under this alternative.

4.3.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, the UWR hatchery facilities would continue to operate as proposed in submitted HGMPs (see section 2.2, "Alternative 2 (Proposed Action/Preferred Alternative): Allow Integration of Natural-origin Fish into Hatchery Broodstocks").The effects of Alternative 2 would be identical to the No-action Alternative because the only difference between these alternatives relates to management of hatchery broodstocks (and not facility operations). Discharge of treated effluent (in compliance with the hatchery facility's NPDES permit) would continue as under current conditions and as analyzed under Alternative 1. This would be a localized, small area of adverse impact directly below the hatchery outfall from discharge of hatchery effluent. However, as the effluent mixes with surrounding waters in the streams and rivers, the impact from hatchery discharge is likely to be undetectable 400 feet downstream from the hatchery outfall. Impacts from hatchery effluent on water quality parameters and NPDES 303(d) listings would be identical to those described under the No-action Alternative 1. Present water quality concerns are related to temperature, dissolved oxygen, lead, and mercury of which the hatchery facility does not affect.

4.3.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the hatchery programs would be managed only to provide sufficient adult returns to provide for broodstock and reintroduction needs. Hatchery production in Alternative 3 would be reduced by 32% compared to Alternative 2 (Proposed Action/Preferred Alternative). With fewer hatchery fish being spawned, incubated, and reared at the hatchery facilities, effluent discharge would decrease compared to the No-action alternative. This would result in lower levels of chemicals, bacteria, and viruses being discharged from hatchery facilities into the adjacent river or stream, and fewer localized impacts to algae growth and insects. If rearing densities remained constant, it would be expected effluent would be reduced in accordance with the reduction in the number of hatchery fish being produced (in this case a 32% reduction under Alternative 3 compared to the No-action Alternative). Since the present issues with water quality (as determined by the 303(d) listings for water quality) do not relate the products discharged in the hatchery effluent, Alternative 3 would result in even lower effects than the No-action alternative.

4.3.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under Alternative 4, all of the existing hatchery programs in the UWR would be terminated. However, the fish collection facilities would still operate to collect and pass natural-origin salmonids at the various dams throughout the UWR. There would be no effects on water quality under Alternative 3 because there would be no effluent discharge from the hatcheries.

4.3.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, hatchery production would increase compared to the No-action alternative. However, the additional hatchery fish would be produced with the existing hatchery facilities and water rights under this alternative. Since it would take more water to produce additional hatchery fish under Alternative 5 (up to existing permitted water rights), discharge of effluent would likely increase compared to the No-action alternative during the lowest streamflow periods (Table 3). In particular, it would be expected the full water rights during the summer would be used, which currently does not occur under the No-action alternative. Consequently, hatchery effluent would increase into adjacent streams and rivers under Alternative 3. However, since this effect is of limited scope and duration with effects non-detectable greater than 200 m from the discharge point(Bartholomew 2013), effects overall will be negligible, compared to other factors that have been identified as water quality limiting factors in the basin. Overall, Alternative 5 would increase water quality impacts compared to the No-action alternative, but the expected impacts are low.

4.4. Effects on Salmon and Steelhead and Their Habitats

The environmental consequences of Alternatives 1-5 on salmon and steelhead and their habitats are described below. The principal mechanisms upon which hatchery programs can affect salmon and steelhead are found in Table 25. To summarize, hatchery programs can affect the genetics of natural populations from straying and interbreeding in the wild. Hatchery programs can increase the number of salmon spawning in historical habitats which may increase the abundance and productivity (in some cases) of the natural population (reintroduction). Hatchery fish can compete and predate upon co-occurring natural-origin fish; particularly at the juvenile life stages. Hatchery fish can transfer diseases and pathogens to natural-origin fish after release from the hatchery. However, in some circumstances, hatchery programs can benefit salmonid viability by supplementing natural spawning and thereby

increasing natural-origin fish abundance and spatial distribution, by serving as a source population for re-populating unoccupied habitat, and by conserving genetic resources.

The effects of the hatchery programs builds upon information presented in prior sections of this document. Section 3.4, Salmon and Steelhead and Their Habitats, provides an overview of the location of hatchery facilities, the number of hatchery fish released, the size of hatchery fish released, and the locations of where hatchery fish are released. It is important to consider the specific locations of the hatchery facilities within the population areas (see Table 1 and Figure 1).). Table 9 describes the time periods and size at release of hatchery fish, which helps inform potential competition and predation effects.

The following assessment information informs the environmental consequences of Alternatives 1-5 on salmon and steelhead and their habitats (see Table 27; Figure 12; Figure 13; Figure 14; Figure 15). This information is related to the ecological interactions between natural- and hatchery-origin juvenile and adults while in the freshwater areas of the Willamette and Columbia rivers. Overall, 27% of the designated critical habitat for UWR spring Chinook salmon and winter steelhead is affected by juvenile hatchery fish. Approximately 73% of the critical habitat does not have the presence of juvenile hatchery fish. This information is further evaluated under each alternative for spring Chinook salmon and winter steelhead.

Effects of Hatchery Programs on Natural-origin Fish

The existing hatchery programs within the UWR affect natural-origin salmon and steelhead and their habitat. Generally speaking, operation of hatchery facilities and release of hatchery fish into the natural environment could affect overlapping populations of natural-origin salmon and steelhead through genetic introgression of hatchery fish into the natural population, increased competition and predation from hatchery fish, transfer of pathogens from hatchery fish and/or the hatchery facility to the adjacent river or stream, operation of the hatchery facility using water and discharging effluent, masking of natural population status from having hatchery fish spawning in the wild, incidental fishing effects, and nutrient input from carcasses (Table 25). The extent of adverse effects depends on how the hatchery program is managed, the current status of the natural-origin populations and how affected they are by the hatchery program, and the condition of the habitat; among other factors.

Hatchery programs can also provide benefits to the natural-origin populations by increasing the amount of marine-derived nutrients to the freshwater environment from having hatchery fish spawn naturally and from the outplanting of carcasses from the hatchery facility. Hatchery programs can also potentially benefit the abundance, productivity (in some cases where the demographic risk of extinction is high), spatial structure, and diversity of natural populations (McElhany et al. 2000). For example, the original intent of the UWR spring Chinook salmon hatchery programs was to enhance harvest opportunity (societal benefit), but since ESA listings, hatchery releases have been used for reintroduction into historical habitat and are being managed more for conservation purposes (ESA benefit) in addition to enhancing harvest opportunity. The summer-run steelhead and rainbow trout programs are not considered conservation programs because the broodstock origin is from out of DPS fish, and potential negative genetic and ecological effects on natural-origin winter steelhead populations.

Hatchery fish that spawn in the wild can interbreed with natural-origin fish and affect the genetic integrity of the natural population (Table 25). Depending upon how the hatchery broodstock has been managed, hatchery fish that interbreed with natural fish can reduce the productivity and long-term fitness of the wild population to varying degrees from inbreeding and outbreeding depression. Prior to release from the hatchery, hatchery fish experience different selection pressures than fish in the wild. This hatchery-influenced selection (often referred to as domestication) occurs in hatchery fish which may alter the genetic make-up of the natural-origin population. Consequently, when hatchery fish interbreed in the wild, genetic changes may occur to the wild population from the hatchery program depending upon the demographic condition of the natural-origin population, and level of straying and interbreeding.

Juvenile and adult hatchery fish can compete with and/or predate upon natural-origin salmon and steelhead (Table 25). Hatchery fish can be much larger than co-occurring natural-origin fish (Table 9); making natural-origin fish vulnerable to predation during the period when the hatchery fish emigrate to the ocean. Hatchery fish can residualize in freshwater and not emigrate to the ocean, which may promote competition with co-occurring natural fish if resources (space and food) are limited.

Hatchery programs can also introduce diseases and pathogens into natural fish populations (Table 25). However, this is most likely uncommon within the UWR because the hatchery programs all use spring Chinook salmon and steelhead[12] from within the region that are naturally exposed to these diseases and

[12] Broodstock for the summer steelhead program is collected at Foster Dam FF, and originated from Skamania stock summer-run steelhead.

pathogens. Hatchery facilities can result in elevated levels of disease and pathogen downstream of the hatchery facility effluent discharge. This is commonly caused by higher densities of fish rearing in the hatchery, which results in greater disease and pathogen levels in the hatchery than under natural conditions. Although poorly managed hatchery programs can increase disease and pathogen transfer risks, compliance with applicable protocols for fish health can effectively minimize this risk. The elevated levels of disease and pathogen are typically concentrated near the hatchery effluent and then are diluted by water as it discharges downstream. The higher concentration of disease and pathogens associated with hatcheries is typically localized and short-lived (Bartholomew et al. 2013).

The operation of hatchery facilities can affect salmon and steelhead by the withdrawal of water from adjacent streams and rivers, whereby decreasing the amount of habitat available for natural fish in the affected reach (Table 25). The discharge of effluent from the hatchery facility can expose natural fish to elevated levels of bacteria and viruses. Both of these potential effects are described above in Section 3.2, Water Quantity and Section 3.3, Water Quantity.

Table 25. General mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations.

Effect Category	Description of Effect
Genetics	• Hatchery-origin salmon and steelhead interbreeding with natural-origin fish in the wild can change the genetics of the affected natural population(s). • Hatchery-origin fish can alter the genetic integrity and/or genetic diversity of the affected natural population(s) depending upon the magnitude of interaction. • If natural-origin fish abundance is critically low, the hatchery stock may contain genetic resources valuable for population conservation and recovery.
Competition and predation	• Hatchery-origin fish can increase competition for food and space. • Hatchery-origin fish can increase predation on natural-origin salmon and steelhead.
Pathogen transfer	• Hatchery fish can have elevated levels of pathogens and bacteria from rearing in the hatchery which can be transferred to the natural-origin population from hatchery fish and/or release of hatchery effluent.

Effect Category	Description of Effect

Hatchery facilities	• Hatchery facilities can reduce water quantity or quality in adjacent streams through water withdrawal and discharge of effluent.
	• Hatchery facilities at weirs and dams to collect broodstock and/or control hatchery fish on the spawning grounds can have the following unintentional consequences:
	  o Isolation of formerly connected populations
	  o Limiting or slowing movement of migrating fish species, which may enable poaching, increase predation, and/or alter spawn timing and distribution
	  o Alteration of stream flow
	  o Alteration of streambed and riparian habitat
	  o Alteration of the distribution of spawning within a population
	  o Increased mortality or stress due to capture and handling
	• Impingement of downstream migrating fish

Natural population masking	o Hatchery-origin fish spawning naturally can mask the true status of the natural-origin population from hatchery supplementation.
Fishing	• Fisheries targeting hatchery-origin fish can have incidental impacts on co-occurring natural-origin fish.
Population viability benefits	Depending upon the objective of the specific hatchery program, hatchery fish can potentially: • Increase the abundance of natural-origin fish from additional natural spawning in the wild. • Increase the productivity of the natural population from hatchery fish spawning and nutrient enhancement, particularly if abundance of natural-origin fish is low. • Preserve and/or increase the genetic and phenotypic diversity of the affected natural population, particularly for severely depressed populations.
Nutrient cycling benefits	• Returning hatchery-origin adults can increase the amount of marine-derived nutrients in freshwater systems from natural spawning and/or outplanting of carcasses from the hatchery.

Hatchery fish can mask the true status of natural populations if straying and spawning by hatchery fish in the wild is substantial (Table 25). The continual supplementation of natural spawning by hatchery fish (intentional or unintentional) can increase total abundance of fish on the spawning grounds and thereby increase uncertainty of the status of the natural population to sustain itself without hatchery influence. Within the UWR, most natural populations of spring Chinook salmon currently have high percentages of hatchery fish on the spawning grounds (e.g., 40 to 70 percent; Table 26). Managers are planning to reduce the percentage of hatchery-origin fish on the spawning grounds once natural-origin fish abundance increases (Table 26). For summer-run steelhead in the UWR, it is the intent of managers to reduce natural spawning of hatchery fish to the lowest degree possible, but some introgression from summer-run hatchery fish with natural-origin winter-run steelhead has been detected (Johnson et al. 2013).

Table 26. The future target and current estimate of the percentage of hatchery-origin spawners (pHOS) in Upper Willamette River sub-basins where spring Chinook salmon are released. Information on targets and current estimate from HGMPs.

Sub-basin	Percentage of hatchery-origin spawners in the wild (pHOS)		Comment
	Future Target	Current estimate	
North Santiam	< 10% pHOS upstream of Detroit Dam and ≤ 21% downstream of dam	66%	Current estimate is the average between 2002-2017 from C. Sharpe, ODFW, personal communication
South Santiam	<30% in the natural population of the South Santiam River (0% above Foster, <80% below Foster)	65%	Current estimate is average from 2007-2017 from C. Sharpe, ODFW, personal communication. pHOS is much greater downstream of Foster Dam (76%) and much lower upstream of the dam (32%).
McKenzie	< 10% for total natural spawning population in the McKenzie River subbasin, excluding the South Fork McKenzie Basin above Cougar Dam and the McKenzie Basin above Trail Bridge Dam.	35% (total basin); 78% downstream of Leaburg Dam, and 26% upstream of dam	Current estimate is average from 2002-2017C. Sharpe, ODFW, personal communication
Middle Fork Willamette	<10% in Fall Creek Basin and upstream of Dexter and Lookout Point dams	81% downstream of Dexter Dam (2002-2017), 19% upstream of Fall Cr. Dam (2002-2017), 98% North Fork Middle Fork River	Current pHOS estimate is average between 2002-2013 from Table 2.2.2-2 of the HGMP for the area between

Sub-basin	Percentage of hatchery-origin spawners in the wild (pHOS)		Comment
	Future Target	Current estimate	
		(2002-2015), and 99% upstream of Hill Cr Dam (2012-2015)67%	Dexter and Jasper, including Fall Creek.

Hatchery programs provide fish for fishery harvest opportunities in the ocean and freshwater (Table 25). Natural-origin salmon and steelhead can be affected by these fisheries to varying degrees. In most cases, natural-origin fish are required to be released upon capture and externally marked hatchery-origin fish can be kept. The incidental effects of these catch-and-release fisheries on natural-origin fish typically range from 0 to 15 percent mortality (NMFS 2001a; NMFS 2001b).

Hatchery programs may also maintain and/or increase salmonid abundance and productivity (in some cases), spatial structure, and diversity (Table 25). Natural spawning by hatchery fish occurs because collection efficiency at the hatchery facilities is not 100 percent and not all excess hatchery fish are harvested. Salmon and steelhead by nature do stray and spawn in non-natal areas. The recent level of hatchery fish spawning in the wild depends upon the specific population (Table 26).

The current hatchery programs have benefitted natural-origin salmon and steelhead by providing additional hatchery fish returns to the freshwater ecosystem, thereby enhancing the amount of marine-derived nutrients available from the decomposed carcasses (Table 25).Marine-derived nutrients are important to the streams of the Project Area, because streams in those areas tend to be low in terrestrial nutrients; the return of anadromous fish from the ocean environment acts as a key mechanism for bringing nutrients into the freshwater ecosystems (Cederholm et al. 1999). The carcasses can provide food for aquatic and terrestrial species via direct consumption. The carcasses can also decompose with the primary nutrients available in the water and deposited in the sediments which are then available for primary production by plants and animals. Both of these pathways increase the productivity of the freshwater environment from salmon and steelhead carcasses.

The proposed action includes the benefit of marine-derived nutrients into the freshwater environment from hatchery fish returns. Hatchery fish that are not harvested or collected at hatchery facilities can spawn in the wild and contribute marine derived nutrients to the environment. This currently occurs at high levels in the natural populations of spring Chinook salmon where the hatchery fish return and spawn in the wild. In addition, hatchery fish collected at the facilities in excess of broodstock needs can be

outplanted in streams for nutrient enhancement after routine fish health testing to ensure carcasses are not carrying non-endemic pathogens and diseases, to avoid elevating the level of risk of diseases and pathogens in the wild. In most years, thousands of hatchery fish carcasses are available for outplanting for nutrient enhancement or other beneficial uses (see HGMPs).

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) designated Essential Fish Habitat (EFH) for Pacific salmon, which includes Chinook salmon within the UWR. 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. Chapter 4, Environmental Consequences, evaluates the effects of the alternatives on EFH. In its evaluation of the HGMPs, NMFS will include analysis of the effects of the proposed action on EFH. For the purposes of this NEPA analysis, effects on habitat – and, in particular, designated critical habitat – will include effects on EFH.

A more detailed discussion of the general effects of hatchery programs on salmon, steelhead, and their habitat can be found in the Final Environmental Impact Statement to Inform Columbia River Basin Hatchery Operations and the Funding of Mitchell Act Hatchery Programs (NMFS 2014).

Table 27. Assessment of hatchery fish releases (CHS- spring Chinook, STS-summer steelhead) and risk of interaction with natural-origin salmon and steelhead in freshwater areas throughout the UWR basin. Further details on the classification of risk (low, medium, high) can be found in Appendix B.

Population Area where Hatchery Fish Released	**Time Period for Hatchery Fish Releases**	**Potential Area of Overlap between Hatchery and Natural Salmon and Steelhead**	**Relative Magnitude of Potential Hatchery Fish Interaction with Natural-origin Salmon and Steelhead**
Molalla (Trout Creek)	CHS- Feb to March	Molalla/Trout Creek confluence downstream to Willamette River (27 miles)	Low
North Santiam (Minto FF)	CHS- Feb to March STS- April	Minto FF downstream to Willamette River (53 miles)	Medium
South Santiam (Foster Dam)	CHS- Feb, Mar, Oct STS- April	Foster Dam downstream to Willamette River (48 miles)	Medium
McKenzie (hatchery and Leaburg Dam)	CHS- Jan to March STS- April	Leaburg Dam downstream to Willamette River (34 miles)	Medium
Middle Fork Willamette (Dexter FF)	CHS- Feb to April STS- April	Dexter FF downstream to Willamette River (27 miles)	High
Coast Fork Willamette (dam)	CHS- Feb	Cottage Grove dam downstream to Willamette River (29 miles)	Low
Willamette (Eugene)	STS- April (CHS – from tributaries)	Eugene to Columbia River (174 miles)	Low (for STS at Eugene) to High (as hatchery fish accumulate from tributaries)

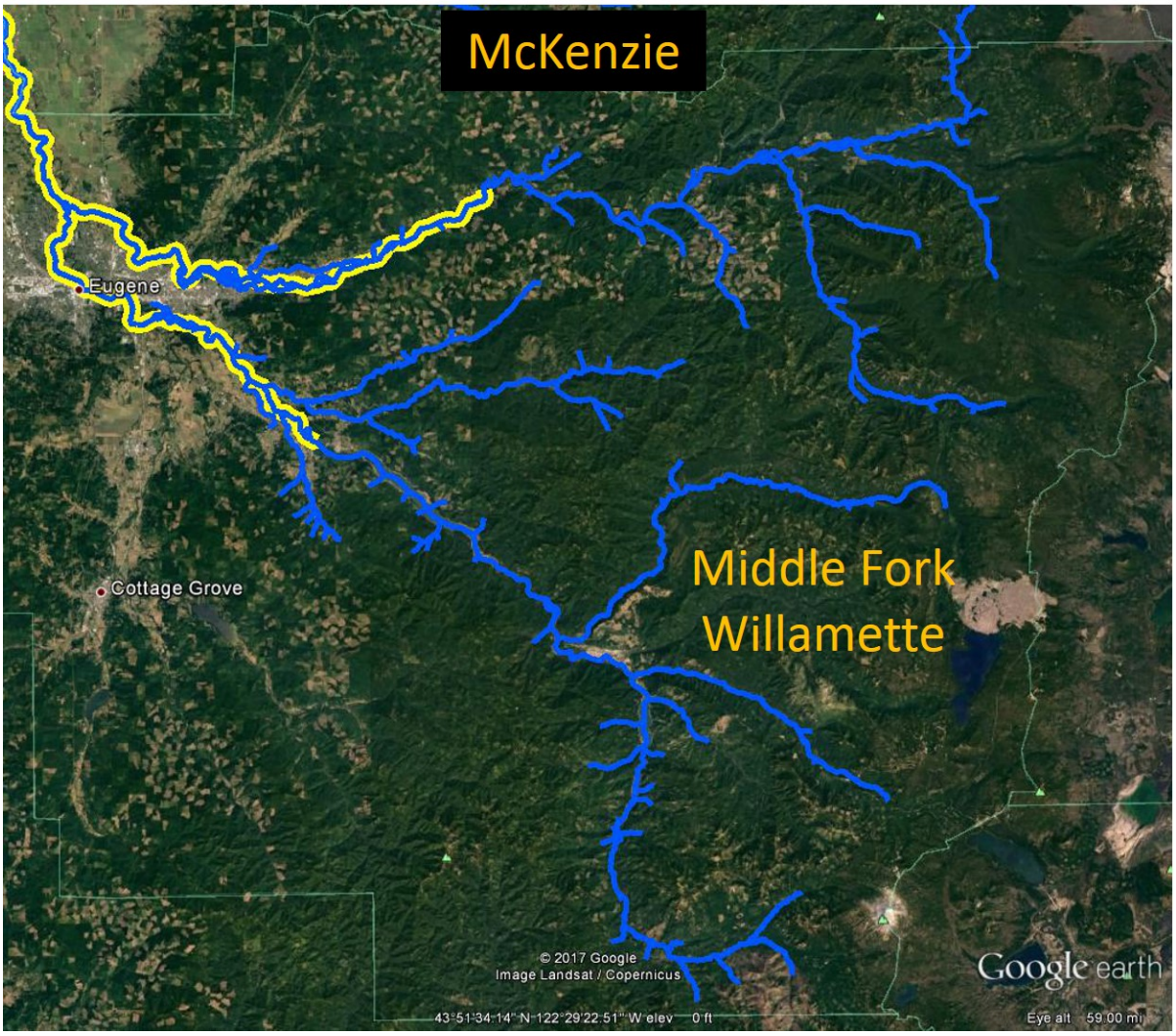

Figure 12. Geographic extent of the interaction area between hatchery fish and natural fish in the upper Willamette region. Hatchery fish are released in the McKenzie and Middle Fork Willamette rivers. The reaches where hatchery fish are released are the yellow lines. Stream reaches designated as critical habitat for UWR spring Chinook salmon and winter steelhead are identified as the blue colored lines.

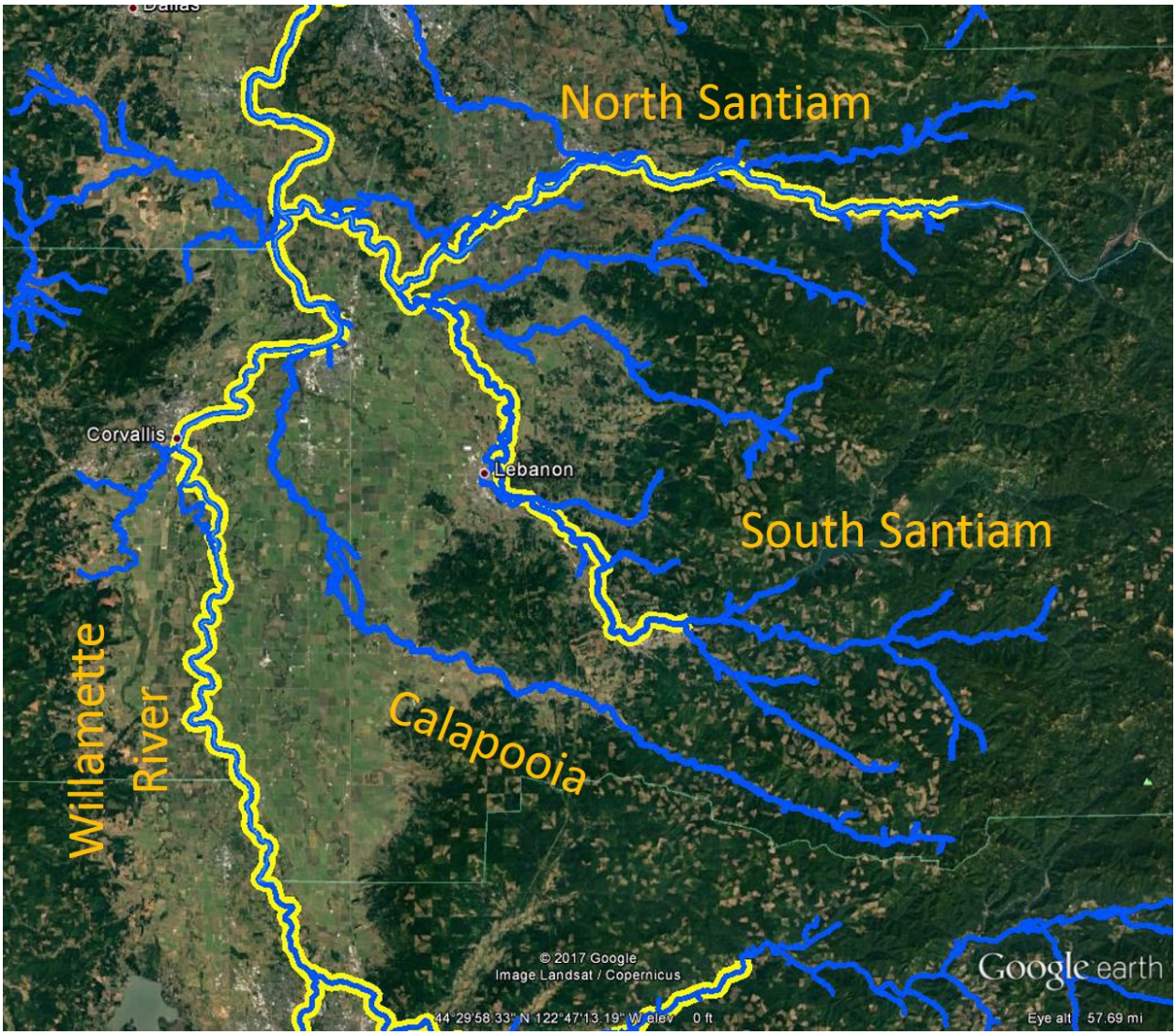

Figure 13. Geographic extent of the interaction area between hatchery fish and natural fish in the mid-Willamette region. Hatchery fish are released into the North Santiam and South Santiam rivers. The reaches where hatchery fish are released are the yellow lines. Stream reaches designated as critical habitat for UWR spring Chinook salmon and winter steelhead are identified as the blue colored lines.

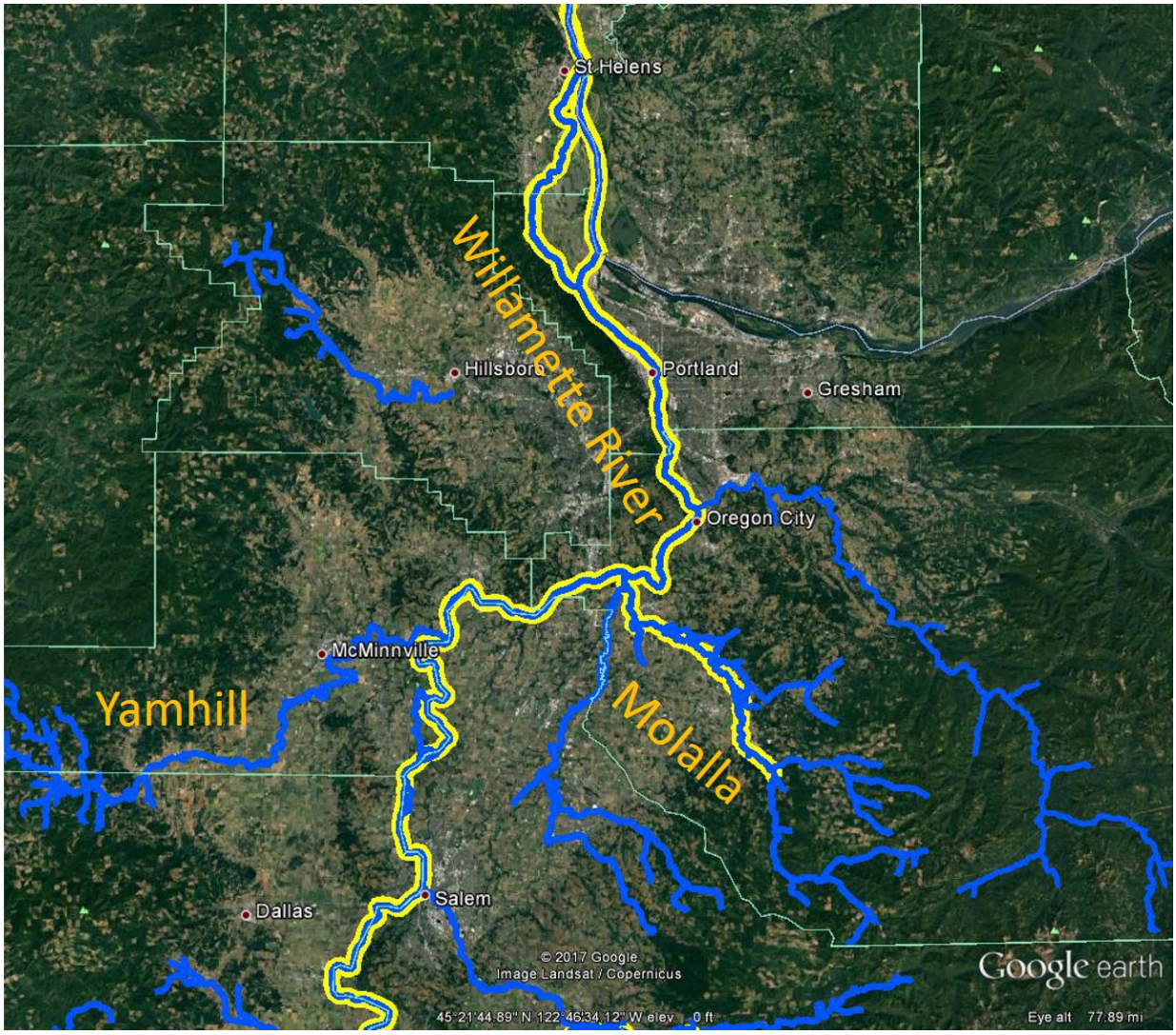

Figure 14. Geographic extent of the interaction area between hatchery fish and natural fish in the Lower Willamette region. Hatchery spring Chinook salmon are released into the mainstem Molalla River. The reaches where hatchery fish are released are the yellow lines. Stream reaches designated as critical habitat for UWR spring Chinook salmon and winter steelhead are identified as the blue colored lines.

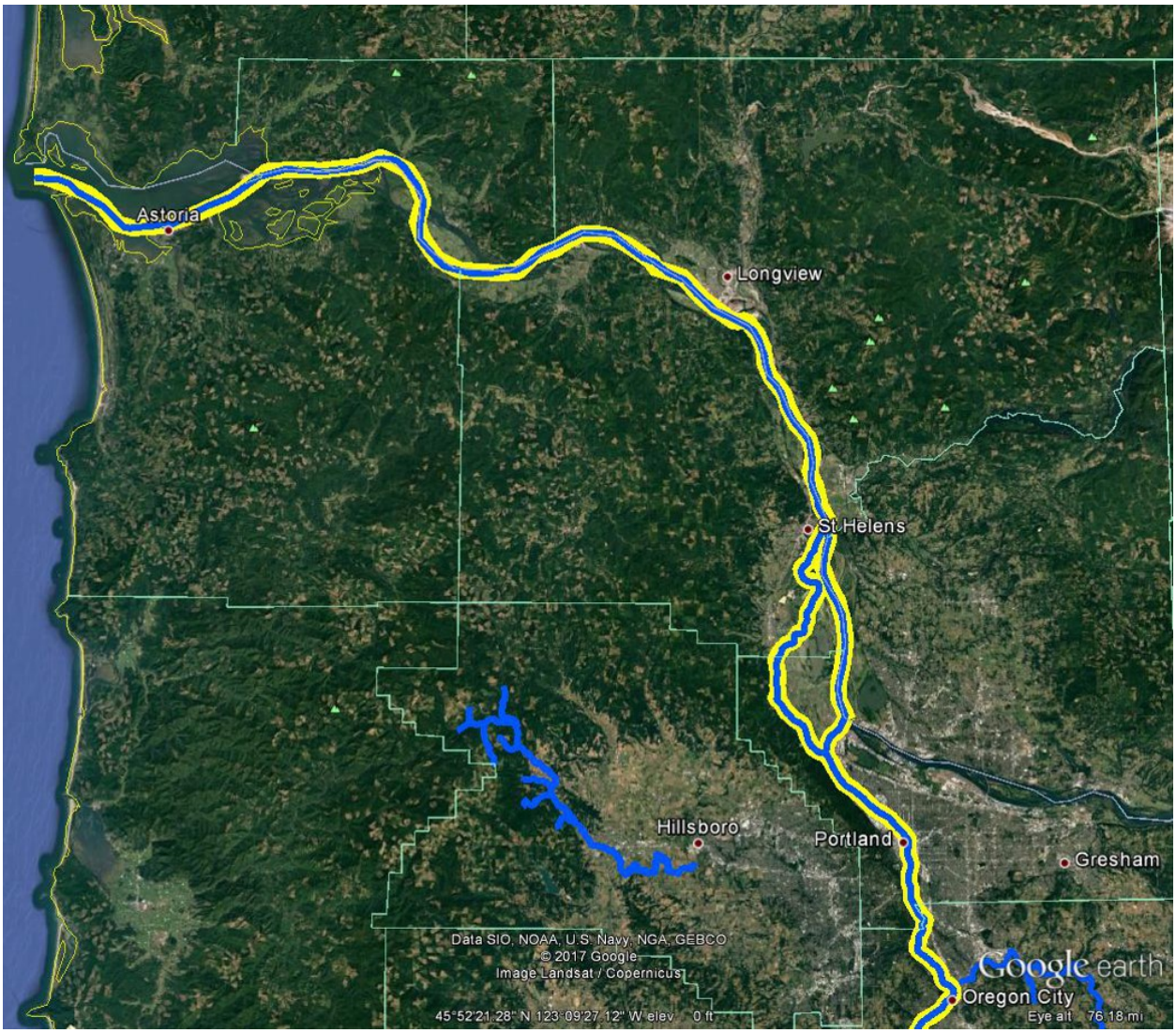

Figure 15. Geographic extent of the interaction area between hatchery fish and natural fish in the Columbia River region. The reaches where hatchery fish (from UWR releases) occur are the yellow lines.Stream reaches designated as critical habitat for UWR spring Chinook salmon and winter steelhead are identified as the blue colored lines.

4.4.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under Alternative 1, the hatchery facilities, and associated hatchery programs, throughout the UWR Basin would continue to operate in accordance with the Biological Opinion for the Willamette Project (NMFS 2008). Alternative 1 would continue to pose short- and long-term risks associated with demographic and genetic effects, competition and predation effects, hatchery facility effects, incidental fishing effects, and transfer of pathogens from hatchery fish and/or the hatchery facility to the adjacent river or stream where natural-origin salmon and steelhead occur. Alternative 1 would continue to provide

some benefits to natural populations from hatchery fish spawning in the wild increasing total spawning escapement above the Corps dams and increase ocean-derived nutrient cycling in the ecosystems (Subsection 3.4, Salmon and Steelhead and Their Habitat). The species-specific effects of Alternative 1 are discussed below.

Critical Habitat under the ESA is designated for spring Chinook salmon and winter steelhead in the UWR Basin. Essential Fish Habitat (EFH) under the Magnuson-Stevens Fishery Conservation and Management Act applies to spring Chinook salmon. The operation of the hatchery facilities adversely affects critical habitat and EFH in the local vicinity where the facilities are located. The primary impact on critical habitat and EFH is from the effluent discharge from the hatchery facilities (Subsection 4.2 and 4.3, above). Alternative 1 would result in undetectable physical habitat changes to critical habitat and EFH compared to current conditions.

UWR spring Chinook Salmon

The No-action Alternative 1 would continue to operate the hatchery facilities and associated programs for spring Chinook salmon and summer steelhead in accordance with the Biological Opinion on the Willamette Project (NMFS 2008) and Upper Willamette River Conservation and Recovery Plan (ODFW and NMFS 2011). This section evaluates the effects of these hatchery programs on natural-origin spring Chinook salmon in the UWR ESU.

For the assessment of Alternative 1 here (and the other alternatives below), it is important to first describe the strategy outlined in the Upper Willamette River Conservation and Recovery Plan (ODFW and NMFS 2011) for the management of natural-origin and hatchery-origin Chinook salmon in the population areas of the UWR ESU. Each spring Chinook salmon population has unique circumstances with its current risk status, current limiting factors/threats, and reintroduction efforts to put salmon back into historical habitat above impassable dams. The overall ESU strategy can be summarized into two conservation and recovery strategies (Figure 16): 1) protect natural-origin Chinook salmon in population areas where they are successfully reproducing, and 2) reintroduce Chinook salmon back into core historical habitats, where they have been eliminated, using the most appropriate stock of hatchery fish (ODFW and NMFS 2011). In summary, management is structured to minimize hatchery-related risks where natural production currently is occurring in greater abundance in the Clackamas River, McKenzie River, South Santiam River above Foster Dam, and Fall Creek above the dam. The goal in these population areas is to minimize pHOS and implement actions to reduce hatchery fish spawning to less than 10% (ODFW and

NMFS 2011). For the other population areas above the federal dams, intentional outplanting of hatchery Chinook salmon is occurring in an effort to restore production back into historical habitat of spring Chinook salmon above Big Cliff, Detroit, Green Peter, Cougar, Dexter, Lookout Point, and Hills Creek dams. No outplanting of salmon is occurring above Dorena, Cottage Grove, or Fern Ridge dams.

The success of reintroduction above the federal dams is being evaluated principally through genetic pedigree analyses, where all salmon outplanted above the dams are genetically sampled. All resultant offspring that are sampled at various life stages (juvenile and adult) can then be genetically tested to verify whether the salmon is offspring from outplanting/reintroduction efforts above the dams (essentially tracing the family tree of salmon outplanted above the dams). To date, extensive monitoring and evaluation have shown hatchery salmon outplanted above the federal dams to produce 100,000's of juvenile spring Chinook salmon fry in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette population areas (Monzyk et al. 2016; Romer et al. 2016). These juvenile salmon emigrate to the reservoirs, but successful passage downstream of the reservoirs and dams has been poor overall (Hansen et al. 2017).

To date, there have been several cases where reintroductions above dams using hatchery Chinook salmon has resulted in substantial numbers of returning natural-origin Chinook salmon. These successes demonstrate the validity of the hatchery management approach in the UWR described by ODFW and NMFS (2011). In the Clackamas River, reintroduction of spring Chinook salmon occurred in the late 1970's when Clackamas hatchery program was initiated. Improvements to upstream and downstream passage at River Mill, Faraday, and North Fork dams on the mainstem Clackamas River have allowed natural-origin Chinook salmon to recover. Current management allows only the passage of unmarked, natural-origin Chinook salmon above North Fork Dam. The Clackamas River now supports the highest abundance of natural-origin Chinook salmon (1,000's of salmon returning annually) throughout the UWR ESU. Fall Creek is another successful reintroduction using hatchery Chinook salmon. The primary improvement to Fall Creek has been the drawdown of the reservoir in the fall to stream level that allows juvenile salmon to emigrate downstream of the dam. Returns of natural-origin Chinook salmon number in the hundreds of fish and hatchery Chinook salmon are no longer needed for reintroduction. In the South Santiam, returns of natural-origin salmon have increased at Foster Dam in sufficient numbers to eliminate the need for hatchery supplementation. Foster reservoir and dam are relatively small and allow for some downstream passage of Chinook salmon. With these recent successes using hatchery Chinook salmon for reintroduction into historical habitats throughout the ESU, it is likely increases will also occur

in the North Santiam, South Fork McKenzie, and Middle Fork Willamette population areas once improvements to downstream passage are implemented (Figure 17).

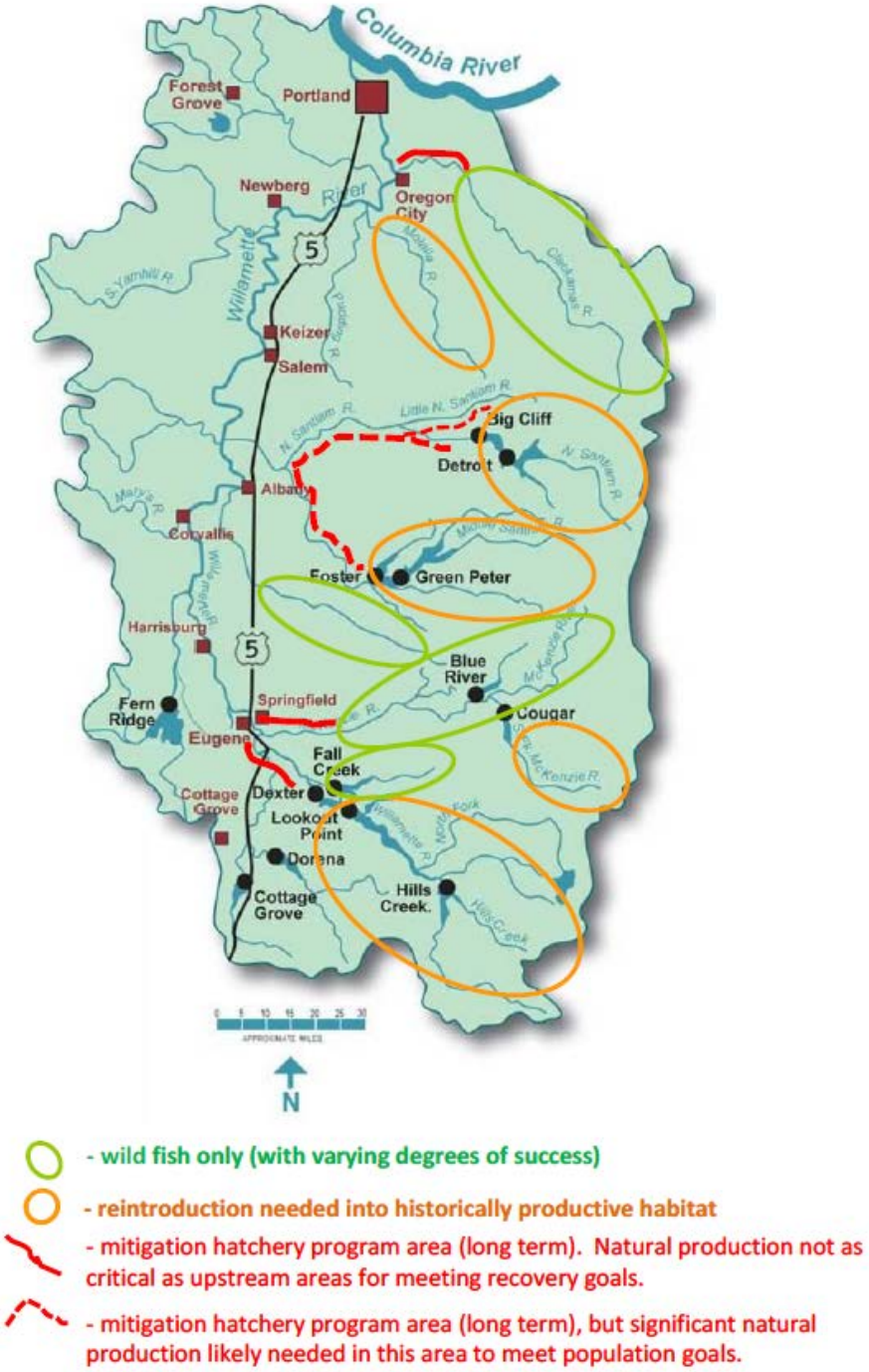

Figure 16. Map of spring Chinook salmon population areas showing the goals for natural-origin fish management areas, reintroduction areas, and hatchery mitigation areas. Figure taken from the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011).

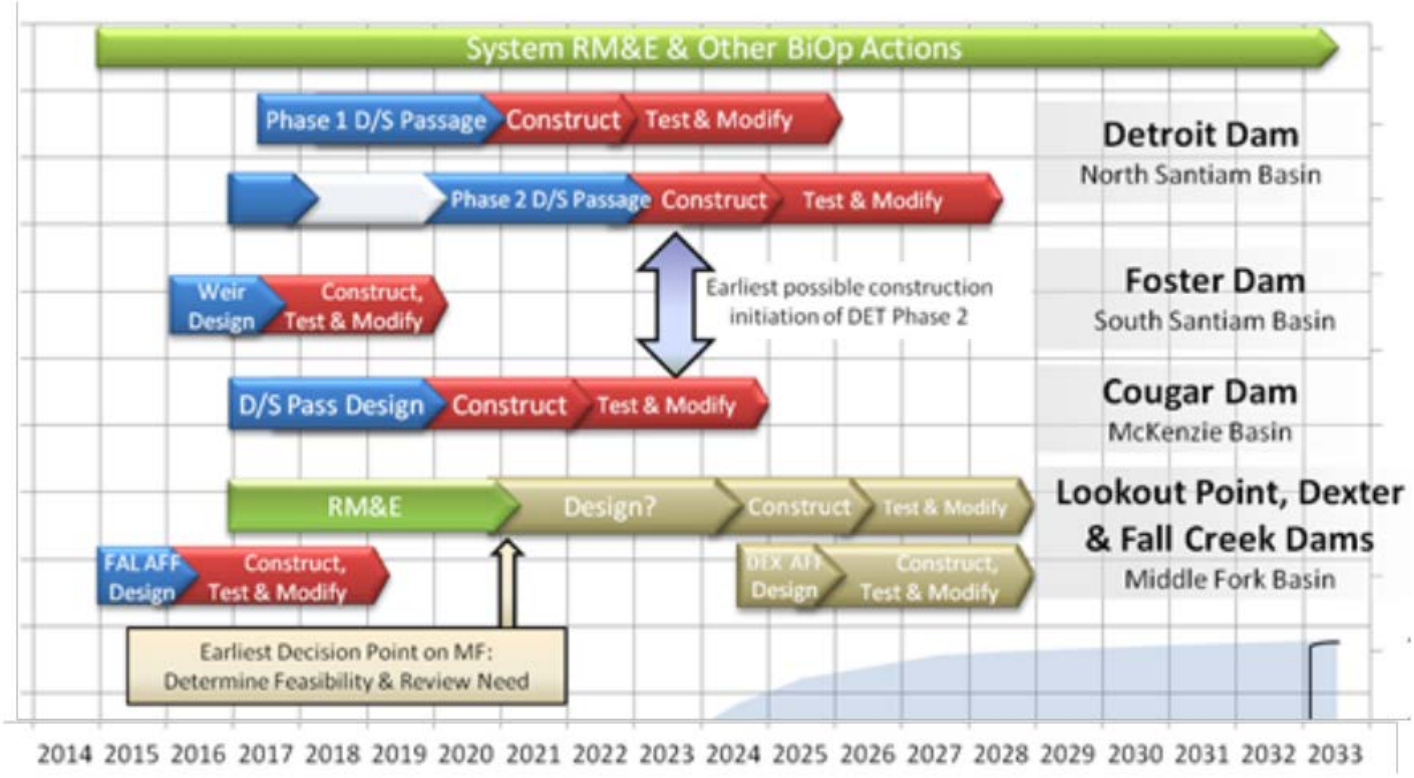

Figure 17. Timetable for design, construction, and modification of adult collection and downstream passage systems at Corps projects in the Upper Willamette Basin (from U.S. Army Corps of Engineers). Figure taken from Myers (2017).

Genetic Effects

The percentage of hatchery-origin spawners (pHOS) on the spawning grounds can indicate the potential effect of the hatchery program on the genetic diversity of the natural-origin population. It is important to understand pHOS is a ratio of hatchery to natural-origin spawners and does not take into account spawner abundance. For example, pHOS can be high when there are only a few natural-origin fish in a population and a low percentage of the returning hatchery fish stray into the wild which can lead to a very high pHOS value (e.g. 10 natural-origin vs 90 hatchery equates to 90% pHOS). This is the current situation with most populations of spring Chinook salmon in the UWR, where natural-origin spawner abundances are low and hatchery-origin returns are high. All of the hatchery programs have low stray rates (defined here as the proportion of hatchery fish that do not return or are not collected at fish collection facilities).

However, pHOS values are high due primarily to the low numbers of natural-origin spring Chinook salmon being produced in the wild.

Currently, pHOS for all core spring Chinook salmon populations, except the McKenzie River population, is greater than 50 percent (Table 26). However, in the McKenzie River population, while the basin-wide pHOS estimate is 35percent, pHOS for fish that spawn downstream of Leaburg Dam is estimated at over 75 percent (and around 25 percent upstream of the dam; Table 26). It is important to understand that when managers try to balance the demographic risk to a population with the genetic risk, it may mean that pHOS is higher than desired in some populations to ensure that the demographic risk is lowered (with more spawning adults, regardless of origin). Another factor that needs to be considered for the UWR spring Chinook salmon ESU is that most of the historical habitat that this ESU used is now inaccessible because of dams, which limits the ESU's productivity. However, as shown in Table 26, long-term management goal for the spring Chinook ESU is to reduce pHOS in all populations.

While pHOS is one indicator of potential genetic effects to a population, another indicator is the proportionate natural influence (PNI). PNI of a population, which is a measure of the natural environment's influence on the genetic diversity of a population, as a whole, is a function of both pHOS in the natural escapement and the proportion of natural-origin broodstock (pNOB) incorporated into the hatchery program. The hatchery science review group (HSRG) suggests that if the desire is to ensure that the natural environment (as opposed to the hatchery environment) influences the genetic diversity of a population, then PNI should be greater than 67 percent (HSRG 2004). Because the UWR natural-origin spring Chinook salmon run is depressed (Table 6; Figure 4), and there can be very high pre-spawning mortality of spring Chinook salmon (see Section 3.4), natural-origin fish have only been incorporated into the hatchery broodstock at very low rates recently (Table 28), essentially reducing PNI to near zero (along with high pHOS). In recent years, the co-managers have not had ESA authorization to use natural-origin Chinook salmon for broodstock and so there has not been any intentional use of natural-origin Chinook salmon for broodstock purposes (i.e. not legally permitted by the ESA yet).

Table 28. Proportionate natural influence (PNI) values for Alternative 1 (recent, no-action) and Alternative 2 (proposed action/preferred alternative) for natural-origin spring Chinook salmon populations with hatchery programs in the UWR.

Hatchery Program	Recent pNOB (no ESA authorization)	Recent pHOS	Recent PNI	pNOB (proposed action)	PNI (proposed action)	Long-term target pHOS	Long-term target pNOB	Target PNI
North Santiam	0	0.8	0.00	0.1	0.11	0.1	0.5	0.83
South Santiam	0	0.65	0.00	0.1	0.13	0.3	0.5	0.63
McKenzie	0	0.35	0.00	0.1	0.22	0.1	0.5	0.83
Middle Fork Willamette	0	0.9	0.00	0.1	0.10	0.1	0.5	0.83

The genetic effects of the current hatchery program on natural-origin spring Chinook salmon likely ranges from low (e.g. upstream of Foster dam where only natural-origin fish are transported and released) to high where pHOS estimates are greater than 60 to 70 percent (e.g. downstream of Detroit, Foster, Leaburg, and Dexter dams). Overall, at the population level, PNI values are very low for every population where hatchery spring Chinook salmon occur. The Calapooia population has a high PNI value of 1.0 because no hatchery fish are released in that river, but the population abundance is less than 50 annually (nearly extinct).

It is also important to acknowledge the recent genetic studies of hatchery and natural-origin spring Chinook populations throughout the Upper Willamette River Basin because it provides insight on the current genetic issues facing these populations. Johnson and Friesen (2014) evaluated the genetic structure and diversity of spring Chinook salmon in the North Santiam, South Santiam, McKenzie, and Middle Fork Willamette populations. There currently is some distinction among populations and all hatchery stocks resemble their respective natural population. However, the genetic heterozygosity is severely constrained in most natural populations due to small population size of natural-origin salmon. Genetic heterozygosity is presently greater in the hatchery stocks, due to the relatively high abundance of hatchery fish compared to natural-origin salmon. Therefore, hatchery fish spawning in the wild is likely providing demographic (increasing the number of natural spawners) and genetic benefits to natural populations (Johnson and Friesen 2014). Since short-term resiliency and long-term adaptive potential depends upon genetic heterozygosity, the current hatchery programs are benefitting the conservation and recovery of natural spring Chinook salmon populations in the UWR (Johnson and Friesen 2014).

Recent pedigree analyses of spring Chinook salmon reintroduced above federal dams in the UWR has also shown the benefits of hatchery Chinook salmon spawning (Black et al. 2017; Evans et al. 2016;

O'Malley et al. 2017(a); O'Malley et al 2017(b); Sard et al. 2017). Outplanting of hatchery Chinook above the dams is increasing spawner abundances and producing significant numbers of juvenile offspring (Hansen et al. 2017; Monyzk et al. 2013). The fitness of hatchery salmon spawning in the wild above the federal dams in the UWR has been not significantly different than natural-origin salmon in most studies (Table 29; Evans et al. 2016); demonstrating the value of using hatchery supplementation to restore salmon above the federal dams (Black et al. 2017; Evans et al. 2016; O'Malley et al. 2017(a); O'Malley et al 2017(b); Sard et al. 2017). In some cases where downstream passage survival of juvenile salmon through the reservoirs and dams is adequate, substantial numbers of returning adults have been observed back to the population areas (i.e. Fall Creek, see below); demonstrating the ultimate success of hatchery reintroductions when survival conditions are adequate. The outplanting of hatchery salmon above the dams has provided significant population benefits by increasing the number of natural-origin salmon returning in the North Santiam River, South Santiam River, and Fall Creek in recent years. Without hatchery salmon supplementation, natural-origin salmon returns would be substantially lower; resulting in higher extinction risks for these populations. The benefits of hatchery supplementation producing natural-origin salmon in these populations (coupled with other recovery actions) has increased their abundance and helped less the risk of the ESU (NWFSC 2015).

Table 29. Summary of fitness estimates for male and female Chinook salmon reintroduced above Foster Dam on the South Santiam River. Note the mean returns of adult offspring produced by natural and hatchery salmon. Table taken from Evans et al. (2016). Abbreviations: TLF (total lifetime fitness), HOR (hatchery origin recruits), NOR (natural origin recruits).

		Adult offspring				
	N	Mean	Median	SD	Min.	Max.
2007 TLF						
Male	127	3.57	1	6.92	0	38
Female	125	2.15	1	3.22	0	19
2008 TLF – HOR						
Male	338	1.50	0	3.33	0	24
Female	155	2.65	0	4.94	0	26
2008 TLF – NOR						
Male	103	1.13	0	3.69	0	25
Female	53	2.94	0	5.63	0	30
2009 TLF						
Male	254	2.37	0	5.13	0	40
Female	158	3.58	1	5.62	0	28
2010 fitness (age-3 and age-4 progeny)						
Male	467	0.09	0	0.36	0	3
Female	233	0.16	0	0.53	0	4
2011 fitness (age-4 progeny)						
Male	677	0.03	0	0.22	0	4
Female	526	0.04	0	0.28	0	5

A recent success with using hatchery Chinook salmon for reintroduction above federal dams has occurred in Fall Creek, a tributary to the Middle Fork Willamette River. This effort is described here as an example of the potential success that can be achieved using hatchery supplementation. The run of spring Chinook salmon has extirpated when Fall Creek dam was finished in 1966. Since 1998, hatchery salmon from Dexter fish collection facility on the Middle Fork Willamette River have been outplanted above the dam in an effort to restore the benefits of salmon to the local ecosystem. As the supplementation

continued, natural-origin spring Chinook salmon began to return to the base of Fall Creek dam and were counted and outplanted by trap and haul above the dam. The numbers of natural-origin salmon returns continued to increase and have stabilized at an annual return in the range of 300 to 600 natural-origin salmon returning to Fall Creek. Due to the increases in natural-origin returns, hatchery supplementation has been reduced and since 2010 only natural-origin spring Chinook salmon have been outplanted above the dam. The run has continued at a level of 400 to 600 salmon annually for several generations. In terms of abundance of a creek the size of Fall Creek, this level of abundance is surprising and very valuable for reducing risk to the ESU. The run of natural-origin salmon to Fall Creek now represents the only production area for the Middle Fork Willamette population presently, and represents a significant proportion of natural-origin returns to the Upper Willamette spring Chinook salmon ESU.

The recovery of the salmon run in Fall Creek is largely due to the successful downstream passage of juvenile salmon through Fall Creek reservoir and dam. The draining of the reservoir every year down to essential stream-level has allowed all juvenile salmon to emigrate downstream past the dam. Even though passage is less than ideal, survival rates are high enough to allow sufficient numbers of salmon pass through. The combination of enhanced growth by juvenile salmon in the reservoirs through the summer and complete draining of the reservoir in the fall (where all salmon emigrate downstream) has resulted in significant natural-origin salmon returns annually to Fall Creek. The run was founded entirely from hatchery fish supplementation and natural-origin fish are adapting to their local conditions in the absence of continual hatchery influences (O'Malley and Bohn 2018).

Ecological Effects

Ecological effects (interactions between hatchery- and natural-origin fish) include, but are not limited to, competition for space and food, predation, disease transference, and density-dependent effects. Hatchery management practices that release large numbers of hatchery juveniles can reduce available food resources for natural origin juveniles; limiting growth and health. Potential effects are greatest in the population areas that have the greatest density of hatchery fish per habitat area. The potential ecological effects are also influenced by the location where hatchery fish are released in the watershed. Releases of hatchery fish in the upper areas of the watershed would potentially have the greatest amount of time and space to affect naturally-occurring salmonids. In addition, if hatchery fish are released in principal spawning and rearing areas of natural-origin salmonids (i.e., tributaries), the interactions would be potentially greater than if hatchery fish are released in mainstem river areas. Therefore, the potential

ecological interactions is dependent upon hatchery- and natural-origin fish sharing space and time within the specific population areas (Table 27).

The potential intermingling in space between hatchery fish and natural-origin spring Chinook salmon was evaluated in this EIS as the percent of UWR spring Chinook salmon critical habitat affected by the releases of all species of hatchery fish. The river and stream reaches where hatchery fish are released compared to spring Chinook salmon critical habitat is shown in Figure 12, Figure 13, Figure 14, Figure 15. Overall, 27 percent of critical habitat is affected by hatchery fish in the spring Chinook salmon ESU. The principal habitat areas affected by hatchery fish are the mainstem river areas, lower Columbia River, and estuary. The vast majority of spring Chinook salmon critical habitat does not have any hatchery fish present (Figure 12, Figure 13, Figure 14, Figure 15). All of the habitat upstream of the federal dams do not have any hatchery smolts released. Rainbow trout are released into the reservoirs.

Another aspect of the ecological interaction between hatchery fish and natural-origin spring Chinook salmon is the period of time affected by the presence of hatchery fish in the streams and rivers. The target release size for hatchery fish within the UWR is the smolt life stage for all steelhead and spring Chinook salmon, although a very small percentage of spring Chinook salmon are released as pre-smolts in the fall. Depending upon the species, average fork length ranges from two inches (~60mm) for fall-released spring Chinook salmon (the smallest) to near 400 mm for rainbow trout (the largest; Table 9). Given hatchery spring Chinook salmon and steelhead are released as smolts and some spring Chinook salmon released as pre-smolts, the interaction period is relatively short-lived because monitoring shows that the vast majority of hatchery fish (smolts) are actively emigrating to the ocean very soon after release. However, some of the pre-smolts released may not emigrate initially.[13]

Hatchery rainbow trout are released into most of the reservoirs where juvenile natural-origin spring Chinook salmon are present. Hatchery rainbow trout are also released in the McKenzie River. Age-0 Chinook salmon are likely to be most susceptible to ecological impacts from hatchery rainbow trout due to their smaller size. The older age classes of Chinook salmon (ages 1-6; Romer and Monzyk 2014) that reside in the reservoirs year round from inadequate downstream passage (Romer et al. 2015) are less likely to be affected by hatchery trout. The larger age classes of Chinook salmon (e.g. 5 to 15 pound

[13] Currently, pre-smolts are only released in Hills Creek Reservoir, which is upstream of two dams that do not have juvenile passage, so it is not expected that these fish will return in large enough numbers to increase natural-origin abundance.

Chinook salmon that have been caught) may even predate upon the smaller hatchery trout (Romer and Monzyk 2014; Stewart and Ibarra 1991).

The goal of all hatchery programs (except rainbow trout) is to release fish when they are ready to migrate to the ocean immediately or soon after liberation. Since all of the fish released from hatchery programs in the UWR are released over 150 miles from the ocean, the total amount of time hatchery fish could potentially interact with natural-origin fish in freshwater habitat areas may be up to 1 to 2 weeks.

Predation is also another form of ecological interaction. While few studies have been completed in the UWR, Naman and Sharpe (2012) reported a wide range of predation impacts from hatchery fish on natural-origin salmonids when they reviewed studies along the West Coast. In general, predation rates were greatest when the number of hatchery fish released was high and the release coincided with the presence of natural-origin salmonids. In most cases, predation by hatchery fish was low overall. However, in specific circumstances and locations, hatchery fish predation could be substantial (i.e., loss of tens of thousands juvenile salmonids). For the UWR, predation by hatchery fish on natural-origin salmonids does occur. Hatchery steelhead predation upon Chinook salmon fry during the release periods of April through May is likely to be the greatest impact. Steelhead fry are probably less impacted because most of the steelhead are still incubating in the gravel when spring Chinook salmon and summer steelhead smolts are released. In addition, hatchery spring Chinook salmon are likely to have lower impacts on natural-origin fish species because they are smaller in size (i.e. more similar in size to natural-origin fish) and thus cannot consume as many fish compared to the larger hatchery steelhead. In all cases, the vulnerability of natural-origin fish to co-occurring hatchery fish is limited in time to a couple of weeks as the majority of the hatchery smolts actively emigrate[14] through the river to the estuary and ocean. In local situations at the individual fish scale, it may be limited to hours or days as the hatchery fish emigrated downstream.

In the UWR subbasins, there is concern that reservoirs associated with flood control/hydropower facilities have created habitat conditions that make juvenile migrants more susceptible to introduced predatory fishes, with greatest concern being largemouth and smallmouth bass. Predation by largemouth bass in Green Peter Reservoir was identified as a limiting factor/threat (LFT) for UWR juvenile salmonids. Centrarchid abundance in Lookout Pt. Reservoir is reported to be high, particularly for crappie (Greg Taylor, USACE Willamette Review symposium 2010), but the magnitude of crappie predation on

[14] Hatchery released steelhead are known to residualize in the UWR and will be discussed in more detail in this section under UWR Winter Steelhead.

juvenile salmonids is unclear. Predation by bass may be a concern in other areas as well, such as slow water areas in sub-basins and the mainstem Willamette River that are associated with the remaining floodplain (Table 13).

Predation by introduced salmonids in the Willamette River Basin has also been identified as LFT for some UWR spring Chinook salmon and steelhead populations. The loss of winter steelhead habitat due to floodcontrol/hydropower facilities is being mitigated with a hatchery program using an out-of-DPS summer steelhead broodstock. Predation on juvenile UWR spring Chinook salmon by summer steelhead has been identified as a secondary LFT for the North Santiam, South Santiam, and McKenzie Chinook populations. In addition, predation on juvenile UWR spring Chinook salmon by an introduced strain of rainbow trout (Cape Cod strain) that supports a hatchery trout mitigation program, has been identified as a secondary LFT for the McKenzie River Chinook salmon population.

Competition between hatchery fish and natural-origin spring Chinook salmon may occur if a resource becomes limited in space and time. Quantifying the impact is difficult because of the variety of factors influencing competition such as availability of potentially limiting resources in space and time and variability in natural-origin salmonid production from year to year that influences density-dependence. Within the UWR, competition between hatchery fish and natural-origin spring Chinook salmon is likely to be very low or non-existent for the following reasons. The greatest impact from hatchery fish are likely to occur if the hatchery fish residualize and do not emigrate to the ocean. Recent information indicates less than 10 percent of the total hatchery release residualize and hatchery steelhead are the most prominent species to residualize (Hausch and Melnychuk 2012). The primary area of competitive interaction area is the area downstream of the hatchery release points. Since this interaction area is relatively small compared to the total amount of habitat available for juvenile Chinook salmon rearing (Figure 12, Figure 13, Figure 14, Figure 15), impacts from competition between hatchery fish and natural-origin fish is likely to be low.

In addition to the risks and concerns mentioned above regarding interactions between juvenile fish, another ecological effect of the hatchery program can be interactions between adult hatchery- and natural-origin fish. Upon returning to the natal river (or river where released), adult Chinook salmon generally seek specific habitat that provides cool water and cover that they utilize while waiting more than a month to spawn. If most of the fish returning to a subbasin are hatchery-origin, it is reasonable to assume they are competing with natural-origin adults for holding and spawning habitat. This may be a risk in areas

where fish are in high densities, or where habitat has been compromised. This generally occurs downstream of dams in the UWR, and is considered a major concern.

Disease transfer is another potential ecological interaction. The work done by Bartholomew (2013)and Fast et al. (2015) suggest that transference of disease from hatchery fish to natural-origin fish is rare, and therefore not a major concern.

The ecological effects of the current hatchery program on natural-origin spring Chinook salmon ranges from low (upstream of dams where mostly natural-origin fish are transported) to medium/high where pHOS estimates are greater than 60 to 70 percent (downstream of Detroit, Foster, Leaburg, and Dexter dams).

Effect of the hatchery program on viability

The viability of salmon populations is described in terms of four interrelated parameters: productivity, abundance, diversity and spatial structure (McElhany et al. 2000). In general, for hatchery programs designed to have fish spawn in the wild (supplementation), the number of spawners and spatial distribution can increase (Black et al. 2017; Fast et al. 2015; O'Malley et al. 2017a; O'Malley et al. 2017b). However, there remains concern that large proportions of hatchery-origin fish on the spawning grounds could reduce fitness of the natural population over the long-term. This concern is based on numerous studies that have shown the relative reproductive success of hatchery fish is lower than natural-origin fish (Araki et al. 2007; Araki et al. 2008; Williamson et al. 2010; Berntson et al. 2011; Christie et al. 2014). In specific pedigree studies conducted in the Willamette River Basin for spring Chinook salmon, the fitness of natural-origin salmon and hatchery-origin salmon have not been significantly different (Table 29; Evans et al. 2016). Hatchery-origin males typically have the lowest fitness and hatchery and natural females being about equal in fitness with spring Chinook salmon in the Willamette Basin. The hatchery stocks also contain important genetic diversity characteristics not found in the depressed natural populations (Johnson and Friesen 2013). Therefore, the effects of the hatchery program have to be considered in the short- and long-term. Presently, the hatchery Chinook salmon programs are providing demographic benefits such as increases in abundance above the below the federal dams, where natural-origin returns are chronically low. The hatchery programs are helping preserve and rebuild genetic resources until limiting factors are addressed. Over the long-term, there are risks with the continual use of hatchery supplementation. However, at present the demographic risks outweigh longer

term genetic risks because most the natural populations (e.g. North Santiam, South Santiam, Middle Fork Willamette, Molalla, and Calapooia rivers) are at high risk of extinction (NWFSC 2015).

There have been a number of operational changes for the spring Chinook salmon hatcheries in the UWR. Mass marking of hatchery-origin Chinook salmon began in 1997, with all returning adults being marked by 2002. Off-station releases within some basins have been curtailed in an effort to limit natural spawning by hatchery-origin fish. Releases of juvenile Chinook salmon into the Coast Fork River, a tributary that does not support an independent natural Chinook salmon population, have been made in an effort to maintain a harvestable hatchery return, but also reduce hatchery *x* natural adult interaction on the natural spawning grounds in Eastside tributaries. Recent improvements at the Cougar (2010), Minto (2012), and Foster (2014) fish collection facilities offer the potential for collecting more hatchery-origin adults and removing them from the natural-spawning component of the populations. These facilities should be able to reduce pHOS in both the North and South Santiam populations.

Analyzing the effects of hatchery fish on the viability of the UWR spring Chinook salmon ESU is complicated because most of the historical habitat is now upstream of high-head dams. In the absence of effective passage programs (that are currently being pursued), spring Chinook salmon will continue to be confined to more lowland reaches where land development, water temperatures, and water quality are limiting production of spring Chinook salmon.

In addition, pre-spawning mortality is a major factor affecting the number of spawners making it back to census points and spawning grounds. Jepson et al. (2013, 2014) found that mortality was higher for hatchery-origin spring Chinook than natural-origin fish. Pre-spawning mortality levels are generally high in the lower tributary reaches where water temperatures and fish densities are generally the highest. Historically, spring Chinook salmon held in the cooler headwater habitats upstream of the federal dams.

Areas immediately downstream of high head dams may also be subject to high levels of total dissolved gas (TDG). While the relationship between TDG levels and mortality is related to a complex interaction of fish species, age, depth, and history of exposure (Beeman and Maule 2006), the relative risks are quite high in some reaches.

In terms of diversity, an outcome of hatchery influence in the UWR (and in other programs; see Fast et al. (2015) and Hillman et al. (2012)) has been that hatchery spring Chinook salmon have differences in various life history and morphological characteristics compared to the historic populations in the

Willamette Basin. Most hatchery juveniles are released as age-1 smolts in the spring, whereas a more continuous migration of naturally produced smolts through the fall and spring periods was observed in the historic populations (Willis et al.1995, cited in NMFS(2004); see also Schroeder et al.(2007)). Hatchery Chinook salmon return at an earlier age than the historic populations. Most of the returns now are age-4 fish instead of age-5 (Willis et al. 1995, cited in NMFS (2004)). It is unknown if younger adults is the result of genetic changes as the result of hatchery operations or fisheries, or simply the result of releasing larger smolts than occurred naturally(ODFW and NMFS 2011).

Hatcheries have been implicated in both decreases in age and size of maturity in Pacific salmon stocks (Bigler et al. 1996). The main hatchery-caused factor appears to be high hatchery growth rates triggering early onset of maturity (physiology; Larsen et al. (2004)), along with potentially other factors (density-dependent growth after release (ocean carrying capacity), and size selection of larger, older fish by selective fisheries (genetic selection)). Decreased body size at reproduction produces potential reductions in reproductive behavior, fecundity, egg size, and survivorship of progeny (Bigler et al. 1996; Berejikian et al. 1997; Berejikian et al. 2000; Heath et al. 2003).

Overall, when considering all of the LFTs for the UWR spring Chinook salmon ESU, hatchery effects appear to be a minor concern for viability, but managers should continue the current long-term strategy to reduce pHOS, which should have positive effects on productivity of the ESU.

UWR Winter Steelhead

The No-action Alternative 1 would continue to operate the hatchery facilities and associated programs for spring Chinook salmon and summer steelhead in accordance with the Biological Opinion (see section 2.1Alternative 1 (No-action): Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks for further details). This section evaluates the effects of these hatchery programs on natural-origin winter steelhead in the UWR DPS.

Genetic Effects

In evaluating the genetic effects of hatchery summer steelhead on natural-origin winter steelhead, it is important to first note that summer and winter steelhead can co-occur naturally in the same population areas. There are many populations of steelhead throughout California, Oregon, and Washington that have healthy summer and winter runs of natural-origin steelhead co-occurring in the same watershed. For

example, summer and winter run steelhead occur naturally in the Klamath, Rogue, Umpqua, Siletz, Kalama, Cowlitz, Hood, and many others in Puget Sound (Busby et al. 1996; Matala et al. 2009; NMFS 2017). In all cases, summer steelhead are at higher risk of extinction due to their life history of having to deal with high water temperatures during the summer as adults. Prince et al. (2017) have shown summer steelhead to possess rare and unique genetic alleles that are not found in their winter-run *O. mykiss* counterparts. Winter steelhead are typically more abundant, have less genetic risk, and are not as exposed to freshwater habitat pressures as are summer steelhead. Problems with genetic and ecological interactions between summer and winter steelhead typically occur only after human actions disrupt natural conditions that allow for temporal and spatial separation of these runs (Matala et al. 2009).

Winter-run steelhead hatchery programs were terminated in the late 1990s. Currently, the only steelhead programs in the UWR release summer steelhead originally taken from Skamania Hatchery on the Washougal River from the Lower Columbia River DPS. Annual total releases have been relatively stable at around 600,000 from (2009-2014), although the distribution has changed with fewer fish being released in the North Santiam River (in response to RPA 6.1.8 of the Willamette Project Biological Opinion (NMFS 2008)) and corresponding increases in the South Santiam and Middle Fork Willamette rivers. Adult summer steelhead typically return to the UWR Basin between March and October, and spawn timing can overlap with native winter steelhead (particularly early spawning winter steelhead in January through March (Figure 21; Firman et al. 2004). Marked summer steelhead have been observed on spawning grounds (Figure 19; Schroeder et al. 2006; Mapes et al. 2017)[15], raising concerns about potential negative ecological interactions and genetic introgression with native winter steelhead in the UWR.

Johnson et al. (2013) found that about 10 percent of unmarked juvenile *O. mykiss* sampled at Willamette Falls in 2009-2011 were summer steelhead and that an additional 10 percent of samples were summer *x* winter steelhead hybrids. Most *O. mykiss* sampled from the McKenzie River were either summer steelhead or summer *x* winter steelhead hybrids. Natural production of pure summer steelhead appeared to be very low in the North and South Santiam rivers, though summer steelhead hybrids represented 11.1 percent and 14.8 percent of samples. Van Doornik et al. (2015) concluded that late winter-run (primarily from eastside tributaries to the Willamette River) steelhead had largely maintained their genetic distinctiveness over time. Even in the absence of long-term introgression, there are still concerns that

[15] Because of water conditions during steelhead spawning (high flow and lower visibility), it is difficult to estimate the proportion of hatchery-origin spawners on the spawning grounds, and therefore, there are no estimates of pHOS downstream of collection facilities where some spawning occurs.

hybridization will decrease the overall productivity of the native population. In their report, Johnson et al. (2013) make recommendations on reducing the occurrence of summer steelhead on the spawning grounds and improving reproductive isolation between hatchery summer steelhead and natural-origin winter steelhead.

Based on the above information, the summer steelhead hatchery program has a medium genetic risk to winter steelhead.

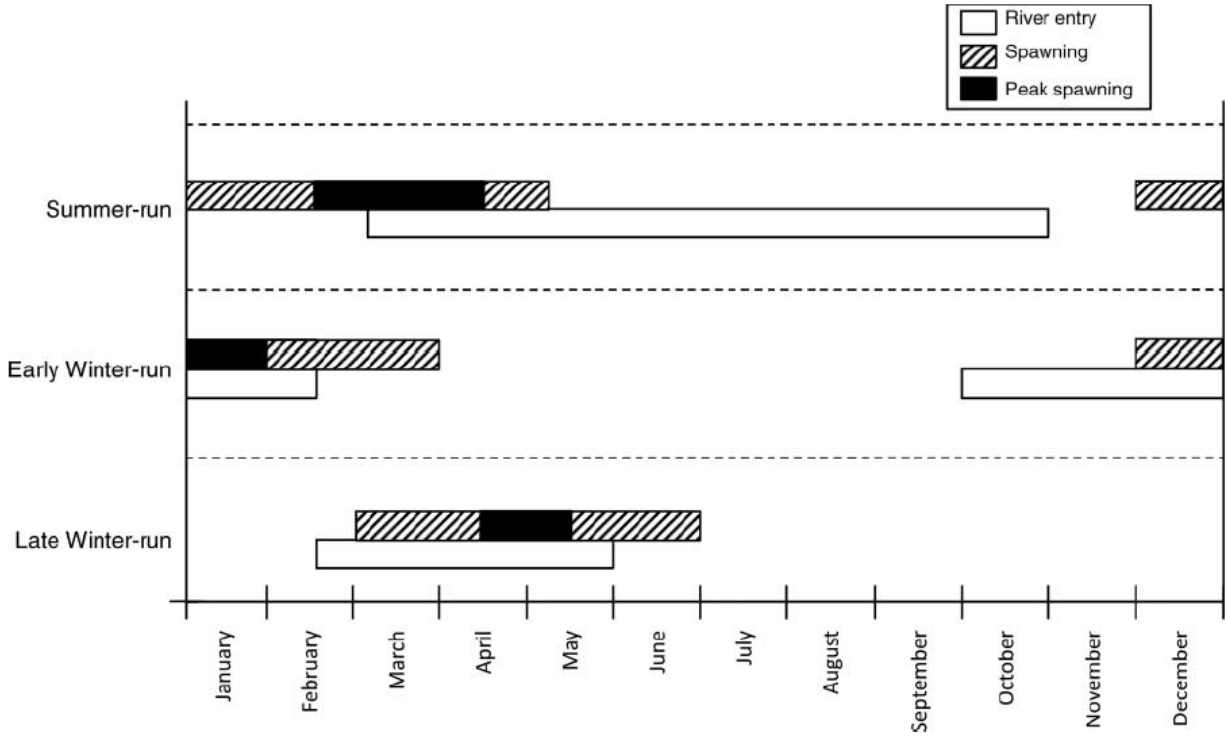

Figure 18. Timing of summer steelhead, early winter-run, and late winter-run entry to freshwater and spawning in the Upper Willamette River. Figure taken from Van Doornik et al. (2015).

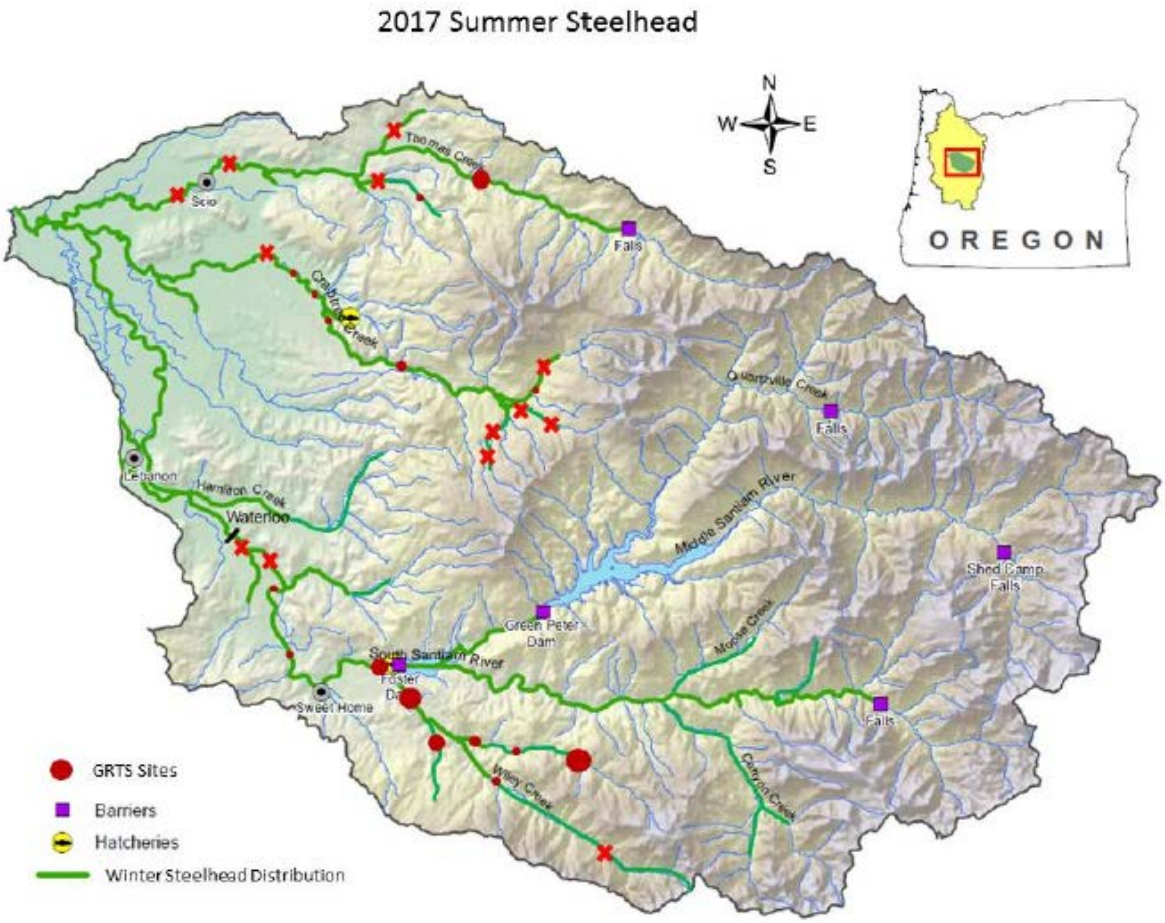

Figure 19. Distribution of summer steelhead redds in the South Santiam River Basin. Size of circle corresponds to density of redds. "X" represents sampling site but no redds were found. No summer steelhead are outplanted above Foster/Green Peter dams. Figure taken from Mapes et al. (2017).

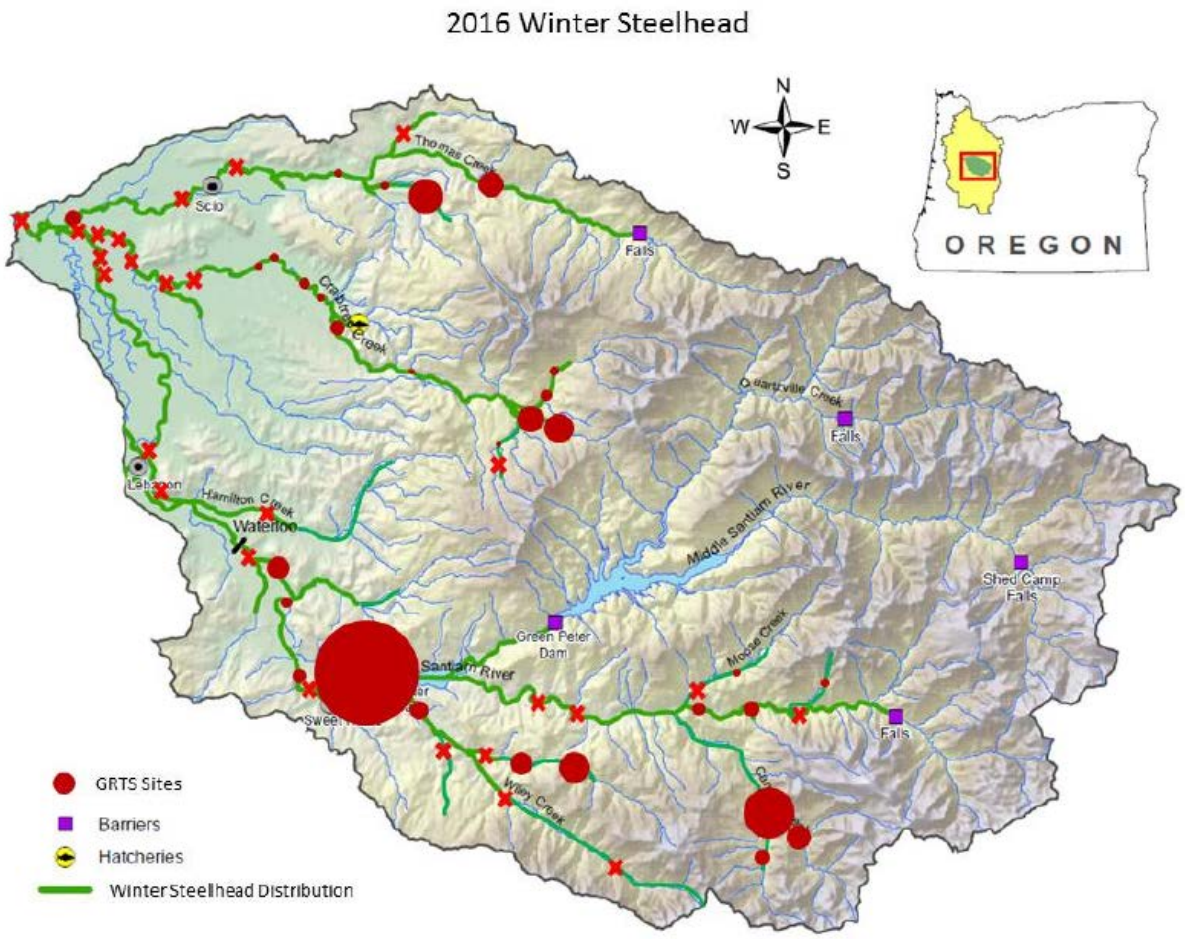

Figure 20. Distribution of winter steelhead redds in the South Santiam River Basin. Size of circle corresponds to density of redds. "X" represents sampling site but no redds were found. No winter steelhead are outplanted above Green Peter dam. Figure taken from Mapes et al. (2017).

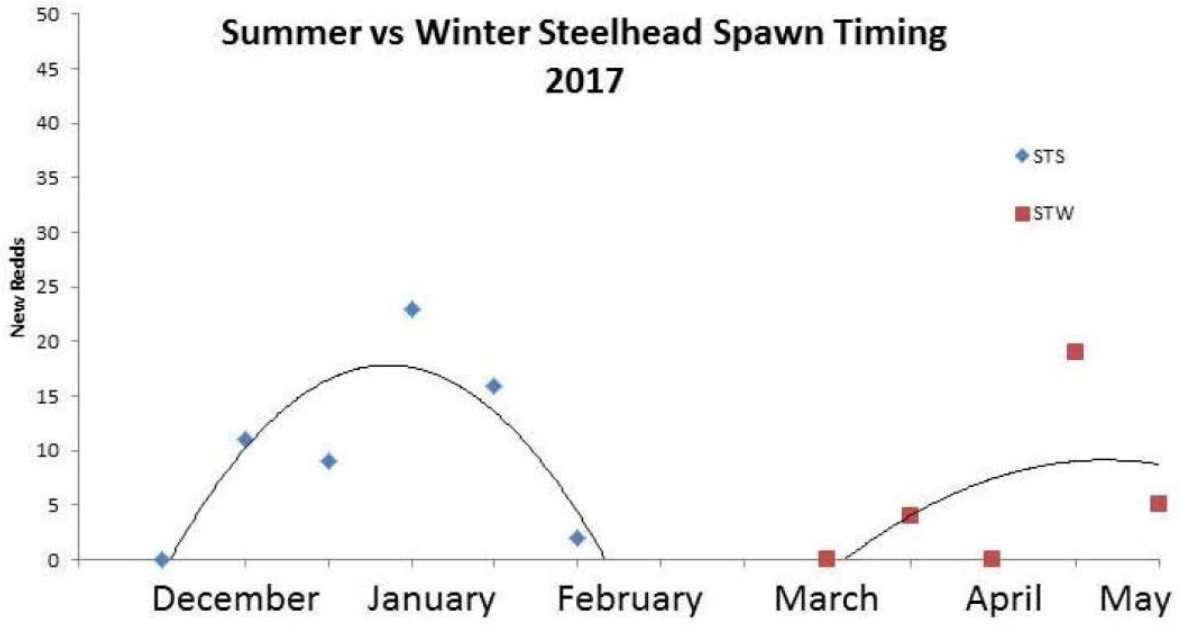

Figure 21. Spawn timing of summer steelhead and winter steelhead in the South Santiam River, 2016-2017. Figure taken from Mapes et al (2017).

Ecological Effects

Assessing the ecological effects of hatchery steelhead on listed winter steelhead is complicated by a variety of factors. Hatchery steelhead released before the smolting phase (active emigration to the ocean) leads to the hatchery steelhead residing in the release location for longer periods of time until they develop into smolts physiologically. Conversely, hatchery steelhead released after the smolting phase have the tendency to residualize near the hatchery release location and not emigrate to the ocean at all but reside in freshwater for extended periods of time. The hatcheries actively manage hatchery steelhead releases for the time period of active smolting to minimize the above ecological interactions with natural-origin, winter steelhead. In addition, even though the vast majority of the hatchery steelhead may be exhibiting smolting, there is still a proportion of hatchery steelhead that are either not quite fully smolts, or more developed smolts based upon the bell shaped curve of the hatchery steelhead population. In addition, steelhead populations are highly diverse and a small proportion of steelhead offspring may not have the propensity to emigrate to the ocean (anadromous life form) but reside in freshwater their entire life as resident, rainbow trout. The resident *O. mykiss* life history form is known to be present in many steelhead populations throughout the west coast region (Busby et al. 1996).

Juveniles of the summer steelhead hatchery mitigation program in the UWR may compete with juveniles of native winter steelhead, and this potential interaction has been identified as a key limiting factor in the North and South Santiam subbasins (ODFW and NMFS 2011).During the one-to-two week period of interaction while in freshwater (see discussion above), the greatest impact is likely to occur in areas where hatchery steelhead are co-occurring with natural-origin salmonids (e.g., mainstem Willamette River). In the North and South Santiam rivers, juveniles are largely confined below much of their historical spawning and rearing habitat. Releases of large numbers of hatchery-origin summer-run steelhead may temporarily exceed rearing capacities and displace winter-run juvenile steelhead (NWFSC 2016).

While most insight regarding ecological effects on steelhead has come from steelhead populations outside the UWR DPS (Chilcote 2003; Kostow et al. 2003; Kostow 2004; Kostow and Zhou 2006), the impacts are likely relevant to the UWR DPS as well. For example, Kostow and Zhou ((2006); citing references therein) suggested that because adult hatchery summer steelhead typically spawn earlier than do wild winter steelhead and their offspring emerge earlier, they may have a competitive advantage in occupying choice feeding territories prior to the emergence of winter steelhead. In addition, when large hatchery releases result in the localized carrying capacity to be exceeded, which is presumed to be the case in UWR sub-basins, there is increased potential for density-dependent mortality on wild fish for early life stages. If a significant number of summer steelhead juveniles residualize in the UWR sub-basins, they could compete with native wild steelhead parr, which primarily have a 1-2 year residence time in freshwater.

Residualization of hatchery steelhead (fish that do not migrate to the ocean in the year of their release) can increase the amount of interaction between naturally produced rearing fish and hatchery summer steelhead. This increase in interaction would occur because the time of potential negative effects through competition and predation would increase. While naturally produced steelhead also exhibit a residual life history strategy, releasing an excessive number of residual hatchery steelhead may have ecological, demographic, and genetic effects not intended by managers (ISRP and ISAB 2005). However, for most steelhead hatchery programs, the estimated residualism rate is less than 10 percent (Snow et al. 2013; Larsen et al. 2017). Hausch and Melnychuk (2012) reviewed 48 estimates of residualism of hatchery-reared steelhead from 16 different studies and found that residualism ranged from 0 percent to 17 percent, averaging 5.6 percent.

A study has been implemented in the UWR to determine the extent to which juvenile hatchery summer steelhead, *O. mykiss,* and wild winter steelhead overlap in space and time, to evaluate the extent of

residualism among hatchery summer steelhead in the South Santiam River, and to evaluate the potential for negative ecological interactions among hatchery summer steelhead and wild winter steelhead (Harnish et al. 2014; McMichael et al. 2014).These researchers found, using two independent methods in 2013 and 2014, a substantial portion[16] of the hatchery summer steelhead released as smolts did not emigrate from the South Santiam River. Based on radio telemetry, they found that the majority of the tagged fish were last detected in the Santiam River basin and, less than one-third of the tagged fish were last detected in the Willamette River downstream of Willamette Falls. Further, snorkeling revealed that residual hatchery steelhead (those present >30 days after release) were present in all locations visited through the final snorkel survey in both 2013 and 2014.

In 2014, snorkeling revealed considerable overlap of habitat use (in space and time) by residual hatchery steelhead and naturally produced *O. mykiss* in the South Santiam River. Results from the study (and others) also indicated that hatchery steelhead juveniles typically dominate interactions with naturally produced *O. mykiss* juveniles. The overlap in space and time, combined with the competitive advantage that residual hatchery steelhead appear to have over naturally produced *O. mykiss*, increases the potential for negative ecological interactions that could have population-level effects on the wild winter steelhead population of the South Santiam River.

In 2014, the researchers also detected a potential displacement of naturally produced *O. mykiss* by residual hatchery juvenile summer steelhead. They observed the highest densities of residual hatchery steelhead in sites located within about seven miles of the South Santiam Hatchery, whereas the density of naturally produced *O. mykiss* generally increased with increasing distance from the hatchery. Much of the quality rearing habitat located downstream of Foster Dam appears to be situated in the roughly 10 miles between Foster Dam and McDowell Creek where the river has a higher gradient. Downstream of McDowell Creek, the South Santiam River has much lower gradient and consists of many long, slow glide habitats. Thus, it is possible that residual hatchery steelhead may be displacing naturally produced *O. mykiss* from the highest quality rearing habitat into suboptimal habitats, which could also negatively affect the wild population.

Hatchery steelhead are large sized when released within the UWR (Table 9), and thus have the high potential to prey upon a variety of other fish species. Residualized summer steelhead may also prey upon juvenile Chinook salmon, and this has been identified as a secondary limiting factor in the Santiam

[16] Because of the study design, the researchers did not estimate a percentage of fish that did not migrate.

populations, as well as the McKenzie population where releases support a sports fishery (ODFW and NMFS 2011).

Based on the information presented above, the ecological risk of the summer steelhead program on natural-origin winter steelhead is medium-high.

Effect of the hatchery program on viability

There is some concern that the summer-run steelhead releases in the South Santiam River may be influencing the viability of native steelhead in the North and South Santiam rivers(NWFSC 2015). Introgression of hatchery summer steelhead with naturally produced winter steelhead is a major concern regarding viability for the winter steelhead DPS in the UWR. Even if the long-term introgression rate is low, there are still concerns that hybridization will decrease the overall productivity of the native population.

As with the UWR spring Chinook ESU, analyzing the effects of hatchery fish on the viability of the UWR winter steelhead DPS is complicated because most of the historical habitat is now upstream of high-head dams. In the absence of effective passage programs (that are currently being pursued), some of the winter steelhead populations will continue to be confined to more lowland reaches where land development, water temperatures, and water quality may be limiting.

For UWR steelhead, the diversity goals for recovery are partially achieved through the closure of winter-run steelhead hatchery programs in the upper Willamette River(NWFSC 2016). However, because the summer steelhead program is operated as a segregated program, where adult fish returning from the hatchery are not meant to spawn naturally, the largest risk from the summer steelhead program on winter steelhead is most likely from ecological interaction as juveniles and potentially adults. Introgression is a concern, but appears to currently be a low rates, albeit any introgression is still a concern.

Overall, as with spring Chinook salmon, when considering all of the LFTs for the UWR winter steelhead DPS, hatchery effects appear to be a low to medium concern for viability, but managers should continue to investigate and manage ecological interactions and overlap of summer- and winter-run steelhead on the spawning grounds, which should have positive effects on productivity of the DPS.

4.4.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, the 10 hatchery facilities and associated hatchery programs within the UWR would operate as proposed in the submitted HGMPs (Subsection 2.2, Alternative 2 (Proposed Action/Preferred Alternative): Approve ODFW's HGMPs for Operation of Hatchery Programs in the UWR); Appendix A). Short- and long-term risks associated with competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer from the hatchery programs would be the same under Alternative 2 as described under Alternative 1 (No-Action). There would likely be a change in the genetic effects under Alternative 2 because including natural-origin broodstock would reduce the genetic risks associated with the current operation of the hatcheries. The analysis of the site-specific effects under Alternative 2 would be identical to effects analyzed under Alternative 1. The hatchery programs would continue to pose short- and long-term adverse risks associated with genetic effects (although reduced somewhat), competition and predation, facility effects, masking of natural population status from hatchery fish spawning, incidental fishing effects, and transfer of pathogens from hatchery fish and/or the hatchery facility to the adjacent river or stream. The hatchery programs would continue to provide some benefits to salmon and steelhead from hatchery fish carcasses and nutrient cycling in the ecosystem.

UWR Spring Chinook Salmon

The primary difference between Alternative 1 and Alternative 2 is that natural-origin spring Chinook salmon would be used in the broodstock. Using natural-origin spring Chinook in the broodstock would decrease the potential for negative genetic effects of domestication to the population (hatchery- and natural-origin fish). By including natural-origin fish in the broodstock, any genetic legacy of local adaption to the natural environment will be incorporated into the population to a higher degree. If, at the same time the long-term goal of reducing pHOS is achieved, the productivity and long-term fitness of the population (and ESU) would increase.

For Alternative 2, integration of natural-origin Chinook salmon into the hatchery broodstocks would be on a sliding scale basis; meaning when returns of natural-origin salmon are poor, no fish would be taken for broodstock purposes and when natural-origin salmon returns are high, a larger percentage of fish could be taken for broodstock purposes. The strategy of sliding scale broodstock integration management is to protect natural-origin salmon to the greatest extent possible when returns are low, but allow some natural-origin fish to be taken from the population for broodstock purposes when returns are higher. In

any case, take of natural-origin salmon for broodstock should never result in a major impact to the affected, natural population. In Alternative 2, pNOB (proportion of natural-origin salmon in the broodstock) ranges from zero to 100% depending upon specific criteria. The most likely averages for pNOB for the hatchery programs defined in Alternative 2 is 0.05 to 0.20. The lowest pNOB will be the Middle Fork Willamette hatchery program because few natural-origin salmon are available and the hatchery program is large. The greatest pNOB could occur in the McKenzie program, where natural-origin returns are greatest and the program is moderately sized. The resultant PNI values depend upon what pNOB and pHOS values are assumed in the future. In general, PNI values for all spring Chinook populations with hatchery releases (Molalla, North Santiam, South Santiam, McKenzie, Middle Fork Willamette, Coast Fork Willamette) will increase compared to the No-action Alternative (see Table 28 above for comparison of Alternatives 1 and 2).. For Alternative 2, resultant PNI values will likely be in the range of 0.1 to 0.83, depending upon the specific population. PNI values for the No-action alternative are in the range of 0 to 0.1.

All other analyses and conclusions regarding the effects of the hatchery programs (ecological interactions, viability) that were discussed in Section 4.4.1 would remain the same, and the overall determination of low and medium-high risk to population viability would be reduced.

UWR Winter Steelhead

Because the difference between Alternative 1 and Alternative 2 regard natural-origin spring Chinook incorporation into the broodstock, there would be no change in the analyses and conclusions regarding the risk of the hatchery program regarding genetic and ecological interaction risks, and viability of UWR winter steelhead that was determined in Section 4.4.1.

4.4.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the hatchery programs would be managed only to provide sufficient adult returns to provide for broodstock and reintroduction needs. Hatchery production of spring Chinook salmon in Alternative 3 would be reduced by 32% compared to Alternative 2 (Proposed Action/Preferred Alternative). However, Alternative 3 also revises the current summer steelhead program and switches to winter steelhead, which will be further analyzed below.

UWR Spring Chinook Salmon

By releasing fewer spring Chinook salmon under this alternative, there would likely be some benefits and risks to the corresponding natural population. The potential benefits of Alternative 3 would be fewer hatchery fish on the spawning grounds below the federal dams, which would reduce pHOS and increase PNI. Natural selection would drive adaptation in the population to a larger degree and less genetic introgression by hatchery fish into the natural populations would result. However, there would also be increased risk to the natural population by having fewer spawners reproducing; as pedigree analyses has shown hatchery Chinook salmon to successfully reproduce in the wild. Since most Chinook salmon populations in the ESU suffer from low population abundance, the demographic risks (too few spawners) typically are of more concern than long-term genetic risks (domestication selection). In Alternative 3, PNI values for most populations would range from 0.3 to 0.8 on average, and would be substantially higher than the No-action alternative. This alternative would allow managers to reach the long-term pHOS goals more readily, but harvest of returning adults would likely be reduced.

By releasing fewer spring Chinook salmon, the potential negative effects of ecological interaction would also be reduced. Fewer juveniles would be competing for potentially limited resources in the areas currently being utilized downstream of the dams. Potential negative effects of predation would also likely be reduced.

Alternative 3 is likely to have less risk on the viability of the spring Chinook salmon ESU than the preferred alternative (Alternative 2) because of the lower chance of negative interactions between hatchery fish and natural-origin fish that could reduce productivity. However, the positive effects of the preferred alternative (additional marine nutrients in the watershed, increased opportunity for sport fishing, and increased forage for bull trout) would also be reduced with fewer spring Chinook salmon being released and returning.

Since Alternative 3 would provide hatchery production only for broodstock and reintroduction purposes, other beneficial uses of the surplus adult spring Chinook salmon would be eliminated compared to the No-action alternative. The number of surplus fish available would be reduced and the priority of their distribution possibly altered. Of particular interest and value would be the reduction and/or loss of spring Chinook salmon provided from the Middle Fork Willamette River hatchery program to the Burns-Paiute Tribe for their ceremonial salmon fisheries in the Malheur River in recent years. The Burns Paiute Tribe has expressed an interest in continuing this program for these purposes during the public scoping for this

EIS. Further analysis of the impacts of Alternative 3 on the Burns Paiute Tribe is included in section 4.8.3 below.

UWR Winter Steelhead

It is generally agreed that the current summer steelhead program does not promote conservation or recovery efforts to the UWR winter steelhead DPS. By switching the program from summer steelhead to winter steelhead, as proposed in this alternative, potential benefits to the UWR winter steelhead DPS could increase. However, additional risks associated with using natural-origin winter steelhead for broodstock are discussed below.

Current information suggests that there is some interbreeding of summer- and winter-run steelhead in the UWR (Johnson et al. 2013). By eliminating the summer-run steelhead program in the UWR, this major genetic risk for the UWR winter steelhead DPS is removed. However, if (at least initially) natural-origin winter steelhead are then taken into the hatchery for broodstock and released into historical habitat, then pHOS becomes a concern and all of the risks associated with the effects on long-term productivity and fitness (see discussion in Section 4.4.1) of hatchery-origin fish spawning in the wild will then become a potential effect of the new program.

The ecological effects of the hatchery program would not change under the switch in the steelhead program from summer to winter run broodstock. There would still be concerns of high densities of fish after release competing for at times limiting resources (see Section 4.4.1 for further discussion). However, if hatchery winter steelhead were only released into historical habitat (currently upstream of dams), then the ecological interactions may be reduced because currently, habitat condition upstream of the dams is in general better condition than habitat downstream of dams. Therefore, the chance of space and food being limited is reduced compared to conditions that are met with the current release of summer steelhead downstream of the dams. However, it would remain uncertain whether large releases of hatchery fish upstream of the dam would still increase density in certain areas at specific times where negative effects could occur.

The viability of the UWR winter steelhead DPS would likely increase if the summer steelhead hatchery program were discontinued because of interbreeding and ecological effects, however, beginning a winter steelhead hatchery program would also present some risks to the viability of the UWR winter steelhead DPS (see discussion in Section 4.4.1).

4.4.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under this alternative, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. All of the activities associated with the hatchery programs would be terminated: no hatchery fish would be released, no broodstock would be collected at trapping locations, trapping facilities would be removed, no returning hatchery fish would be removed from various locations, the hatchery facilities would not use water for operation, and the hatcheries would not discharge hatchery water effluent. The existing fish collection facilities (i.e. Minto Dam FF, Foster Dam FF, Dexter Dam FF) would continue to be used to collect only natural-origin salmon for reintroduction above the federal dams.

UWR Spring Chinook Salmon

Any risks associated with the current hatchery program for spring Chinook salmon (see discussion in Section 4.4.1) would be gone. However, any of the benefits of the program, such as using fish for reintroduction upstream of dams into historical habitat, increases in marine derived nutrients associated with increase of fish on the spawning grounds, and forage for bull trout in some watersheds would also be gone. Overall, Alternative 4 would result in a substantial increase in extinction risk for the ESU from the termination of the spring Chinook salmon hatchery programs. Abundance and productivity of natural populations would decrease from the elimination of all hatchery-origin spawners above and below the federal dams. The spatial structure of the populations would be substantially reduced from the discontinuation of the outplanting of hatchery Chinook salmon above the federal dams where insufficient numbers of natural-origin fish are available (e.g. above Big Cliff, Detroit, Green Peter, Cougar, Blue River, Dexter, Lookout Point, and Hills Creek dams). Since the genetic diversity and heterozygosity in the hatchery stocks of the UWR ESU are greater than in most natural-origin populations due to depressed population sizes (Johnson and Friesen 2014), terminating the hatchery programs would also result in significant impacts to the ESU from the loss of hatchery stocks (which in many cases represent the only genetics of historical runs extirpated by the construction of the federal dams).

UWR Winter Steelhead

As discussed above, there is potential that eliminating the summer steelhead hatchery program may increase the viability of the UWR winter steelhead DPS by reducing the genetic effects of interbreeding

and the ecological interaction effects with hatchery summer steelhead. Discontinuing the rainbow trout hatchery program would also likely increase the viability of the UWR winter steelhead DPS by reducing ecological effects and potentially fishing mortality associated with the rainbow trout program. However, the current sport fishery that brings increased financial benefit to the area would also disappear.

4.4.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. The increased hatchery production would allow for increased harvest opportunities on hatchery produced fish in recreational and commercial fisheries in the ocean and freshwater.

UWR Spring Chinook Salmon

Increasing the release of hatchery spring Chinook salmon would likely intensify the risks associated with the current program (see Section 4.4.1). Even though the intent of increasing the number of fish released is to increase the opportunity to harvest more fish, it is likely that a larger percentage of hatchery spring Chinook salmon would be interacting with natural-origin fish on the spawning grounds since it is difficult to harvest the full allotment of fish. This would likely increase the prespawning mortality rates (Bowerman et al. 2018), the amount of interbreeding between hatchery- and natural-origin spring Chinook salmon, possibly reducing productivity and long-term fitness of the ESU. Additional hatchery spring Chinook on the spawning grounds would make it more difficult to meet the long-term pHOS goals that are described in the submitted HGMPs.

Additional releases of hatchery spring Chinook would also likely increase competition with natural-origin juveniles in areas where they overlap, especially in areas downstream of dams where the habitat is limited in some watersheds. Predation may increase too by the large number of hatchery fish attracting predators and additional natural-origin fish being preyed upon.

However, the additional hatchery adults returning would increase the amount of marine derived nutrients that would be beneficial to production. In some areas, the increase in the number of juveniles released could also increase forage for bull trout.

Assuming that pHOS would increase, and other potential ecological interactions, it is likely that increasing the number of hatchery spring Chinook salmon would most likely have a detrimental effect on the viability of the UWR spring Chinook salmon ESU.

UWR Winter Steelhead

An increase in the number of summer steelhead released in the UWR would most likely increase the concerns and risks associated with the current hatchery program (see Section 4.4.1). Additional returns of adult hatchery summer steelhead could increase pHOS and subsequent interbreeding with winter steelhead, potentially lowering productivity, genetic diversity, and long-term fitness. Ecological interactions, discussed in Section 4.4.1, would likely increase, further negatively affecting productivity of winter steelhead.

In general, increases in releases of summer steelhead would likely reduce the viability of the UWR winter steelhead DPS.

4.5. Effects on Other Fish and Their Habitats

4.5.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Alternative 1 would maintain all existing hatchery programs within the UWR. Alternative 1 would continue current conditions for bull trout, lamprey, sculpin, shiners, dace, trout, sucker, pikeminnow, chub, and non-native fish species (Table 13. Range and status of other fish species **that may interact with UWR spring Chinook salmon and steelhead. This is not an exhaustive list of fish species, but includes the fish most abundant and widespread in the analysis area.** .Some of these species are affected by hatchery facilities, compete with hatchery fish, and certain fish (i.e., redside shiners, dace, sculpin) are potentially eaten by hatchery fish. Other species such as bull trout and lamprey would benefit from hatchery fish as a potential prey base. Genetic risks of hatchery fish spawning in the wild would continue to be non-existent because no hatchery programs exist for these species, with the possible exception of rainbow trout.[17] Hatchery fish would contribute nutrients from naturally spawning carcasses and from outplants of surplus fish from the hatcheries similar to current conditions. Alternative 1 would result in similar hatchery impacts on these other fish species as under

[17] Rainbow trout that are currently released in the UWR are sterilized prior to release, but there is very low potential for it not to be 100 percent effective.

current conditions from incidental harvest impacts and operation of the hatchery collection facilities. Thus, the adverse effects of these impacts are expected to be negligible from the hatchery programs.

4.5.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, the 10 hatchery facilities within the UWR would operate as proposed in the submitted HGMPs (Subsection 2.2, Alternative 2 (Proposed Action/Preferred Alternative): Approve ODFW's HGMPs for Operation of Hatchery Programs on the Oregon Coast); Appendix A). Alternative 2 would continue current conditions for bull trout, lamprey, sculpin, shiners, dace, trout, sucker, pikeminnow, chub, and non-native fish species (Table 13. Range and status of other fish species **that may interact with UWR spring Chinook salmon and steelhead. This is not an exhaustive list of fish species, but includes the fish most abundant and widespread in the analysis area.** As with Alternative 1, under Alternative 2, some species of fish are affected by hatchery facilities, compete with hatchery fish, and certain fish (i.e., redside shiners, dace, sculpin) are eaten by hatchery fish. These effects are expected to be negligible in total, but result in some beneficial (medium effect from hatchery carcass nutrient enhancement) and low adverse effects (from operation of the hatchery facility and potential incidental catch of these species from targeting hatchery fish).

4.5.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the co-managers would produce only enough hatchery fish for reintroduction of adult salmon and steelhead above the Corps dams (and other areas as deemed appropriate). The hatchery programs would be managed solely for conservation and recovery purposes and providing enough returning adult salmon and steelhead for outplanting in under-utilized historical habitats. This alternative would reduce hatchery smolt releases compared to the No-action alternative.

The effect to other fish species would be negligible, and for some species, such as dace, red-side shiners and others that are preyed on by hatchery fish, this alternative could have a positive effect on the species productivity. For other species that prey upon hatchery fish (e.g., Northern pikeminnow, bull trout), there may be a negligible negative effect.

4.5.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under Alternative 4, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. The effects from this alternative on other fish species is assumed to be similar to those of Alternative 3, but potentially more amplified.

4.5.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. Since in the UWR, all resident fish species may compete with, be predators of, and/or serve as prey for hatchery fish depending upon the life stage and time of year (**Table 13**), it is likely that there would be medium to high effects from increasing the hatchery program releases.

The effects from this alternative would be low to medium depending on the interaction between hatchery fish and these other species.

4.6. Effects on Wildlife

4.6.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under Alternative 1, the hatchery facilities within the UWR would continue to operate as proposed in submitted HGMPs (Subsection 2.2, Alternative 2 (Proposed Action/Preferred Alternative): Approve ODFW's HGMPs for Operation of Hatchery Programs in the UWR)). Consequently, the number of salmon and steelhead (juvenile and adult) available to predators and scavengers that use salmon as a food source (Subsection 3.6, Wildlife), would be the same as under current conditions. Most of the ESA-listed wildlife species do not interact with hatchery salmon and steelhead because of their habitat and food preferences and distribution (Table 14).

Alternative 1 would maintain the number of juvenile salmon and steelhead available as a food source for marine mammal and bird populations under current conditions.

Habitat disruption may occur from physical damage or disruption by anglers targeting hatchery-origin salmon and steelhead. Operation of the hatchery facilities uses water from the adjacent stream. The area

from intake to outfall would be affected, although these areas are extremely limited. There is also some potential for these activities to displace wildlife that may be in the area. Habitat impacts from fishing activities are usually localized and short-lived and are currently occurring related to ongoing fisheries in the analysis area. Additionally, fishery access points, roads, boat launches, and campsites are already present in the analysis area.

Alternative 1 would result in a negligible beneficial effect overall. The hatchery programs would provide hatchery fish as a prey source for all wildlife (e.g., birds, marine mammals, and terrestrial mammals) that feed upon juvenile and adult salmon and steelhead (medium benefit). There would be a negligible adverse effect from habitat alterations near the hatchery facilities from operation and anglers fishing near the local vicinity.

4.6.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, the hatchery facilities within the UWR would operate as proposed in the submitted HGMPs (Subsection 2.2, Alternative 2; Appendix A). Salmon and steelhead (juvenile and adult) would be available to predators and scavengers that use salmon as a food source for Alternative 2 as described under Alternative 1 (No-Action).

The analysis of the site-specific effects under Alternative 2 would be identical to effects analyzed under Alternative 1. Alternative 2 would result in a negligible beneficial effect overall. The hatchery programs would provide hatchery fish as a prey source for all wildlife (e.g., birds, marine mammals, and terrestrial mammals) that feed upon juvenile and adult salmon and steelhead (medium benefit). There would be a negligible adverse impact from habitat alterations near the hatchery facilities from operation and anglers fishing near the local vicinity.

4.6.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the co-managers would produce only enough hatchery fish for reintroduction of adult salmon and steelhead above the Corps dams (and other areas as deemed appropriate). The hatchery programs would be managed solely for conservation and recovery purposes and providing enough returning adult salmon and steelhead for outplanting in under-utilized historical habitats. This alternative would reduce hatchery smolt releases compared to the No-action alternative.

The effect to wildlife would be negligible, and for some species that prey upon hatchery fish (e.g., cormorants, osprey, Caspian terns, etc.), there may be a negligible negative effect.

4.6.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under Alternative 4, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. The effects from this alternative on wildlife is assumed to be similar to those of Alternative 3, but potentially more amplified.

4.6.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. In the UWR, some wildlife species are predators of hatchery fish (**Table 14**), it is likely that there would be a medium positive effect from increasing the hatchery program releases.

4.7. Effects on Socioeconomics

4.7.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Under Alternative 1, 10 hatchery programs within the UWR would continue to operate as proposed in submitted HGMPs (Subsection 2.2, Alternative 2 (Proposed Action/Preferred Alternative): Approve ODFW's HGMPs for Operation of Hatchery Programs in the UWR)). There would continue to be 37full-time jobs associated with the hatchery programs (Subsection 3.7, Socioeconomics). Additionally, these hatchery programs would continue to use local goods and services, which would contribute to personal income or jobs within the UWR.

Alternative 1 would continue to provide salmon and steelhead available for commercial and recreational harvest within the UWR. Fishing opportunities provided under Alternative 1 would continue similar to current conditions for the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses (Subsection 3.7, Socioeconomics). Additionally, anglers would continue to contribute to the economy through outfitter/guide/charter fees. Alternative 1 would maintain the $48million spent by anglers fishing in the lower Columbia River (Subsection 3.7, Socioeconomics). For the UWR, the hatchery programs provide substantial benefits (medium to high effect) to socioeconomics.

Depending upon the specific fishery, the benefits can be high to the local economy. Even though fishing-related expenditures is a low percentage of total state revenue (less than one percent), in the UWR, fisheries can be an important local economic contribution particularly during the seasons when spring Chinook salmon and summer steelhead return.

In addition to the economic benefits from having hatchery fish available to catch in ocean and freshwater fisheries, there is also possible economic losses on fisheries that target natural-origin salmon and steelhead in the populations where hatchery programs occur. As described in Subsection 4.4, Effects on Salmon and Steelhead and Their Habitats and Subsection 4.5, Effects on Other Fish and Their Habitats, hatchery programs can have negative effects on the abundance and productivity of natural-origin fish populations. Consequently, natural production may be reduced in the population areas where hatchery programs occur. This translates into fewer natural-origin fish being available for fisheries. Depending upon the specific population and hatchery program, the effect of the negative impacts of hatchery fish on natural production and fisheries likely ranges from a negligible to a very low effect on the overall socioeconomics for the UWR.

4.7.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Under Alternative 2, six hatchery programs within the UWR would continue to operate as proposed in submitted HGMPs (Subsection 2.2, Alternative 2, Proposed Action/Preferred Alternative). There would continue to be 37full-time jobs associated with the hatchery programs (Subsection 3.7, Socioeconomics). Additionally, these hatchery programs would continue to use local goods and services, which would contribute to personal income or jobs within the UWR as described under Alternative 1 (No-Action). Depending upon the specific fishery and circumstances, the hatchery programs would provide substantial benefits (medium to high effect) to the local economies from anglers targeting hatchery fish. For the popular fisheries targeting predominately hatchery-origin salmon, the hatchery program provides a definitive boost to the local economies in the UWR from the purchasing of tackle, sporting goods, fishing guide services, food, and lodging purchases that facilitate their outdoor activities.

4.7.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the co-managers would produce only enough hatchery fish for reintroduction of adult salmon and steelhead above the Corps dams (and other areas as deemed appropriate). The hatchery programs would be managed solely for conservation and recovery purposes and providing enough

returning adult salmon and steelhead for outplanting in under-utilized historical habitats. This alternative would reduce hatchery smolt releases compared to the No-action alternative.

Since the facilities that are currently in use would be used to capture adults for broodstock and relocation, raise hatchery fish for release would continue to operate, there would be no reduction in jobs, but the fisheries for hatchery-origin fish would likely be reduced. This could have a low to medium effect on the amount of money that is currently funneled into local economies, depending on the specific fisheries affected.

4.7.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under this alternative, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. All of the activities associated with the hatchery programs would be terminated. This would likely have a medium to high effect on the local economies in the UWR, with the loss of jobs and money associated with the fisheries for hatchery-origin fish.

4.7.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5,the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. The increased hatchery production would allow for increased fishery harvest opportunities on hatchery produced fish in recreational and commercial fisheries in the ocean and freshwater. This alternative would improve the current local economies within the UWR. While the number of jobs would likely not increase, the revenue generated by the increased fishing opportunity would have a medium to high effect on local economies with the UWR.

4.8. Effects on Environmental Justice

4.8.1. Alternative 1 (No-Action) – Status Quo Hatchery Programs with No Integration of Natural-Origin Fish into Hatchery Broodstocks

Four of the five counties in the analysis area are environmental justice communities of concern because they meaningfully exceed thresholds for low income or minority populations (Table 23). In addition, all native American tribes interested or with reservation lands within the Upper Willamette River basin are of

concern. In particular, the Confederated Tribes of the Grand Ronde and Burns Paiute Tribe have expressed interest during public scoping for this EIS (section 3.8).

Under Alternative 1, the following ecological, cultural, economic, and social effects on environmental justice communities would be expected in both the short and long term:

- No change in the amount of hatchery salmon and steelhead potentially available to native American tribes to meet Tribal fishery needs annually. Depending upon the year, surplus adult spring Chinook salmon from Upper Willamette hatchery programs are taken by Tribal governments for fishery needs.
- A negligible reduction in the amount of surface and ground water around the local vicinity of the hatchery facilities, but would be of no consequence to environmental justice communities (Subsection 4.2.2, Effects on Water Quantity)
- A negligible reduction in water quality around the local vicinity of the hatchery facilities. Impacts are undetectable downstream of the hatchery facilities (Subsection 4.3.2, Effects on Water Quality)
- A medium to high beneficial impact to environmental justice communities from the purchase of goods and services to support hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial impact to environmental justice communities from the employment of 37 full-time 2seasonal employees at the hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial impact to environmental justice communities from fisheries targeting hatchery salmon and steelhead that increase the local purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses; these increases would benefit environmental justice communities (Subsection 4.7.2, Effects on Socioeconomics)
- There would be a medium beneficial impact in environmental justice communities through the hiring of guide and charters to take people fishing (Subsection 4.7.2, Effects on Socioeconomics)

4.8.2. Alternative 2 (Proposed Action/Preferred Alternative) – Allow Integration of Natural-origin Fish into Hatchery Broodstocks

Four of the five counties in the analysis area are environmental justice communities of concern because they meaningfully exceed thresholds for low income or minority populations (Table 23). In addition, all native American tribes interested or with reservation lands within the Upper Willamette River basin are of concern. In particular, the Confederated Tribes of the Grand Ronde and Burns Paiute Tribe have

expressed interest during public scoping for this EIS (section 3.8). Under Alternative 2, the proposed programs would have ecological, cultural, economic, and social effects and effects on environmental justice communities identical to those described under Alternative 1 (No-Action).

- A negligible reduction in the amount of surface and ground water around the local vicinity of the hatchery facilities, but would be of no consequence to environmental justice communities (Subsection 4.2.2, Effects on Water Quantity)
- A negligible reduction in water quality around the local vicinity of the hatchery facilities. Impacts are undetectable downstream of the hatchery facilities (Subsection 4.3.2, Effects on Water Quality)
- A medium to high beneficial effect to environmental justice communities from the purchase of goods and services to support hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial effect to environmental justice communities from the employment of 37 full-time 2seasonal employees at the hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial effect to environmental justice communities from fisheries targeting hatchery salmon and steelhead that increase the local purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses; these increases would benefit environmental justice communities (Subsection 4.7.2, Effects on Socioeconomics)
- There would be a medium beneficial effect in environmental justice communities through the hiring of guide and charters to take people fishing (Subsection 4.7.2, Effects on Socioeconomics)

4.8.3. Alternative 3 – Reduce Hatchery Production to Reintroduction Needs

Under Alternative 3, the proposed programs would have ecological, cultural, economic, and social effects and effects on environmental justice communities similar to those described under Alternative 1 (No-Action), with the exception of surplus adult salmon being available for Tribal governments. The following is a summary of impacts of Alternative 3 compared to the No-action alternative:

- Elimination of adult hatchery salmon for Tribal use. This would predominately affect the Burns Paiute Tribe, who have relied upon Willamette salmon exclusively for their ceremonial fisheries in the Malheur River. Other Tribal governments would potentially have other hatchery salmon available for tribal needs outside of the Willamette River basin from other hatcheries in the Columbia Basin.

- A negligible reduction in the amount of surface and ground water around the local vicinity of the hatchery facilities, but would be of no consequence to environmental justice communities (Subsection 4.2.2, Effects on Water Quantity)
- A negligible reduction in water quality around the local vicinity of the hatchery facilities. Impacts are undetectable downstream of the hatchery facilities (Subsection 4.3.2, Effects on Water Quality)
- A medium to high beneficial effect to environmental justice communities from the purchase of goods and services to support hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial impact to environmental justice communities from the employment of 37 full-time 2seasonal employees at the hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high beneficial effect to environmental justice communities from fisheries targeting hatchery salmon and steelhead that increase the local purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses; these increases would benefit environmental justice communities (Subsection 4.7.2, Effects on Socioeconomics)
- There would be a medium beneficial effect in environmental justice communities through the hiring of guide and charters to take people fishing (Subsection 4.7.2, Effects on Socioeconomics).

4.8.4. Alternative 4 – Terminate the Existing Hatchery Programs in the Upper Willamette River Basin

Under this alternative, the co-managers would terminate the funding and implementation of all of the hatchery programs in the UWR. All of the activities associated with the hatchery programs would be terminated. It is expected that this would have a high effect on the environmental justice communities within the UWR.

- A reduction in the amount of surface and ground water around the local vicinity of the hatchery facilities, which would likely have a low effect to environmental justice communities (Subsection 4.2.2, Effects on Water Quantity)
- An increase in water quality around the local vicinity of the hatchery facilities (Subsection 4.3.2, Effects on Water Quality)
- A medium to high negative effect to environmental justice communities from the purchase of goods and services to support hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)

- A medium to high negative effect to environmental justice communities from the employment of 37 full-time 2seasonal employees at the hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A medium to high negative effect to environmental justice communities from the lack of fisheries targeting hatchery salmon and steelhead that decrease the local purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses; these decreases would have a negative effect on environmental justice communities (Subsection 4.7.2, Effects on Socioeconomics)
- There would be a medium negative impact in environmental justice communities because there would be no hiring of guide and charters to take people fishing (Subsection 4.7.2, Effects on Socioeconomics).

4.8.5. Alternative 5 – Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5,the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. The increased hatchery production would allow for increased fishery harvest opportunities on hatchery produced fish in recreational and commercial fisheries in the ocean and freshwater. Under Alternative 5, the proposed programs would have larger ecological, cultural, economic, and social effects and effects on environmental justice communities then those described under Alternative 1 (No-Action) and Alternative 2 (Proposed Action/Preferred Alternative).

- A negligible reduction in the amount of surface and ground water around the local vicinity of the hatchery facilities, but would be of no consequence to environmental justice communities (Subsection 4.2.2, Effects on Water Quantity)
- A negligible reduction in water quality around the local vicinity of the hatchery facilities. Impacts are undetectable downstream of the hatchery facilities (Subsection 4.3.2, Effects on Water Quality)
- A high beneficial effect to environmental justice communities from the purchase of goods and services to support hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A high beneficial effect to environmental justice communities from the employment of 37 full-time 2seasonal employees at the hatchery facilities (Subsection 4.7.2, Effects on Socioeconomics)
- A high beneficial effect to environmental justice communities from fisheries targeting hatchery salmon and steelhead that increase the local purchase of supplies such as fishing gear, camping

equipment, consumables, and fuel at local businesses; these increases would benefit environmental justice communities (Subsection 4.7.2, Effects on Socioeconomics)

- There would be a high beneficial effect in environmental justice communities through the hiring of guide and charters to take people fishing (Subsection 4.7.2, Effects on Socioeconomics)

5. CUMULATIVE IMPACTS

5.1. Introduction

The National Environmental Policy Act defines cumulative effects as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency (Federal or non-Federal) or person undertakes such other actions" (40 CFR 1508.7). The cumulative effects of a Proposed Action can be represented as an equation:

Proposed Action + Past Actions + Present Actions + Reasonably Foreseeable Future Actions = Cumulative Effects

The CEQ provides an 11-step process for cumulative effects analyses that is woven into the larger NEPA process and into documents supporting a Federal action (CEQ 1997) (Table 30). Other subsections of this EIS are relevant as support for this cumulative effects analysis. Chapter 3, Affected Environment, describes the existing conditions (or baseline, for the purposes of this chapter) for each resource and reflects the effects of past actions and present condition. Chapter 4, Environmental Consequences, evaluates the direct and indirect effects of the alternatives on each resource's baseline conditions. This chapter considers the cumulative effects of each alternative in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions.

Table 30. CEQ cumulative effects analysis process and documentation within this EIS.

		Steps in the Process	Location within this EIS
Scoping	1	Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals	Subsections 1.2, 1.3, 1.6, and 5.5
	2	Establish the geographic scope for the analysis	Subsections 1.4 and 5.1.1
	3	Establish the time frame for the analysis	Subsection 5.1.1
	4	Identify other actions affecting the resources, ecosystems, and human communities of concern	Subsection 5.4
Describing the Affected Environment	5	Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses	Chapter 3
	6	Characterize the stresses affecting these resources, ecosystems, and human communities and relations to regulatory thresholds	
	7	Define a baseline condition for the resources, ecosystems and human communities	
Determining the Environmental Consequences	8	Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities	Chapter 3 and Subsections 5.2 to 5.5
	9	Determine the magnitude and significance of cumulative effects	Subsection 5.6
	10	Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects	Chapter 2
	11	Monitor the cumulative impacts of the selected alternatives and apply adaptive management	Alternative 2 (Proposed Action) includes monitoring and adaptive management as described in HGMPs

5.1.1. Geographic and Temporal Scales

The cumulative effects analysis area includes the project area and the analysis area described in Subsection

1.4, Project Area and Analysis Area. This cumulative effects area was determined based on the geography, topography, waterways, and natural interactions that occur among the ecosystems present in the Willamette and lower Columbia basins. Biological resources and human populations in the Willamette Basin cumulative effects area share a common airshed, common watershed, and common flyway. The Willamette River basin region has a population size of approximately 2.8 million residents in 2016. The greatest number of people live in the Portland metropolitan area near the confluence of the Willamette and Columbia rivers.

The temporal scope of past and present actions for the affected resources encompasses actions that occurred prior to and after the listing of Chinook salmon and winter steelhead under the ESA. This is also the temporal context within which affected resources are described in Chapter 3, Affected Environment, whereby existing conditions are a result of prior and ongoing actions in the EIS project area.

5.1.2. Other Programs, Plans, and Policies

Provided below are known past, present, and future actions within the Willamette/Lower Columbia Region that have occurred, are occurring, or are reasonably likely to occur within the cumulative effects analysis area. Subsection 5.2, Past Actions, summarizes past actions that affected the cumulative effects analysis area; Subsection 5.3, Present Conditions, describes current overall trends for the area; and Subsection 5.4, Future Actions and Conditions, describes climate change effects, development, habitat restoration, hatchery production, and fisheries activities and objectives supported by agencies and other non-governmental organizations to restore habitat in the cumulative effects analysis area. Finally, Subsection 5.5, Cumulative Effects by Resource, describes how these past, present, and future actions affect each resource evaluated in this EIS, and specifically focuses on the effects of alternatives, when possible.

5.2. Past Actions

Humans occupied the Willamette/Lower Columbia Region for thousands of years. Before Europeans arrived in the late 1700s, most human inhabitants were hunter-gatherers associated with the Native American Tribes. They relied on aquatic and terrestrial resources for food and clothing, and trees for building materials. Indigenous peoples were known to use the waterways of the region as trading routes. Fire was used in some areas of the Willamette Valley to modify the environment, to clear areas to aid hunting, to promote berry production, and to support the growth of grasses for making nets, baskets, and blankets.

In the 1800s, with the continued increase in European descendants to Oregon, trapping, logging, and fishery harvest were initiated on a large scale, which dramatically altered the landscape. The lower Columbia River near Astoria, Oregon became the first development by European descendants, with fur trading and salmon harvest the principal economies. As time passed, further development, increases in human populations, and natural resource extraction began to substantively affect the natural ecosystems of the Willamette/Lower Columbia region. Land ownership became fragmented with many different owners and purposes (Figure 22). Most of the old-growth forest was harvested by private, state, and federal identities, and much forestland in the lowland, open areas was converted to human-dominated uses, such as agriculture and urban development in private ownership. Many tributary rivers of the Willamette and Columbia rivers were dammed in order to reduce the impacts of flooding on human development and to produce hydroelectric power for society. This dramatically reduced historical habitat for salmonids and reduced the natural characteristics of the rivers below the dams. Other freshwater ecosystem types also declined, floodplains were altered, rivers and streams were channelized, estuary and wetland areas were filled, shorelines were hardened and/or modified, water and air quality declined, pollution and marine traffic increased, and habitat was lost.

Forest and agricultural management continued to drive the local economies. Splash damming occurred in several watersheds as a method to get timber to local mills, which degraded the aquatic habitat dramatically. By the late 1980s, most of the Willamette/Lower Columbia region had been logged at least one time, with the exception of designated wilderness areas or other special designation that helped preserve the local landscape. All of the associated activities that occur with logging, like road building and building stream crossings, became extensive across the landscape. All of these activities severely affected the aquatic habitat in streams and rivers throughout the region. Much of the stream complexity that included large woody debris, deep pool habitat, braided channels, and intact riparian areas was lost. Streams and rivers are now much simpler, less complex, dominated by shallow riffle habitat, and exhibited warmer water temperatures than occurred historically.

Fishery harvest of salmon and steelhead and other aquatic species also increased with the increase in human population across the region. Initially, fishery harvest occurred for subsistence needs but then grew into commercial harvest in the rivers and ocean. By the 1920s, fishery harvest in freshwater had severely affected the salmon and steelhead runs from the millions of pounds harvested annually. Commercial and recreational harvest increased throughout the 20th century until the early 1990s when many of the salmon runs plummeted to all-time low abundances. Fishery harvest rates were dramatically reduced and still occur at much lower harvest rates than occurred historically.

The decreases in salmon and steelhead harvest from overexploitation and reduced productivity from freshwater habitat degradation initiated hatchery programs for salmon and steelhead since the late 1800s in the Willamette/Lower Columbia region in an effort to increase fishery harvest. The hatchery programs increased fishery harvest in many cases, especially during the high ocean survival periods. However, many concerns arose over excessive harvest of natural-origin stocks, interbreeding between hatchery- and natural-origin fish, and competition reduced hatchery production beginning in the 1980s. Over 200 million hatchery fish were released in the Columbia River Basin prior to the mid-1990s

5.3. Present Conditions

As described in Subsection 5.2, Past Actions, substantial changes have occurred to terrestrial and aquatic ecosystems over the last century in the Willamette/Lower Columbia region. Presently, the landscape continues to be managed for agriculture and timber production over a broad landscape given the superb growing conditions for timber and various crops. Several regulations and best management practices have been implemented and are still in effect to help recover and protect aquatic habitat, such as the Oregon State Forest Practices Act and the Northwest Forest Plan (Subsection 1.7.1, Oregon Plan for Salmon and Watersheds). Federal lands in the region have greater riparian protections and are managed to a greater extent for late-successional timber stands than what typically occurs on private timberlands in the region. On private lands, timber harvest occurs regularly on 25-35 year rotations. Over the last two decades, timber harvest has decreased overall on federal lands but increased on private lands. Agriculture, including the growing of grass seed, hazelnuts, nursery stock, and other products, continues to dominant the landscape in the Willamette Valley. Land development has been a major influence in the lower Willamette River Basin, where the Portland metropolitan area occurs. Other communities are expanding such Salem, Corvallis, and Eugene in the Willamette Valley.

The existing hatchery programs within the UWR affect natural-origin salmon and steelhead and their habitat (Subsection 3.4, Salmon and Steelhead and Their Habitats). Operation of the hatchery facilities and release of hatchery fish into the natural environment has affected natural-origin salmon and steelhead through genetic introgression of hatchery fish into the natural population, increased competition and predation from hatchery fish, transfer of pathogens from hatchery fish and/or the hatchery facility to the adjacent river or stream, operation of the hatchery facility using water and discharging effluent, masking of natural population status from having hatchery fish spawning in the wild, incidental fishing effects, and nutrient input from carcasses (Table 25). The extent of adverse effects depends on how the hatchery

program is managed, the current status of the natural-origin populations and how affected by the hatchery program, and the condition of the habitat; among other factors.

Hatchery programs within the UWR can also provide benefits to the natural-origin populations by increasing the amount of marine-derived nutrients to the freshwater environment from having hatchery fish spawn naturally and from the outplanting of carcasses from the hatchery facility. Hatchery programs can also potentially benefit the abundance, productivity (in some cases), spatial structure, and diversity of natural populations (McElhany et al. 2000). Current spring Chinook salmon hatchery programs within the UWR are managed for the supplementation or restoration of natural-origin populations and to augment harvest opportunities. The summer steelhead and rainbow trout hatcheries are managed to increase harvest opportunities only.

Hatchery programs within the UWR continue to be operated and managed by ODFW at levels specified in the current HGMPs being considered in this EIS. Overall production levels have remained stable over the last 10 years. There were some reforms that occurred from implementation of ODFW's Management Plans under its Native Fish Conservation Policy (ODFW 2002), but production levels have remained similar across the UWR overall. For ESA-listed spring Chinook salmon, total hatchery releases for the entire UWR is greater than 4,000,000 smolts annually. In addition, over 550,000 summer steelhead and about 960,000 rainbow trout are released annually in the UWR.

Altogether, the stressors described above under present conditions (e.g., human development and habitat degradation, hatchery practices, and fisheries) are expected to continue under future actions and conditions as described below.

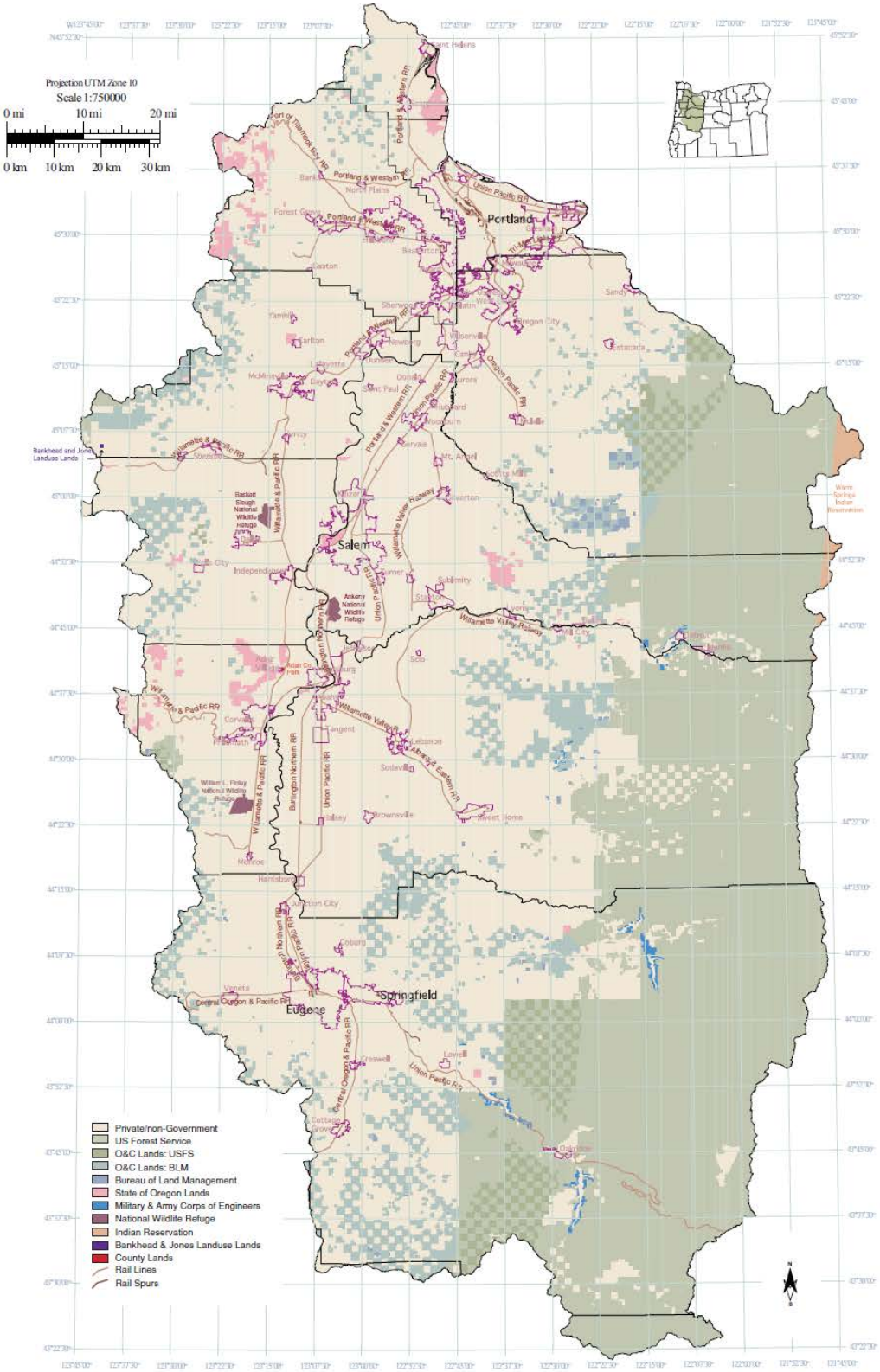

Figure 22. Land ownership throughout the Willamette River Basin. Figure taken from Willamette River Basin Atlas (PNERC 2016).

5.4. Future Actions and Conditions

Reasonably foreseeable future actions and conditions include forest management, land use and development, hatchery production, fisheries, habitat restoration activities, and climate change. Many plans, regulations, and laws are in place at the local, state, and federal levels within the UWR to continue economic benefits while minimizing and/or reducing environmental degradation (Subsection 1.7.1, Oregon Plan for Salmon and Watersheds). However, it is unclear if these plans, regulations, and laws will be successful in meeting their environmental goals and objectives. It is not possible to predict the magnitude of effects from future timber harvest, land use and development, and habitat restoration with certainty for several reasons: (1) the activities may not have yet been formally proposed, (2) mitigation measures specific to future actions may not have been identified for many proposed projects, and (3) there is uncertainty whether mitigation measures for these actions will be fully implemented. However, it is possible to evaluate carefully thought out potential future management and land use scenarios and use a model to predict projected effects to the environment that can be compared between various scenarios (Hulse et al. 2002). In addition, when the projected changes in environment are considered in combination with climate change, a general trend in expected cumulative effects can be estimated for each resource as described in Subsection 5.5, Cumulative Effects by Resource.

Because of the large geographic scope of this analysis, it is not feasible to conduct a detailed assessment of all project-level activities that have occurred, are occurring, or are planned in the future for the cumulative effects analysis area. Rather, this cumulative effects analysis qualitatively assesses the overall trends in cumulative effects considering past, present, and reasonably foreseeable future actions, and describes how the alternatives contribute to those trends.

The Willamette River Basin Planning Atlas (see http://oregonstate.edu/dept/pnw-erc/; accessed November 28, 2017) evaluated the long-term, large-area perspective on the combined effects of the multiple policies and regulations affecting the quality of the environment and natural resources within the Willamette River Basin. The process[18]produced a suite of alternative potential scenarios for the future expressed as maps of land use and land cover that reflected the possible outcomes of the scenarios. The

[18]The Willamette Restoration Initiative was established in 1998 to develop a basin-wide strategy to protect and restore fish and wildlife habitat, increase populations of declining species, enhance water quality, and properly manage flood-plain areas – all within the context of human habitation and continued basin growth (http://www.oregonwri.org).

alternative evaluation included characterizing the current and historical landscape, development of two or more alternative scenarios for the future landscape that reflected varying assumptions about land and water use and the range of stakeholder viewpoints, and the likely effects of these landscape changes and alternative futures on ecological and socio-economic endpoints. Three future alternatives were evaluated; one represented the expected future landscape should current policies be implemented as written and recent trends continue, another reflected additional conservation measures to protect habitat to a greater degree, and the last loosened current policies to allow freer rein to market forces across all components of the landscape, but still within the range of what stakeholders considered plausible. The results of this analysis forms the basis for the discussion below concerning forest management and land use effects.

5.4.1. Forest Management

The modeling results of Hulse et al. (2002) suggested that under the scenario where current practices and trends continued, there would be older aged forests, primarily on federally managed lands, and the area of conifer forest that was greater than 80 year in age was reduced by 19 percent relative to 1990. Under the potential scenario that relaxed current land use practices, there was a greater amount of clear-cutting and less stream and riparian protection. The area of conifer forest greater than 80 years in age declined by 22 percent relative to 1990. Under the additional conservation measures scenario, private forestry lands included a 30-meter or wider riparian buffers on all streams, a gradual decrease in the average clear-cut size, and retention of small patches of legacy trees. The modeled result suggested that there would be a 17% increase in the area with conifer forests aged 80 years and older, relative to 1990. Still, the extent of older age conifer forest would be less than half of what occurred prior to Euro-American settlement

5.4.2. Land Use and Development

The number of people living in the Willamette River Basin is expected to nearly double between the early 2000s and 2050(Hulse et al. 2002). The modeling results of Hulse et al. (2002) suggested that under model scenario where current practices and trends continued, new development occurred only within designated urban growth boundaries and existing rural residential zones. As a result, population density within urban areas almost doubled relative to ca. 1990 (from 9.4 residents/ha in ca .1990 to 18.0 in 2050), while the amount of urbanized land plus land influenced by rural development increased by less than 25 percent. Surface water consumption increased by 57 percent, reflecting a 20 percent increase in diversions for municipal and industrial uses and 65-120 percent increase in diversions for irrigated agriculture. Demands for water for municipal, industrial, and domestic uses were met in most areas; however, stream flows declined.

Under the scenario where land use regulations were relaxed, population densities within urban growth boundaries increased by 55 percent (to 14.6 residents/ha) relative to 1990. Urbanized areas expanded by almost 50 percent and the area influenced by rural structures by 68 percent. Most of this new development occurred on agricultural lands. Furthermore, the location of urban growth boundaries, a consequence of historical settlement patterns, predisposes urban expansion to occupying higher quality soils and particularly valuable agricultural resource lands. Twenty-four percent of 1990 prime farmland was lost. In this scenario, water consumption for out-of-stream uses increased markedly, by 58 percent relative to ca. 1990.

Under the scenario where greater priority on ecosystem protection and restoration, Hulse et al. (2002) found that there was relatively little (2 percent) conversion of agricultural lands to urban or rural development. Yet, 15 percent of ca. 1990 prime farmland was still lost, converted in this scenario mostly to natural vegetation. Conservation strategies on agricultural lands included 30-meter or wider riparian buffers along all streams, conversion of some cropland to native vegetation (in particular natural grasslands, wetlands, oak savannah, and bottomland forests) in high priority conservation zones, establishment of field borders and consideration of wildlife habitat as a factor in crop selection in environmentally sensitive areas, and a 10 percent increase in irrigation efficiency. Areas along the Willamette River that historically had complex, dynamic channels were targeted for restoration of river habitat complexity and bottomland forest. Under this scenario, water consumption increased relative to ca. 1990, but to a somewhat lesser degree than for the other scenarios. No water planning areas were projected to have near zero flow in a moderately dry summer, although an estimated 225 km of 2nd to 4th order streams would still go dry (70% more km than ca. 1990).

5.4.3. Hatchery Production

It is likely that the type and extent of salmon and steelhead hatchery programs and the numbers of fish released in the analysis area will change over time. These changes are likely to reduce effects to natural-origin salmon and steelhead such as genetic effects, competition, and predation risks that are described in Subsection 3.4, Salmon and Steelhead and Their Habitats, especially for those species that are listed under the ESA. For example, effects to natural-origin salmon and steelhead would be expected to decrease over time to the extent that hatchery programs are reviewed and approved by NMFS under the ESA. Hatchery program compliance with conservation provisions of the ESA will ensure that listed species are not jeopardized, and that “take” under the ESA from salmon and steelhead hatchery programs is minimized or avoided.

Where needed, reductions in effects on listed and natural-origin salmon and steelhead may occur through changes such as refinement of times and locations of fish releases to reduce risks of competition and predation; management of overlap in hatchery-origin and natural-origin spawners to meet gene flow objectives; decreased use of isolated hatchery programs; increased use of integrated hatchery programs for conservation purposes; when available, incorporation of new research results and improved best management practices for hatchery operations; decreased production levels; or termination of programs. Similar changes would be expected for non-listed species as well, motivated by the desire to avoid species from becoming listed or further threatening listed species. For example, if the winter steelhead DPS continues to decline, a conservation hatchery program for winter steelhead may be necessary to reintroduce fish back into historical habitat above the federal dams.

Since the existing hatchery programs are managed by ODFW, substantial increases in hatchery production is not likely in the foreseeable future because the hatchery programs in the UWR are primarily federal mitigation programs. These programs are likely to be continually funded, but will not likely increase in production because of the original mitigation obligations when the UWR dams were built.

5.4.4. Fisheries

It is likely that the salmon and steelhead fisheries in the analysis area will change over time. These changes are likely to reduce effects to natural-origin salmon and steelhead listed under the ESA. For example, effects to natural-origin salmon and steelhead would be expected to decrease over time to the extent that fisheries management programs continue to be reviewed and approved by NMFS under the ESA, as evidenced by the beneficial changes to programs that have thus far undergone ESA review. Fisheries management program compliance with conservation provisions of the ESA will ensure that listed species are not jeopardized and that “take” under the ESA from salmon and steelhead fisheries is minimized or avoided. Where needed, reductions in effects on listed salmon and steelhead may occur through changes in areas or timing of fisheries, or changes in types of harvest methods used.

5.4.5. Habitat Restoration

To rehabilitate the negative human-induced changes that have affected biodiversity in the cumulative effects analysis area (Subsection 5.4.1, Forest Management and Subsection 5.4.2, Land Development) habitat conservation and restoration activities are occurring in the UWR. Funding for habitat conservation and restoration is likely to continue into the foreseeable future because the majority of

habitat restoration projects occurs from Federal funding to the state of Oregon's Watershed Enhancement Board to local Watershed Councils for on-the-ground implementation of projects. As funding continues for habitat restoration projects, projects that reduce the most critical limiting factors and threats within the watershed will be prioritized. These habitat restoration projects will continue to enhance the conservation and recovery of the watersheds and the fish and wildlife species within them.

5.4.6. Climate Change

The changing climate is becoming recognized as a long-term trend that is occurring throughout the world. Within the Pacific Northwest, Ford (2011) summarized expected climate changes in the coming years as leading to the following physical and chemical changes (certainty of occurring is in parentheses):

- Increased air temperature (high certainty)
- Increased winter precipitation (low certainty)
- Decreased summer precipitation (low certainty)
- Reduced winter and spring snowpack (high certainty)
- Reduced summer stream flow (high certainty)
- Earlier spring peak flow (high certainty)
- Increased flood frequency and intensity (moderate certainty)
- Higher summer stream temperatures (moderate certainty)
- Higher sea level (high certainty)
- Higher ocean temperatures (high certainty)
- Intensified upwelling (moderate certainty)
- Delayed spring transition (moderate certainty)
- Increased ocean acidity (high certainty)

These changes will affect human and other biological ecosystems within the cumulative effects analysis area (Ecology 2012a). Changes to biological organisms and their habitats are likely to include shifts in timing of life history events, changes in growth and development rates, changes in habitat and ecosystem structure, and rise in sea level and increased flooding (Littell et al. 2009; Johannessen and Macdonald 2009).

For the Pacific Northwest portion of the United States, Hamlet (2011) notes that climate changes will have multiple effects. Expected effects include:

- Overtaxing of storm water management systems at certain times
- Increases in sediment inputs into water bodies from roads
- Increases in landslides
- Increases in debris flows and related scouring that damages human infrastructure
- Increases in fires and related loss of life and property
- Reductions in the quantity of water available to meet multiple needs at certain times of year (e.g., for irrigated agriculture, human consumption, and habitat for fish)
- Shifts in irrigation and growing seasons
- Changes in plant, fish, and wildlife species' distributions and increased potential for invasive species
- Declines in hydropower production
- Changes in heating and energy demand
- Impacts to homes along coastal shorelines from beach erosion and rising sea levels

The most heavily affected ecosystems and human activities along the Pacific coast are likely to be near areas having high human population densities, and the continental shelves off Oregon and Washington (Halpern et al. 2009).

5.5. Cumulative Effects by Resource

Provided below is an analysis of the cumulative effects of forest management, land development, hatchery production, fisheries, habitat restoration, and climate change under the alternatives and for each resource analyzed in this EIS. The resources for which cumulative effects are described are:

- Water quantity
- Water quality
- Salmon and Steelhead and Their Habitats
- Other Fish and Their Habitats
- Wildlife
- Socioeconomics
- Environmental justice

5.5.1. Water Quantity

Subsection 3.2, Water Quantity, describes the baseline conditions of water quantity, and Subsection 4.2, Effects on Water Quantity, evaluates the direct and indirect effects of the five alternatives of the hatchery

programs within the UWR. All of the hatchery facilities divert water from nearby sources, pass the water through the hatchery, and then discharge the water back into the stream or river. There is typically a net gain of water at the point of discharge from the hatchery if groundwater sources are used at the hatchery. The amount of water available in the stream or river at the hatchery and local groundwater sources is the result of many years of past practices of forest management, land use and development, and climate change.

Future actions in the overall cumulative effects analysis area are described in Subsection 5.4, Future Actions and Conditions. This subsection considers effects that may occur as a result of the alternatives being implemented at the same time as other anticipated future actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on water quantity.

Successful operation of hatcheries depends upon the use of water from adjacent streams and rivers and groundwater at the hatchery facilities. The hatchery programs are subject to the amount and availability of water at the hatchery facility by all of the other prior influences and uses. The primary upstream influence on water quantity for the hatchery facilities within the UWR is forest management and climate change. Land use and development and urbanization are not primary influences because all of the major population areas are primarily downstream of the hatchery facilities.

Habitat restoration could principally influence water quantity, especially if diversions are eliminated. Fisheries do not influence water quantity. It is uncertain how water quantity will be affected at the hatchery facilities due to Federal land management being more conservative now and into the future for recovering aquatic habitat and climate change likely leading to less water being available during the low streamflow periods of the summer (surface and groundwater). Given these future conditions, it is likely water quantity in the analysis area will be the same or slightly worse than current conditions.

All of the five alternatives evaluated in Subsection 4.2, Effects on Water Quantity, resulted in negligible impacts on water quantity from the operation of the hatchery facilities. Therefore, hatchery programs are not likely to influence future conditions for water quantity downstream of the hatchery facilities. None of the five alternatives evaluated in this EIS are likely to contribute to the issues related to water quantity downstream of the hatchery facility because there is no net loss of water from use at the hatchery. At Willamette Hatchery, water used through the hatchery is discharged into a different stream before flowing together downstream (area affected is approximately 7,400 feet in length (Table 3).

In summary, cumulative effects from forest management, land use and development, climate change, and habitat restoration would likely impact water quantity in the analysis area more than the direct or indirect effects of the hatchery water withdrawal that is described in Subsection 4.2, Effects on Water Quantity, under all alternatives. However, implementation of any of the five alternatives would not affect or contribute to the overall trend in cumulative effects on water quantity within the UWR.

5.5.2. Water Quality

Subsection 3.3, Water Quality, describes the baseline conditions of water quality, and Subsection 4.3, Effects on Water Quality, evaluates the direct and indirect effects of the five alternatives of the hatchery programs within the UWR. All of the hatchery facilities divert water from nearby sources, pass the water through the hatchery, and then discharge the water back into a stream or river. The hatchery fish and operations add substances and diseases to the water within the specified limits of the NPDES permit for each hatchery.

Future actions in the overall cumulative effects analysis area are described in Subsection 5.4, Future Actions and Conditions. This subsection considers effects that may occur as a result of the alternatives being implemented at the same time as other anticipated future actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on water quality.

The most common substances found in the effluent of UWR hatcheries are ammonia, nitrogen, phosphorus, and antibiotics. Bacteria, parasites, and viruses can also be transmitted from the hatchery fish to the effluent. These substances and organisms are a byproduct of hatchery fish rearing and treating the fish to ensure high survival while being grown at very high densities. Most of the streams and rivers within the UWR have reaches that are on the EPA's 303(d) list for impaired waters. Water temperature, fecal coliform, sedimentation, dissolved oxygen are the current 303(d) listings for the UWR, regardless of whether there is a hatchery facility in the basin or not (Figure 2). Lack of riparian shade, effects of dams, and forestry practices are some of the causes for the current 303(d) listings. The hatchery facilities are not identified as a cause for any of the current 303(d) listings within the UWR (ODEQ 2013).

As long as the hatchery facilities continue to operate as evaluated under the alternatives of this EIS (Chapter 4, Environmental Consequences), the hatcheries will continue to discharge substances, viruses, and bacteria into the effluent of the hatchery facility. However, as evaluated in Subsection 4.3, Effects on

Water Quality, the effects are minimal and short-lived because the effluent is diluted as it travels downstream and becomes undetectable a few hundred meters downstream (Bartholomew et al. 2013). The 303(d) list impairments for water quality are expected to continue into the foreseeable future in areas where hatchery facilities are (and are not) present. Future forest management on non-federal lands, land development, and climate change can be expected to further impair water quality on existing 303(d) stream reaches due to increases in water temperature, continued agricultural practices, and logging activities. However, such impairments from these activities would not be increased by hatchery operations under any alternative.

5.5.3. Salmon and Steelhead and Their Habitats

Subsection 3.2, Salmon and Steelhead, describes baseline conditions for salmon and steelhead. These conditions are the result of many years of dam construction and operation, forest management, climate change, land use and development, habitat restoration, hatchery production, and fisheries (Lackey et al. 2006). The expected direct and indirect effects of the alternatives on salmon and steelhead are described in Subsection 4.4, Effects on Salmon and Steelhead and Their Habitat.

Future actions are described in Subsection 5.4, Future Actions and Conditions. This subsection describes cumulative effects on salmon and steelhead that may occur as a result of implementing any of the alternatives at the same time as other future actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on salmon and steelhead.

Salmon and steelhead abundance naturally alternates between high and low levels on large temporal and spatial patterns that may last centuries and on more complex ecological scales than can be easily observed (Rogers et al. 2013). Cumulative effects on salmon and steelhead may be greater than the direct and indirect effects of each alternative as analyzed in Subsection 4.4, Effects on Salmon and Steelhead and Their Habitats, under all alternatives. This subsection provides brief overviews of the effects of forest management, climate changes, land use and development, habitat restoration, hatchery production, and fisheries on salmon and steelhead.

Within the UWR, the effects of forest management on salmon and steelhead have been widespread across the landscape. Timber harvest on unstable slopes and riparian areas has led to the decoupling of watershed processes. Improperly located, constructed, or maintained roads have degraded stream flow and sediment supply processes. The effects of these actions create conditions in streams where they lack

complex structure needed to retain gravels for spawning and invertebrate production, and the connectivity with shallow, off-channel habitat areas that once provided refugia from floods, over-wintering and hiding cover, and productive early-rearing habitat. The legacy effects of splash dams to transport logs continues to inhibiting stream structural complexity and available spawning gravel in several stream systems(ODFW and NMFS 2011). Some species of salmon have been more impacted by forest management than other species that spend a minimal time rearing as juvenile fish in freshwater (Meehan 1991). ESA-listed spring Chinook and salmon and steelhead have been and are impacted from these actions (ODFW and NMFS 2011). Future projections suggest salmon and steelhead and their habitat will continue to be impacted by forest management (Hulse et al. 2002). However, the magnitude and severity of those impacts varies greatly depending upon land ownership. Private, industrial timberlands are expected to be harvested in compliance with Oregon Forest Practices Act, which are less protective of riparian and aquatic habitats than would occur from timber harvest on Federal lands.

One of the largest threats to UWR spring Chinook salmon and winter steelhead is from the effects of construction and continued operation of the dams that were built as part of the Willamette Project for flood control and power production. Specific threats from flood control and hydropower management include: 1) blocked or impaired fish passage for adults and juveniles, 2) loss of some riverine habitat (and associated functional connectivity) due to reservoirs, 3) reduction in instream flow volume due to water withdrawals, 4) lack of sediment transport and role in habitat function, 5) altered physical habitat structure, and 5) altered water temperature and flow regimes (ODFW and NMFS 2011). Within the UWR, the flood control structures block or delay adult fish passage to major portions of the historical holding and spawning habitat for UWR spring Chinook salmon (North Santiam, South Santiam, McKenzie and Middle Fork Willamette subbasins), and for UWR winter steelhead in the North Santiam and South Santiam basins. In addition, past operations and current configurations of the Willamette Project have effected several salmonid life stages, through impacts on water flows, water temperatures, total dissolved gas (TDG), sediment transport, and channel structure.

The Biological Opinion for the Willamette Project describes a Reasonable and Prudent Alternative (RPA) with a suite of actions to be implemented that would avoid jeopardizing ESA-listed spring Chinook salmon and winter steelhead (NMFS 2008). Several actions have been implemented including the rebuilding of the fish collection facilities at Minto dam and Foster dam to allow safer handling, collection, and transporting of adult salmon and steelhead above the federal dams. Additional actions to improve juvenile fish passage through the reservoirs and dams in the North Santiam, McKenzie, and Middle Fork Willamette populations are in the planning phases. A water temperature control tower in planned for

Detroit reservoir/dam in the North Santiam River. All of these future actions will significantly benefit these salmon and steelhead populations and their habitat once implemented.

In recent years, predation by marine mammals of salmon and steelhead migrating upstream at Willamette Falls has become a substantial source of mortality. Predation rates have been up to 25% and 9% for winter steelhead and spring Chinook salmon, respectively (84 FR 52038; November 9, 2017). This loss of adult salmon and steelhead has increased the extinction risks for both of these species (ODFW 2017; ODFW 2018). Under a separate action, NMFS has authorized the lethal removal of problem sea lions under the MMPA in order to reduce these risks to salmon and steelhead.

Effects of land management on UWR spring Chinook salmon and steelhead include current land use practices causing limiting factors, as well as current practices that are not adequate to restore limiting factors caused by past practices (legacy impacts). Past land use (including agricultural, mining and grazing activities, diking, damming, development of transportation, and urbanization) are significant factors now limiting viability of UWR spring Chinook salmon and winter steelhead. These factors severed access to historically productive habitats, and reduced the quality of many remaining habitat areas by weakening important watershed processes and functions that sustained them.

Agricultural development, especially along lowland valley bottoms in the mainstem Willamette River reaches, and lower reaches of principal subbasins has directly impacted riparian areas and floodplains. Historical floodplain habitats were also lost through the filling of wetlands and levee construction. Runoff from agricultural lands where pesticides, herbicides, and fertilizers are applied has reduced sediment and water quality;

- Livestock grazing has directly impacted soil stability (trampling) and streamside vegetation (foraging), and delivered potentially harmful bacteria and nutrients (animal wastes) to streams;
- Construction of small scale dams, culverts, and other barriers has limited access to spawning and rearing habitats;
- Urban and rural-residential development in the lower subbasins and the mainstem Willamette River floodplain has led to the degradation of riparian and floodplain conditions, as well as an alteration of the natural drainage network due to roads, ditches and impervious surfaces. For example, prior to the 1850s, the lower Willamette River was comprised of approximately 80 percent shallow water and 20 percent deep habitat. Those proportions have now reversed, and the river is 80 percent deep and 20 percent shallow water habitat.

- Sand and gravel mining along some Willamette basin streams has impacted stream channels by altering instream substrate and sediment volumes.

Together these activities continue to inhibit the amount and quality of spawning and rearing habitats available to UWR spring Chinook salmon and winter steelhead populations, principally by severing access to historically productive habitats, and by weakening the important watershed processes and functions that once created and maintained healthy freshwater ecosystems for UWR spring Chinook salmon and winter steelhead production. Today, many streams have lower frequency and complexity of pools compared to historical conditions. And many of those that remain lack the complex structure needed to retain gravels for spawning and invertebrate production, and the connectivity with shallow, off-channel habitat areas that once provided refugia from floods, over-wintering and hiding cover, and productive early-rearing habitat.

In addition, accidental discharges of oil, gas, and other hazardous materials and the potential for landowner and developer noncompliance with regulations continue to affect aquatic habitat used by salmon and steelhead. Although regulatory changes for increased environmental protection (such as local critical areas ordinances), monitoring, and enforcement have helped reduce impacts of development on salmon and steelhead in freshwaters, development and noncompliance may continue to reduce salmon and steelhead habitat, decrease water quality, and contribute to salmon and steelhead mortality.

Today, many land use practices are better than they were in the past and, as a result, many stream reaches once degraded by past practices are recovering. Many landowners now understand the advantages of good conservation practices and are changing their approaches to contribute to restoration of healthy watershed processes and functions. A suite of regulatory programs have also been implemented to protect and restore salmon and steelhead physical habitat and water quality. Together these changes are improving the physical quality of salmon and steelhead habitats and providing more suitable environments for spawning and rearing.

The primary cause of these continuing effects on salmon and steelhead habitat is the continued increase in human population in the cumulative effects analysis area (Subsection 5.4.2, Land Development). Effects from development are expected to affect salmon and steelhead similarly under all alternatives because preferred development sites would not change by alternative scenario.

Restoration of habitat in the cumulative effects analysis area will improve salmon and steelhead habitat in general under all alternatives, with particular benefits to environments considered to be important for the survival and reproduction of fish. As a result, habitat restoration would be expected to improve fish survival in local areas. However, habitat restoration alone will not substantially increase survival and abundance of salmon and steelhead. In addition, habitat restoration is dependent on continued state or Federal funding, which is difficult to predict. Benefits from habitat restoration are expected to affect salmon and steelhead survival similarly under all alternatives.

The effects to natural-origin salmon and steelhead from releases of hatchery fish in the future is expected to be stable or decrease over time for a variety of reasons (Subsection 5.4.4, Hatchery Production).If abundance and productivity of natural-origin populations of salmon and steelhead increases enough to provide fishery opportunities on healthy natural-origin runs, many of the existing hatchery programs may be reduced or terminated. However, unless access to historical habitat is improved by successful juvenile fish passage, the hatchery mitigation programs in the UWR are not likely to be reduced due to the ongoing impacts of Willamette Project dams and reservoirs.

The effects of climate change on salmon and steelhead are described in general in ISAB (2007), and would vary among species and among species' life history stages. Effects of climate change may affect the life history of UWR spring Chinook salmon and winter steelhead in the cumulative effects analysis area (Glick et al. 2007; Mantua et al. 2009). Cumulative effects from climate change, particularly changes in streamflow and water temperatures, would likely impact hatchery-origin and natural-origin salmon and steelhead life stages in various ways as shown in **Table 31**. Under all alternatives, impacts to salmon and steelhead from climate change are expected to be similar, because climate change would impact fish habitat under each alternative in the same manner.

Table 31. Examples of potential impacts of climate change by salmon and steelhead life stage under all alternatives.

Life Stage	Effects
Egg	1) Increased water temperatures and decreased flows during spawning migrations for some species would increase pre-spawning mortality and reduce egg deposition. 2) Increased maintenance metabolism would lead to smaller fry. 3) Lower disease resistance may lead to lower survival. 4) Changed thermal regime during incubation may lead to lower survival. 5) Faster embryonic development would lead to earlier hatching. 6) Increased mortality for some species because of more frequent winter flood flows as snow level rises. 7) Lower flows would decrease access to or availability of spawning
Spring and Summer Rearing	1) Faster yolk utilization may lead to early emergence. 2) Smaller fry are expected to have lower survival rates. 3) Higher maintenance metabolism would lead to greater food demand. 4) Growth rates would be slower if food is limited or if temperature increases exceed optimal levels; growth could be enhanced where food is available, and temperatures do not reach stressful levels. 5) Predation risk would increase if temperatures exceed optimal levels. 6) Lower flows would decrease rearing habitat capacity. 7) Sea level rise would eliminate or diminish the rearing capacity of tidal wetland habitats for rearing salmon, and would reduce the area of estuarine beaches for spawning by forage fishes.

Life Stage	Effects
Overwinter Rearing	1) Smaller size at start of winter is expected to result in lower winter survival. 2) Mortality would increase because of more frequent flood flows as snow level rises. 3) Warmer winter temperatures would lead to higher metabolic demands, which may also contribute to lower winter survival if food is limited, or higher winter survival if growth and size are enhanced. 4) Warmer winters may increase predator activity/hunger, which can also contribute to lower winter survival.

Sources: ISAB (2007), Glick et al. (2007), Beamish et al. (2009), and Beechie et al. (2013).

In summary, habitat capacity has been reduced significantly in most freshwater areas, and it is unknown to what extent this capacity will be restored with continual anthropogenic impacts still occurring across the landscape. To the extent aquatic habitat will continue to degrade over time under all alternatives, the abundance and productivity of natural-origin salmon and steelhead populations may continue to be reduced in the future. Hatchery-origin salmon and steelhead may be similarly affected, but likely to lesser extent.

The potential benefits of habitat restoration actions within the cumulative effects analysis area may not fully mitigate for the impacts of climate change and development on fish and wildlife and their associated habitats. However, climate change and land use and development will continue to occur over time and affect aquatic habitat, while habitat restoration (which is dependent on funding and is localized in areas where agencies and stakeholders' habitat restoration actions occur) is less certain under all alternatives.

The current impacts from the operation of the hatchery facilities and release of hatchery fish are likely to continue into the future. Since hatchery production is not likely to increase given current constraints with funding and hatchery capacity, hatchery impacts will most likely remain constant into the future. However, if natural-origin salmon and steelhead populations continue to decrease from other factors, then hatchery impacts could increase (e.g., higher pHOS from having fewer natural-origin fish spawning in the wild).

Impacts from commercial and recreational fisheries in freshwater and in the ocean that catch hatchery fish produced from UWR hatcheries will likely remain similar to current levels into the future. The fisheries management structure is based upon the status of natural-origin salmon and steelhead, and not on the abundance of hatchery fish. Therefore, fisheries will continue to be restricted if natural-origin fish abundance decreases, and liberalized in years when abundance increases. The harvest of available hatchery fish will be within the limits established for natural-origin salmon and steelhead, and thus not likely change substantially in the future.

Although none of the alternatives would affect the overall trend in cumulative effects on salmon and steelhead, Alternative 3 and Alternative 4 could help mitigate some of the negative genetic and ecological effects on natural-origin steelhead and salmon associated with hatchery programs. That is, because under Alternative 3 hatchery programs would be reduced, and under Alternative 4 hatchery production would be terminated. However, since the existing hatchery programs overall result in relatively low impacts to the affected species populations, reducing or eliminating these hatchery programs would not substantially affect the adverse risks facing these populations in the future due to other factors (dams, forest management, land use and development, climate change, fisheries). Substantial improvements to the status of natural-origin salmon and steelhead within the UWR is not likely if the current hatchery programs were reduced and/or eliminated. Alternative 5 could potentially increase the genetic and ecological impacts associated with hatchery programs, but increasing the number of hatchery fish released is not expected to increase the risk to natural-origin fish because the other factors affecting abundance and productivity outweigh the hatchery effects.

5.5.4. Other Fish Species and Their Habitats

Subsection 3.5, Other Fish and Their Habitat, describes the baseline conditions of fish species other than salmon and steelhead. These conditions are the result of many years of forest management, climate change, land use and development, habitat restoration, hatchery production, and fisheries. The direct and indirect effects of the alternatives on other fish species are described in Subsection 4.5, Effects on Other Fish and Their Habitat.

Future actions in the overall cumulative effects analysis area are described in Subsection 5.4, Future Actions and Conditions. This subsection considers effects that may occur as a result of the alternatives being implemented at the same time as other anticipated future actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on fish species other than salmon and steelhead.

Other fish species that have a relationship to salmon and steelhead include rainbow trout, coastal cutthroat trout, sturgeon, lamprey, forage fish, and other resident freshwater fish, both native and non-native to the UWR (Subsection 3.5, Other Fish and Their Habitats). Similar to salmon and steelhead species, these fish species require and use a diversity of habitats. However, similar to effects described above for salmon and steelhead, these other fish species, including bull trout may also be affected by climate change and development because of the overall potential for loss or degradation of aquatic habitat or the inability to adapt to warmer water temperatures. In addition, climate change and land use and development may attract non-native aquatic plants that may, over time, out-compete native aquatic plants that provide important habitat to native fish (Patrick et al. 2012). Non-native fish, such as bass and walleye may actually thrive and increase in abundance and productivity as the climate (and water temperatures) warms, further negatively affecting UWR spring Chinook salmon and winter steelhead viability.

As discussed in Subsection 5.4.3, Habitat Restoration, the extent to which habitat restoration actions may mitigate impacts from climate change and development is difficult to predict. These actions most likely will not fully mitigate for the effects of climate change and development.

As discussed in Subsection 5.4.4, Hatchery Production, changes in hatchery programs over time may affect other fish species that have a relationship to salmon and steelhead. For example, reductions in hatchery production or terminations of hatchery programs may decrease the prey base available for other fish species (like cutthroat and bull trout) that use salmon and steelhead as a food source.

In summary, cumulative effects from dams, forest management, climate change, land use and development, habitat restoration, and hatchery production on other fish species would likely result in a decrease in the abundance of those fish species in the analysis area. Cumulative effects on fish species that compete, prey on, or are prey items for salmon and steelhead may be greater than the direct and indirect effects described under Subsection 4.5, Other Fish and Their Habitats. None of the alternatives would affect the overall trend in cumulative effects on other fish species because the range of production levels under the alternatives would be a small fraction of the total salmon and steelhead in the analysis area that these other fish species could compete with, prey on, or be prey items for.

5.5.5. Wildlife

Subsection 3.6, Wildlife, describes the baseline conditions for wildlife. These conditions represent the effects of many years of dams, forest management, climate change, land use and development, habitat

restoration, and hatchery production. The expected direct and indirect effects of the alternatives on wildlife are described in Subsection 4.6, Effects on Wildlife.

Future actions are described in Subsection 5.4, Future Actions and Conditions. This subsection considers potential effects that may occur as a result of implementing any one of the alternatives at the same time as other anticipated actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on wildlife.

The cumulative effects on wildlife from the alternatives varies depending upon the specific alternative. Alternative 1 and Alternative 2 are expected to provide benefits to nearly all wildlife species because hatchery fish are an important prey item for wildlife. These benefits would help offset some of the impacts expected in the future due to forest management and land use and development and the resultant loss in natural production of salmonids. Alternative 3 and Alternative 4, which would reduce or eliminate hatchery production and the number of fish released, would result in negligible, and negative impacts to wildlife species from the loss of salmon and steelhead as a potential food source. When combined with future forest management and land use and development, Alternative 3 and Alternative 4 would have the greatest negative effects on wildlife. Alternative 5, which increases hatchery releases could have a positive effect on wildlife.

5.5.6. Socioeconomics

Subsection 3.7, Socioeconomics, describes the baseline conditions for socioeconomics. These conditions represent the effects of many years of dams, forest management, climate change, land use and development, habitat restoration, and hatchery production. The expected direct and indirect effects of the alternatives on socioeconomics are described in Subsection 4.7, Effects on Socioeconomics.

Future actions are described in Subsection 5.4, Future Actions and Conditions. This subsection considers potential effects that may occur as a result of implementing any one of the alternatives at the same time as other anticipated actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on socioeconomic resources.

Although unquantifiable, climate change and land use and development actions, and changes in hatchery production and fisheries may reduce the number of salmon and steelhead available for sport fisheries (catch and release on natural-origin fish) over time as described in Subsection 5.5.3, Salmon and

Steelhead and Their Habitats. This, in turn, may reduce angler expenditure and economic revenue relative to conditions considered in Subsection 4.7, Effects on Socioeconomics. Likewise, it may reduce the number of salmon and steelhead available to the public as a food source and may increase reliance on other consumer goods or increase travel costs to participate in other fisheries.

The potential benefits of habitat restoration actions within the cumulative effects analysis area are difficult to quantify. These actions may not fully mitigate for the impacts of climate change and land use and development.

As discussed in Subsection 5.4.4, Hatchery Production, and Subsection 5.4.5, Fisheries, changes in hatchery programs and fisheries may occur over time. Changes in hatchery programs may affect the socioeconomic effects from hatchery production of salmon and steelhead. For example, reductions in hatchery production or terminations of hatchery programs may decrease the number of fish available for harvest, decrease associated angler expenditures and revenues generated from fishing, and reduce the number of salmon and steelhead available to the general public.

In summary, it is likely that cumulative effects from dams, forest management, climate change, land use and development, and hatchery production would decrease the number of fish available for sport and commercial fisheries and reduce angler expenditure and economic revenue relative to conditions considered in Subsection 4.7, Socioeconomics.

5.5.7. Environmental Justice

Subsection 3.8, Environmental Justice, describes environmental justice communities and counties of concern in the analysis area. Environmental justice user groups and communities of concern within the cumulative effects analysis area include people that fish for salmon and steelhead and low income or minority communities. The expected direct and indirect effects of the alternatives on environmental justice are described in Subsection 4.8, Effects on Environmental Justice.

Future actions are described in Subsection 5.4, Future Actions and Conditions. This subsection considers potential effects that may occur as a result of implementing any one of the alternatives at the same time as other anticipated actions. This subsection discusses the incremental impacts of the alternatives in addition to past, present, and reasonably foreseeable future actions (i.e., cumulative effects) on environmental justice user groups and communities of concern.

Forest management, dams, climate change and land use and development actions, and changes in hatchery production and fisheries may reduce the number of salmon and steelhead available for sport fisheries (catch and release on natural-origin fish) over time as described in Subsection 5.5.3, Salmon and Steelhead and Their Habitats. This, in turn, may reduce fishing opportunity in the analysis area relative to conditions considered in Subsection 4.8, Effects on Environmental Justice.

The potential benefits of habitat restoration actions within the cumulative effects analysis area are difficult to quantify. These actions may not fully mitigate for the impacts of climate change and land use and development on the abundance of fish that would be available for commercial or recreational harvest.

As discussed in Subsection 5.4.3, Hatchery Production, and Subsection 5.4.4, Fisheries, changes in hatchery programs and fisheries may occur over time. Changes in hatchery programs may affect the number of salmon and steelhead available for harvest by environmental justice communities.

In summary, it is likely that cumulative effects from climate change, development, and hatchery production would decrease the number of fish available for harvest relative to conditions considered in Subsection 4.8, Effects on Environmental Justice. However, none of the alternatives would affect the overall trend in cumulative effects on environmental justice because the range of production levels under the alternatives would result in a small fraction of the total harvestable salmon and steelhead in the analysis area available to environmental justice communities.

5.6. Summary of Effects

Table 32 summarizes the combined effects of past, present, and reasonably foreseeable actions, other than the Proposed Action and alternatives (summarized above), affecting the environmental resources reviewed in this EIS, affected by dams, forest management, climate change, land use and development, habitat restoration, hatchery production, and fisheries.

Table 33 summarizes the conclusions made above on the impacts of past, present, and reasonably foreseeable actions when combined with the impacts of the Proposed Action. Definitions for effects terms are the same as described in Subsection 3, Affected Environment, and Subsection 4, Environmental Consequences. The relative magnitude and direction of impacts is described using the following terms:

Undetectable:	The impact would not be detectable.
Negligible:	The impact would be at the lower levels of detection, and could be either positive or negative.

Low: The impact would be slight, but detectable, and could be either positive or negative.

Moderate: The impact would be readily apparent, and could be either positive or negative.

High: The impact would be greatly positive or severely negative.

Table 32. Summary of effects of past, present, and reasonably foreseeable future actions on the affected resources evaluated in this EIS.

Affected Resource	Past Actions	Present Actions	Reasonable Foreseeable Future Actions	Past, Present, and Reasonably Foreseeable Future Actions
Water Quantity	Negligible to low negative due to water withdrawals from human development	Negligible to low negative	Low negative	Low negative
Water Quality	Moderate	Moderate	Moderate	Moderate
Salmon and Steelhead and Their Habitat	Moderate to high negative due to land use and development, past fishery, hatcheries, and habitat management practices	Mixed (negligible to moderate negative, to low positive) due to ESA compliance and improved fishery, hatcheries, habitat management practices, and habitat restoration, depending on population	Mixed (moderate negative to low positive), depending on population	Mixed (moderate negative to low positive), depending on population
Other Fish and Their Habitats	Mixed (negligible to low negative, to	Mixed (negligible negative to	Negligible to low negative	Negligible to low negative

Affected Resource	Past Actions	Present Actions	Reasonable Foreseeable Future Actions	Past, Present, and Reasonably Foreseeable Future Actions
	negligible positive) depending on species, due to land use and development, past fishery, hatcheries, and habitat management practices	negligible positive) depending on species	depending on species	depending on species
Wildlife	Mixed (negligible to low negative, to low positive) due to habitat degradation and hatchery-origin salmon and steelhead as a food source	Low positive	Negligible to low positive	Low positive
Socioeconomics	Moderate positive from benefits to recreational fisheries and tribal fisheries, although some have been reduced in recent years as numbers of fish available to harvest have declined	Low positive due to declines in harvest opportunities	Low positive	Low positive
Environmental Justice	Low to moderate negative due to reductions in fish available for use by	Low negative to low positive	Negligible negative	Low negative

Affected Resource	Past Actions	Present Actions	Reasonable Foreseeable Future Actions	Past, Present, and Reasonably Foreseeable Future Actions
	communities of concern and populations of concern such as treaty Indian tribes			

Table 33. Summary of the cumulative effects of Alternative 2, Proposed Action/Preferred Alternative.

Affected Resource	Baseline	Past, Present, and Reasonably Foreseeable Future Actions	Proposed Action	Cumulative Effects of the Proposed Action
Water Quantity	Mixed (negligible negative to negligible positive)	Low negative	Negligible negative	None
Water Quality	Moderate	Moderate	Moderate	Moderate
Salmon and Steelhead and Their Habitat	Mixed (negligible to moderate negative, to low positive) due to ESA compliance and improved fishery, hatchery, habitat management practices, and habitat restoration,	Mixed (moderate negative to low positive), depending on population	Negligible negative	None

Affected Resource	Baseline	Past, Present, and Reasonably Foreseeable Future Actions	Proposed Action	Cumulative Effects of the Proposed Action
	depending on population			
Other Fish and Their Habitats	Mixed (negligible negative to negligible positive) depending on species	Negligible to low negative depending on species	Mixed (negligible negative to negligible positive) depending on species	None
Wildlife	Low negative	Low positive	Negligible positive	None
Socioeconomics	Moderate positive	Low positive	Moderate positive	None
Environmental Justice	Low negative to low positive	Low negative	Negligible positive	None

6. LIST OF PERSONS AND AGENCIES CONTACTED AND CONSULTED

The following were consulted during the development and assessment described herein:

- Bonneville Power Administration
- Burns-Paiute Tribe
- Environmental Protection Agency
- Grande Ronde Tribe
- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife
- U.S. Army Corps of Engineers
- U.S. Fish and Wildlife Service
- U.S. Forest Service

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8. DISTRIBUTION LIST

State Agencies

- Oregon Department of Environmental Quality
- Oregon Department of Fish and Wildlife

Federal Agencies

- Army Corps of Engineers
- Bonneville Power Administration
- Bureau of Land Management
- Environmental Protection Agency
- Forest Service

Native American Tribes in Oregon

- Burns Paiute Tribe
- Columbia River Inter-Tribal Fish Commission
- The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians
- The Confederated Tribes of Grand Ronde
- Confederated Tribes of Siletz Indians
- Confederated Tribes of the Umatilla Indian Reservation
- Confederated Tribes of the Warm Springs Reservation of Oregon
- Coquille Indian Tribe
- Cow Creek Band of Umpqua Tribe of Indians
- The Klamath Tribe

Organizations and Associations

- Coastal Conservation Association
- Conservation Angler
- McKenzie River Flyfishers
- McKenzie River Guides Association
- Native Fish Society
- Northwest Sportfishing Industry Association
- Trout Unlimited

Individuals

(An extensive distribution list of individuals were notified by email that contained an electronic link to the EIS.)

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11. APPENDIX A

Table 1. List of the HGMPs and primary hatchery facility under consideration in this EIS.

Hatchery Program	Hatchery Facility (primary)	HGMP Reference
North Santiam Spring Chinook Salmon	Marion Forks	ODFW 2016
South Santiam Spring Chinook Salmon	South Santiam	ODFW 2016
McKenzie Spring Chinook Salmon	McKenzie	ODFW 2016
Middle Fork Willamette Spring Chinook Salmon	Willamette	ODFW 2016
Upper Willamette Summer Steelhead	South Santiam	ODFW 2017; ODFW 2018
Upper Willamette Rainbow Trout	Leaburg, Roaring River, Desert Springs	ODFW 2005; ODFW 2017; 2018

12. APPENDIX B

Data used to calculate interaction area between hatchery and natural salmon and steelhead.

River segment	Miles of river	Total Number Hatchery Fish Released	# hatchery fish/ # miles	relative density classification
Columbia	99	all hatchery fish		high
Multonomah channel	21.7	all hatchery fish		high
Willamette mainstem	174	hatchery fish accumulate downstream		high
Molalla	26.6	100,000	3,759	low
North Santiam	40.7	825,000	20,270	medium
South Santiam	35.9	1,182,500	32,939	medium
Santiam	12.3	N. and S. Santiam fish		high
McKenzie	34	712,750	20,963	medium
Middle Fork Willamette	27.2	1,733,000	63,713	high
Coast Fork Willamette	28.8	267,000	9,271	low

Total miles affected by hatchery fish	471.4
Total miles of habitat	1772
Percentage of habitat with hatchery fish	27%

13. APPENDIX C

Responses to Comments on the Draft EIS

The draft Environmental Impact Statement (EIS) was published for public review and comment in March 23, 2018 (83 FR 12753, March 23, 2018). The draft EIS was available for public review and comment until May 29, 2018 (83 FR 18554, April 27, 2018). Ten public comment letters were received. These comments were used to inform, shape, and improve this final EIS.

In the following pages, each comment letter is provided with color highlights of each comment NMFS provided responses for. After each letter are NMFS' responses to the public comments.

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Re: Comment on Upper Willamette River Hatchery DEIS

Introduction:

Wild winter steelhead and spring chinook were listed as protected species through the Endangered Species Act in 1999. The initial policy adopted by NMFS states that ESA "mandates the restoration of threatened and endangered species in their natural habitats to a level at which they can sustain themselves" (FR 58 17573). The National Marine Fisheries Service and the U.S. Fish and Wildlife Service formed a joint policy that states "controlled propagation is not a substitute for addressing factors responsible for an endangered or threatened species decline" (FR 65 56919). The new policy (FR 69 31357) states that NMFS is not precluded "from giving special recognition to naturally spawned fish." However the modified existing policy does not clearly state that self-sustaining natural populations are the first priority necessary to meet the goals of the ESA. This interpretation of recovery by NMFS provides no rationale for its reinterpretation of the ESA that de-emphasizes the conservation of natural populations because it does not unambiguously require conservation of natural populations. This interpretation is inconsistent with the interim and joint policies that make conservation the first priority. This administrative interpretation not only fails to comply with the ESA it ignores scientific information over the last 30 years to justify it. There is no biological justification supporting the belief that populations dependent on artificial propagation can be considered viable in the long term. "Although the…policy appears to de-emphasize the importance of natural populations compared to previous policies, the degree of the de-emphasis is ambiguous. This ambiguity will make interpreting and applying the policy difficult and subjective" (Varanasi and Fox 2004). #1

The glossary supplied by the UWR Hatchery DEIS does not make a clear distinction between artificially propagated and wild naturally sustaining populations of wild spring chinook and winter steelhead: "**Native fish:** Fish that are endemic to or limited to a specific region." **Natural-origin: "**A term used to describe fish that are offspring of parents that spawned in the natural environment rather than the hatchery environment, unless specifically explained otherwise in the text." "**Naturally spawning**" and similar terms refer to fish spawning in the natural environment. #2

Hatchery-origin fish: A fish that originated from a hatchery facility. **Hatchery-origin spawner:** A hatchery-origin fish that spawns naturally. **Hatchery-influenced selection:** The process whereby genetic characteristics of hatchery populations become different from their source populations as a result of selection in hatchery environments (also referred to as domestication).

These definitions conflate hatchery and wild naturally spawning salmon and steelhead because there is no distinction between the two forms in the definition of naturally spawning fish. Therefore hatchery fish affected by "hatchery-influenced selection" or "domestication selection," caused by the hatchery environment, can spawn naturally and in

the first generation be defined as a "hatchery-origin spawner, but in the second generation it becomes a natural origin spawner. The interbreeding between natural and hatchery origin spawners influences genetic and phenotypic traits in the offspring causing the reproductive success of the paired mating to be less viable in terms of survival and reproductive success (Araki et al. 2009; Chilcote 2011. But domesticated hatchery produced offspring survive and can spawn naturally which is the stated purpose of hatchery supplementation. Returning progeny of hatchery-origin spawners can spawn with natural-origin (wild) fish and cause reduced survival in the resulting progeny Blouin 2009; Chilcote 1986, 2002). Therefore, the proposed UWR Hatchery DEIS assumes that all naturally spawning fish are equal if not the same in genetic and phenotypic diversity, reproductive success and survival. By making the assumption that all naturally spawning fish regardless of their pedigree are the same contributes to the eventual replacement of wild salmon and steelhead with generations of hatchery origin fish. This inherit ambiguity will make interpreting and applying the UWR Hatchery DEIS policy difficult and subjective. By definition, any reference to wild salmon and steelhead has been removed so that all naturally spawning populations are defined the same regardless of their origin.

Just in case you were curious some, I've collected some sayings from those I spoke of afore.

Chilcote et al. 1986: "The success of hatchery fish in producing smolt offspring was only 28% of that for wild fish. We also found that 62% of the naturally produced summer-run smolts were offspring of hatchery spawners. Their dominance occurred because hatchery spawners within the watershed we examined effectively outnumbered wild spawners by at least 4 .5 to 1. We suggest that, under such conditions, the genetic integrity of wild populations may be threatened."

Chilcote 2002: "Based upon a multiple regression analysis, recruitment and productivity in 12 naturally reproducing populations of Oregon steelhead were found to be significantly influenced by four variables, one of which was the level of hatchery fish in the spawning population. It appeared that the presence of hatchery fish depressed overall population productivity, reduced the number of recruits, and lowered the fitness of wild fish. This negative effect was insensitive to the type of hatchery fish. Although hatchery fish represented in five of the study populations were from hatchery broodstocks developed from local wild populations and managed in a manner to avoid domestication, the advantages of this strategy were not apparent. The negative effect of hatchery fish on natural production was not trivial."

Araki et al 2009: "The F2 individuals compared in the study were all born in the same river, presumably experienced the same environment, and spawned in the river in the same year. Thus, genetic differentiation during captive breeding in the previous generation is most likely responsible for the reduced fitness of wild-born fish from hatchery parents. A strong genetic effect of captive breeding is consistent with the results of previous studies (Araki et al. 2007, 2008). However, this study also suggests a carry-over effect of the captive breeding, which reduces the reproductive fitness of wild-born descendants in the wild and the population fitness of subsequent generations."

Blouin 2009: "If anyone ever had any doubts about the genetic differences between hatchery and wild fish, the data are now pretty clear. The effect is so strong that it carries over into the first wild-born generation. Even if fish are born in the wild and survive to reproduce, those adults that had hatchery parents still produce substantially fewer surviving offspring than those with wild parents."

"The implication is that hatchery salmonids – many of which do survive to reproduce in the wild– could be gradually reducing the fitness of the wild populations with which they interbreed. Those hatchery fish provide one more hurdle to overcome in the goal of sustaining wild runs, along with problems caused by dams, loss or degradation of habitat, pollution, overfishing and other causes. Aside from weakening the wild gene pool, the release of captive-bred fish also raises the risk of introducing diseases and increasing competition for limited resources."

"There is about a 40% loss in reproductive fitness for each generation spent in a hatchery."

Alternative 2 (preferred alternative) of the UWR Hatchery DEIS proposes to adopt Limit 5 of the 4(d) rule to bring wild winter steelhead into artificial propagation. This action will cause genetic, phenotypic, and ecological, survival and reproductive impacts for threaten ESA protected wild winter steelhead.

Proposed Alternatives and Related Issues:

The following general summaries of proposed alternatives is provided for reference. My comments will refer to these proposed alternatives.

Alternative 1: "The co-managers could choose to continue to operate the existing hatchery programs under status quo conditions and not incorporate natural-origin fish into the hatchery broodstocks. Continue to release non-native hatchery summer steelhead even though ODFW and NMFS recognize there are genetic and ecological impacts and risks for threatened wild winter steelhead."

Issue: This alternative continues the status quo management impacts on ESA-protected UWR since wild spring chinook and wild winter steelhead. After 19 years NMS and ODFW have finally documented genetic and ecological threats to ESA-protected species in the UWR and can no longer ignore over 30 years of scientific evidence that artificially propagated fish have an impact on wild salmon and steelhead, so this alternative can no longer be justified. Since this alternative does not protect ESA-listed species, it is no longer justified because it does not include hatchery production of wild winter steelhead. #3

Alternative 2

(Proposed Action/Preferred Alternative)

For spring Chinook salmon, integration of natural-origin salmon into hatchery increases demographic risk by reducing spawning abundances, but benefit from reduced genetic domestication effects of hatchery fish.

For summer steelhead and rainbow trout, overall same as Alternative 1:

Summer Steelhead Programs:

Benefits include fishery harvest opportunities. Risks include: genetic impacts (out of DPS), predation, and competition.

Rainbow Trout Programs:

Benefits include fishery harvest opportunities. Risks include: predation and competition, disease transfer, increased exploitation of natural-origin salmon and steelhead.

Issues: This alternative includes adoption of Limit 5 of the 4(d) that would initiate a hatchery program for winter steelhead and is therefore the preferred alternative. However even though impacts from resident trout programs and non-native summer steelhead on ESA-protected wild spring chinook and winter steelhead are recognized those programs are too important for the revenue they provide ODFW and will continue. This alternative will expand the hatchery program but provide no scientific evaluation to define the impact of HGMPs on ESA-listed fish in the natural environment saying without evidence: "including natural-origin broodstock would reduce the genetic risks associated with the current operation of the hatcheries." (page 127) The alternative provides no scientific evaluation of the expanded hatchery program on wild spring chinook and winter steelhead authorized by the Limit 5 of the 4(d) rule, saying only impacts will be "minimized" without defining how it will be done in a scientific credible way based on measurable criteria. #4

Alternative 2 (Preferred Alternative) For threatened wild spring chinook: This alternative proposes a "hatchery integration program of natural-origin salmon that would increase demographic risk by reducing spawning abundances, but benefit from reduced genetic domestication effects of hatchery fish." The best scientific information

available for over 30 years does not support hatchery integration of wild and hatchery fish or developing wild broodstock programs because of reduced survival and reproductive success of natural spawners. Increasing demographic risk by cultivating selective pressure on native wild and threatened spring chinook salmon. The NMFS proposal will increase demographic risk as well as changes in genetic, phenotypic diversity by relying on artificial propagation for production of spring chinook. This approach, using hatcheries, will only further degrade and eventually replace wild threatened spring chinook with hatchery origin fish. A recommended alternative is to establish adult spawner escapement and egg deposition criteria (not goals) for each wild population by watershed in the UWR. Harvest management would be controlled on all approach fisheries to achieve these criteria. Without escapement and egg deposition criteria by wild population and watershed, recovery of threatened wild spring chinook is impossible. This means that Alternative 2 will not achieve ESA required recovery of threatened wild spring chinook. #5

Using hatchery propagated spring chinook for supplementation does not work even when the source is from native wild broodstock. The accumulated scientific evaluation of this practice has provides evidence of its failure ((Bryne et al 1992; Byrne and Copeland 2012; Ford 2010; Lynch and O'Hely 2001, Miller WH 1990; Miller LM 2014; Naish et al 2008). The most recent evidence was established by the Idaho Supplementation Study where following the termination of hatchery supplementation the treatment populations returned to pre-hatchery abundance.

The legal and scientific purpose for recovery of wild salmon and steelhead protected as threatened species cannot be achieved through artificial propagation. This technology has been applied for over 80 years in the UWR basin and the result has been continued decline in wild spring chinook abundance and resulting to their protection through the ESA. Continuing to apply the same technology to salmon and steelhead recovery has failed to rebuild the wild salmonids and runs counter to the purpose of the ESA. The NMFS own SW and NW Science Centers have said: "Evolutionary models predict that domestication and loss of productivity in the wild are expected to occur in populations that are supplemented for long periods of time. In the long-term, therefore, even use of local stocks to supplement natural populations has the potential to lead to declines in natural productivity and natural origin abundance (Varansi and Fox (2004). Consequently, the preferred Alternative 2 is deeply flawed, ignores the science, and continues jeopardize protected wild spring chinook and winter steelhead in the UWR basin. #6

Alternative 3

(Reduce Hatchery Production to Reintroduction Needs)

For the spring Chinook salmon program, a benefit would be that domestication effects would be reduced by having smaller program and higher integration of natural-origin broodstock compared to No-action alternative. However, fishery harvest opportunities would be reduced compared to No-action alternative.

The summer steelhead program would be changed to a reintroduction program for winter steelhead. This would benefit winter steelhead because out-of-DPS genetic effects would be eliminated compared to No-action alternative. Other benefits would include increased spawning abundances of winter steelhead, increase marine derived nutrients. Risks would include domestication effects, predation, and competition.

The rainbow trout program would be eliminated under this alternative because there are no conservation benefits of this program to salmon and steelhead.

This alternative warns that reduction in hatchery releases would reduce harvest opportunities. The mission of NMFS is to protect and recover ESA protected species not maintain the state's harvest agenda. Alternative 3 is constructed to purposely promote rejection of the alternative by user groups, creating a conflict between conservation of a threatened species and harvest. #7

The DEIS states: "Domestication effects of hatchery rearing would be reduced by integration of hatchery and wild chinook in the hatchery program." However, scientific evidence points out that even using wild broodstock hatchery program results in lower survival of adults and reduced reproductive success in naturally spawning hatchery product (Araki et al. 2007, 2008, 2009; Araki and Schmid 2010; Blouin 2009, 2012; Chilcote 2013). #8

Supplementation with integrated hatchery-wild fish can reduce the reproductive success of wild fish according to extensive scientific evidence the most recent being the Idaho Supplementation Study. Using integrated hatchery chinook and steelhead for translocation above high dams may initiate a new spawning population but continued hatchery supplementation will not allow this new population to become self-sustaining (Bryne et al 1992; Bryne and Copeland 2012; Ford 2010; Lynch and O'Hely 2001, Miller WH 1990; Miller LM 2014; Naish et al 2008). A whole new set of complex problems develop as managers attempt to identify returning adults from integrated releases for passage above the dam and to not mine the existing wild run below the dam for eggs, potentially causing their extinction.

By maintaining a high pHOS below the dams will only contribute to genetic impacts on the wild population and undermine the survival and productivity of the proposed integrated hatchery stock used to re-introduce a population above the dams.

Eliminating the hatchery summer steelhead program would reduce genetic (Johnson et al. 2013) and ecological effects (Harnish et al. 2014) that are now contributing to the decline rather than recovery of wild threatened winter steelhead. The NMFS mission is to effectively implement the purpose of the ESA to recover protected threatened species including threatened wild winter steelhead in the UWR. This Alternative 3 for threatened wild winter steelhead is consistent with the NMFS authority and mission. Therefore it should be implemented. #9

However, translocation of wild winter steelhead will introduce problems identified for chinook (above) and may even contribute to the continued decline and potential extinction of threatened wild winter steelhead below the dams.

Issue: Alternative 3 is fake alternative because it would have an impact on fisheries and revenue generated by those fisheries important to ODFW. The summer steelhead program is not required but potentially would be eliminated in exchange for a hatchery program for winter steelhead that would initiate new hatchery impacts on ESA-listed winter steelhead. #10

Alternative 4

(Terminate the Existing Hatchery Programs in the Upper Willamette River Basin)

For spring Chinook, salmon, demographic risks would increase because population viability would decrease in populations where hatchery program would be eliminated compared to No-action alternative from not having hatchery Chinook salmon spawning in the wild. However, the genetic risk would decrease compared to the No-action and preferred alternative.

For winter steelhead, a benefit would be that population viability may increase from the elimination of genetic effects in populations where summer steelhead releases would be terminated in the North Santiam and South Santiam rivers.

For the rainbow trout program, spring Chinook salmon and winter steelhead competition/predation risks would decrease from termination of releases. Catch and release mortality effects may increase on salmon and steelhead from termination of harvestable trout stockings.

Alternative 4 (Terminate Hatcheries) the DEIS states: "For spring Chinook, salmon, demographic risks would increase because population viability would decrease in populations where hatchery program would be eliminated compared to No-action alternative from not having hatchery Chinook salmon spawning in the wild."

That is a confusing statement. In the Glossary viability is defined: "As used in this EIS, a measure of the status of listed salmon and steelhead that uses four criteria: abundance, productivity, spatial distribution, and diversity." Viability was defined by McElhany et al. (2000) to apply only to wild populations not mixed hatchery and wild populations (Varansi and Fox 2004). So the term is redefined to fit this DEIS purpose and is a departure from the accepted definition used by NMFS. In addition, the peer reviewed scientific literature does not support the use of the term used in this EIS. #11

Varansi and Fox (2004) "Evolutionary models predict that domestication and loss of productivity in the wild are expected to occur in populations that are supplemented for long periods of time. In the long-term, therefore, even use of local stocks to supplement natural populations has the potential to lead to declines in natural productivity and natural origin abundance.

"…conservation strategies that rely heavily on hatchery production as a substitute for conservation of natural populations and ecosystems are far less likely to conserve diversity than strategies that conserve viable natural populations and natural ecosystems. For example, it is effectively impossible to create a sufficient number of hatchery stocks to replicate the thousands of genetically varying natural spawning populations that exist (or existed) naturally.

"We point out, however, that many of the hatchery reform efforts underway will require the existence of healthy natural populations in order to be effective."

Chilcote et al 2013 states: "We found a negative relationship between the reproductive performance in natural populations of steelhead, coho, and Chinook salmon and the proportion of hatchery fish in the spawning population. We used intrinsic productivity as estimated from fitting a variety of recruitment models to abundance data for each population as our indicator of reproductive performance. The magnitude of this negative relationship is such that we predict the recruitment performance for a population comprised entirely of hatchery fish would be 0.128 of that for a population comprised entirely of wild fish. The effect of hatchery fish was the same among all three species. Further, the impact of hatchery fish from 'wild type' hatchery broodstocks was no less adverse than hatchery fish from traditional, domesticated broodstocks. We also found no support for the hypothesis that a population's productivity was affected by the length of exposure to hatchery fish. In most cases, measures that minimize the interactions between wild and hatchery fish will be the best long-term conservation strategy for wild populations."

Also in Alternative 4 the DEIS uses the term "demographic risk" saying that it would increase without hatchery fish spawning in the wild. According to Ford (2001) "abundance level below which demographic, genetic, and other risk factors to the populations become of increasing concern, and uncertainties in production response become magnified. These levels (one for each population) were determined primarily from the lower end of the spawning abundances exhibited by the Upper Columbia populations during the time period when they were considered to be relatively healthy. We set the cautionary abundance levels for the Wenatchee, Entiat, and Methow River spring chinook salmon populations to be 1200, 150, and 750 spawners per year, respectively. In order be considered recovered, a population must have a geometric mean NRR significantly greater than 1.0. This means that in order to be considered recovered, the populations must be growing. In the long term (after recovery is complete), a stable population without hatchery straying is expected to have a geometric mean NRR of 1.0.

It is clear from NMFS scientists and others that low viability and demographic risk is increased in a wild threatened population managed for recovery when naturally spawning hatchery fish are included in the breeding population. Therefore the DEIS presents information to the public for review and an alternative that is not supported by the best available science including NMFS scientists. #12

In Alternative 4 "For winter steelhead, a benefit would be that population viability may increase from the elimination of genetic effects in populations where summer steelhead releases would be terminated in the North Santiam and South Santiam rivers.

That is a true statement but non-native hatchery summer steelhead also have ecological effects on wild threatened winter steelhead (Harnish et al. 2018) evaluated the impact of residualized non-native summer steelhead on wild threatened winter steelhead and found: that 23,616 residual hatchery summer steelhead residualized in the Santiam River. Hatchery summer steelhead dominated 16 of 19 (84%) of the interactions. 61.7% of all interactions observed were initiated by hatchery steelhead, hatchery steelhead initiated more aggressive interactions than wild steelhead, concluding that "residualization is a problem in the South Santiam River due to the large numbers of residual hatchery summer steelhead observed." To compensate for this problem the ODFW encouraged anglers to fish for trout in the river for ad-clipped juvenile steelhead (non-native hatchery summer steelhead). However, the ODFW ignored the impact on rearing juvenile wild threatened winter steelhead in this promoted fishery. ODFW has long standing policy of not releasing hatchery trout in anadromous streams to protect wild juvenile salmon and steelhead, but this new fishery ignored this policy. Research in Idaho shows that wild steelhead contributed more to the recreational fishery than did stocked hatchery trout. The wild fish are more aggressing and the fishery encounter rate was greater for wild steelhead juveniles (Pollard and Bjornn 1973). Therefore, the ODFW was encouraging a fishery that would cause an unquantified mortality on juvenile wild winter steelhead in an attempt to reduce the residualism impacts of their hatchery summer steelhead program. #13

Issue: Alternative 4 is the most protective of ESA-listed wild spring chinook and winter steelhead but would cause a reduction in fisheries and revenue collected by ODFW from license sales and operation of hatcheries. This is another fake alternative in the NMFS Hatchery DEIS. #14

Alternative 5

Increase Hatchery Production to Support Fisheries Consistent with ESA Impact Limits

Under Alternative 5, the co-managers would increase hatchery production to the extent possible using existing hatchery facility capacities and existing water rights. The increased hatchery production would allow for increased harvest opportunities on hatchery produced fish in recreational and commercial fisheries in the ocean and freshwater.

Even though the intent of increasing the number of fish released is to increase the opportunity to harvest more fish, it is likely that a larger percentage of hatchery spring Chinook salmon would be interacting with natural-origin fish on the spawning grounds. would make it more difficult to meet the long-term pHOS goals… likely increase competition with natural-origin juveniles. #15

For steelhead an increase in the number of summer steelhead released in the UWR would most likely increase the concerns and risks associated with the current hatchery program… increase pHOS and subsequent interbreeding with winter steelhead, potentially lowering productivity, genetic diversity, and long-term fitness…. Ecological interactions and would likely increase, further negatively affecting productivity of winter steelhead. Increases in releases of summer steelhead would likely reduce the viability of the UWR winter steelhead DPS.

Issue: Alternative 5 recognizes the risk to wild threatened spring chinook and steelhead from the existing hatchery program and that this risk would increase hatchery production and expand risk to ESA-protected species with the adoption of this alternative. It also acknowledges a biological limit to management of these populations to increase benefits to user groups. This is another fake alternative that if adopted would even cause the NMFS and ODFW difficulty to justify but it does remind the consumptive user groups that they were not forgotten.

Summary: The alternatives have been selected to drive reviews to Alternative 2 (Preferred Alternative) as the only choice because it continues and expands the hatchery program and revenue the ODFW gets for hatchery operations and fisheries. The purpose is directed toward an economic rather than an ecological purpose of salmon and steelhead management for fishery user groups rather than conservation, protection and recovery of wild salmon and steelhead. Thus, the public trust obligation by government is not being served and recovery of ESA-protected wild populations are not the measure of success. #16

Except for Alternative 3 all other alternatives increase genetic and ecological impacts on ESA-protected species even though this has made little difference in other ESA protected populations throughout the entire Columbia River basin, indicating that the risks to protected species is not an important legal concern for NMFS and ODFW's conservation policy.

Since wild winter steelhead and wild spring chinook are protected threatened species through the ESA, it is the legal obligation of the NMFS to select actions that promote the recovery of these threatened species. Alternatives that include hatchery programs increase risk to these populations therefore under the ESA protected species will not be recovered. ESA-protected wild winter steelhead have been listed for 19 years and five generations and are continuing to decline. Additional risk imposed by Limit 5 of the 4(d) rule would only contribute to their decline. ESA-protected spring chinook are exposed to artificial propagation and these animals have not shown they can be recovered in the 19 years since listed as a threatened species.

Some Historical Notes on the Hatchery Solution:

"The water resource developments of the Willamette basin had their beginnings in an act of Congress passed June 28, 1938" (Staley 1983)

"Even at this late date the hatcheries had not proven their worth to biologists and conservationists. Many felt the complacent confidence of fishermen, laymen, and administrators in the ability of artificial propagation to counterbalance the inroads of civilization was a serious stumbling block to the development of proper conservation programs" (Rich 1941). To the water development agencies of the Federal government, however, fish culture was a boon" (Staley 1983).

Wild spring chinook have been exposed to hatchery propagation in the upper Willamette River since Willamette Hatchery was converted from an egg mining station, established in 1911, to supply eggs for the Central Hatchery (Bonneville Hatchery) and Klatskanine Hatchery. In 1919 the hatchery began producing spring chinook for the Middle Fork Willamette for the last 99 years (Wallis 1962). Wild spring chinook have declined in the UWR since then. While recognizing all the problems facing both wild winter steelhead and spring chinook in the Willamette Basin, the extensive hatchery programs have not improved their abundance nor prevented their eventual protection through the ESA. Therefore, hatcheries, based on at least the last 30 years of scientific evaluation, are not likely to contribute to their recovery. #17

The Molalla River one of two rivers without dams in the UWR and according to habitat surveys had the capacity to produce 5,000 wild spring chinook (Parkhurst et al. 1950). However, ODFW transferred hatchery spring chinook, releasing 100,000 smolts per year from the South Santiam River Hatchery even though a small run of wild spring chinook was still found in this river they are now extinct (NOAA 2004). The ODFW had no interest in protecting the wild spring chinook in the Molalla even though there was public support to do so and used it as a dump for non-native hatchery fish to provide some unquantified fishery benefit. The Molalla is an example how the state and federal fishery agencies have favored hatcheries to support fisheries rather than wild spring chinook protection and recovery. #18

The history of using hatcheries to benefit fisheries and at the same time claiming an unproven conservation benefit for wild salmon and steelhead is a standard ruse perpetuated by state and federal fishery managers even after ESA protection throughout the region.

Wild self-sustaining salmon and steelhead is the recovery goal for ESA-protected fish in the UWR. These fish are recognized as important by the ODFW's Native Fish Conservation Policy (2003). This policy states:

"*The purpose of this policy is to ensure the conservation and recovery of native fish in Oregon. The policy focuses on naturally produced native fish. This focus is because naturally produced native fish are the primary basis for Endangered Species Act delisting decisions and the foundation for long-term sustainability of native species and*

hatchery program. Therefore, conservation of naturally produced native fish species in the geographical areas to which they are indigenous is the Department's principle obligation for fish management."

Hatchery and Wild Salmonids have Distinctly Different Management Criteria

Hatchery salmon and steelhead are managed to achieve an adult spawner target and fisheries have been suspended to achieve those targets. This is considered necessary in order to achieve the egg take criteria for each hatchery program and if the egg take criteria is not achieved, eggs from other hatcheries in other rivers and stocks are transferred to make up the deficit. The history of each hatchery program is to fill its production capacity regardless of impacts on fisheries or concern for mixing fish among rivers and protection of affected wild populations. #19

This problem has not been recognized by NMFS and the state fishery agencies in their recovery policy for wild threatened fish. The reason for this unequal treatment of wild salmonids was initiated 143 years ago when it was claimed that hatcheries made fishery regulation and habitat protection obsolete (Baird 1875). This concept of management has persisted so that salmon and steelhead are managed for economic benefits rather than by ecological criteria that would sustain their productivity and abundance.

Preventing interbreeding between hatchery and wild fish and regulation of harvest to achieve adult escapement and egg deposition criteria for each wild steelhead and spring chinook by spawning area or tributary is a requirement for recovery. Only in this way can NMFS secure a recovery program for federally listed threatened species.

The history of hatchery production to increase production of salmon and steelhead for harvest predates the construction of federal dams in the UWR. The spawning tributaries were racked to capture adults and eggs were exported to the Central Hatchery (now Bonneville Hatchery) for release into the Columbia River, effectively mining the UWR wild spring chinook of eggs needed to maintain these populations. Since dam construction promoted by the State of Oregon, hatcheries in the UWR were used to promote harvest and license sales for the state fishery agency. For example, the reason that the state fishery agency introduced non-native and non-ESU hatchery summer steelhead to the UWR was to expand the recreational fishery. This action was done even though the agency recognized, based on the best available science, that hatchery summer steelhead would cause genetic and ecological damage to wild winter steelhead. Likewise, the state fishery agency introduced non-native coho salmon and fall chinook into the UWR to increase harvest and license sales. Non-native winter steelhead from the lower Columbia River (Big Creek Hatchery) were introduced to benefit harvest and license sales. All this was completed without regard to the conservation and protection of wild winter steelhead in the UWR. #20

The actions of the state fishery agency were taken to increase harvest opportunity while ignoring the impacts on native wild winter steelhead and spring chinook in the UWR. The NMFS however has a distinct and different mission to protect and recover wild salmon and steelhead. Most alternatives under the NMFS Hatchery DEIS 2018, including the Preferred Alternative, include harvest and artificial propagation decisions by the state fishery management agency. NMFS is under no obligation, legal or otherwise, to be including the state agency decisions that continue to degrade and jeopardize ESA protected wild salmon and steelhead in the UWR.

Alternative 2 (Preferred Alternative) For threatened wild spring chinook: This alternative proposes a hatchery integration program of natural-origin salmon that would increase demographic risk by reducing spawning abundances, but benefit from reduced genetic domestication effects of hatchery fish. The best scientific information available for over 30 years does not support hatchery integration of wild and hatchery fish or developing wild broodstock programs because of reduced survival and reproductive success of natural spawners. Increasing demographic risk by cultivating a downward selective pressure on native wild and threatened spring chinook salmon. The NMFS proposal will increase demographic risk as well as changes in genetic, phenotypic diversity by relying on artificial propagation for production of spring chinook. This approach, using hatcheries, will only further degrade and eventually replace wild threatened spring chinook with hatchery origin fish. A recommended alternative is to establish adult spawner escapement and egg deposition criteria (not goals) for each wild population by watershed in the UWR. Harvest management would be controlled on all approach fisheries to achieve these #21

criteria. Without escapement and egg deposition criteria by wild population and watershed, recovery of threatened wild spring chinook is impossible. This means that Alternative 2 will not achieve ESA required recovery of threatened wild spring chinook.

Using hatchery propagated spring chinook for supplementation does not work even when the source is from native wild broodstock. The accumulated scientific evaluation of this practice provides evidence of its failure ((Byrne et al 1992; Byrne and Copeland 2012; Ford 2010; Lynch and O'Hely 2001; Miller WH 1990; Miller LM 2014; Naish et al 2008). The most recent evidence was established by the Idaho Supplementation Study where following the termination of hatchery supplementation the treatment populations returned to pre-hatchery abundance. #22

The legal and scientific purpose for recovery of wild salmon and steelhead protected as threatened species cannot be achieved through artificial propagation. This technology has been applied for over 80 years in the UWR basin and the result has been continued decline in wild spring chinook abundance and their protection through the ESA. Continuing to apply the same technology to salmon and steelhead recovery has failed to rebuild the wild salmonids and runs counter to the purpose of the ESA. The NMFS own SW and NW Science Centers have said: "Evolutionary models predict that domestication and loss of productivity in the wild are expected to occur in populations that are supplemented for long periods of time. In the long-term, therefore, even use of local stocks to supplement natural populations has the potential to lead to declines in natural productivity and natural origin abundance (Varansi and Fox (2004). Consequently, the preferred Alternative 2 is deeply flawed, ignores the science, and continues jeopardize protected wild spring chinook in the UWR basin.

Issues Related to the Limit 5 of the 4(d) rule and HGMPs.

1.5.3. Biological Opinion on NMFS's Determination as to Compliance with the 4(d) Rule

"ESA section 7(a) (2) provides that any action authorized, funded, or carried out by a Federal agency shall not jeopardize the continued existence of any endangered or threatened species or result in the adverse modification or destruction of designated critical habitat."

Alternative 1 Comment: The co-managers could choose to continue to operate the existing hatchery programs under status quo conditions and not incorporate natural-origin fish into the hatchery broodstocks. Continue to release non-native hatchery summer steelhead even though ODFW and NMFS recognize there are genetic and ecological impacts and risks for threatened wild winter steelhead. #23

Alternative 2: (Preferred Alternative) Comment: "Under this alternative, NMFS would approve the recently submitted HGMPs for spring Chinook salmon by issuing an approval letter to the co-managers under limit 5 of the 4(d) Rule.

"In addition, there are three other potential actions being evaluated as part of the proposed action: 1) initiation of a supplementation program for spring Chinook in the Calapooia River using adult hatchery spring Chinook salmon, 2) outplanting of adult winter steelhead above Mercer Dam on Rickreal Creek, and 3) initiation of a conservation hatchery program for winter steelhead in the North and South Santiam rivers for reintroduction above Corps dams, using natural-origin wild ESA-protected winter steelhead.

"Best management practices (BMPs) are defined as protocols for the operation of hatchery facilities and hatchery programs to appropriately meet the objectives of the hatchery program, including minimizing impacts on ESA-listed fish (IHOT 1995; HSRG 2004; Mobrand et al. 2005)."

All BMP and HGMP practices listed are confined to the hatchery environment and do not address the impacts of hatchery fish on the wild ESA-listed fish outside the hatchery fence, therefore, the protocols ingrained in the HGMPs do not address "minimizing impacts on ESA-listed fish." The term minimizing impacts and how to do it is not defined and is used routinely by fishery managers. To minimize impacts means zero impacts. If impacts exist they cannot be minimized unless the actual impacts are identified, evaluated and limits are placed on those impacts #24

so they are resolved in favor of threatened spring chinook and winter steelhead recovery and not affected by the hatchery program in the natural environment.

Impacts of hatchery fish in the natural environment beyond the hatchery fence on wild threatened salmon and steelhead take numerous forms from predation, predator attraction, harvest related mortality, genetic and ecological impacts to name a few. All of these impacts and others need to be evaluated to determine whether each and all impacts are jeopardizing ESA-listed salmon and steelhead. The preferred alternative (Alternative 2) does not establish a scientific basis to determine whether hatchery fish releases and fisheries "minimize" impacts on protected threatened species.

Proportion of Naturally Spawning Hatchery Steelhead and Chinook with Wild Populations (pHOS):

The joint NMFS and ODFW UWR Recovery Plan (2011) concludes the following regarding pHOS: "We concur with the WLC-TRT that viable populations would have low hatchery genetic influence, and based on the guidelines for the proportion of hatchery fish spawning with wild fish (pHOS) in McElhany et al. (2007) we have adopted the following levels for the pHOS: If the overall desired status goal for a population is low risk or very low risk, then in addition to meeting the abundance and productivity targets for this designation, the diversity target is achieving an average pHOS of ≤10%, regardless of their spawn timing. Likewise, if the recovery goal risk category for a population is 'moderate' then the target average pHOS is ≤ 30%." (Page 6-6)

"Because most of the populations are proposed to be deliberately managed with split subbasin goals (mitigation production emphasis below mainstem barriers, wild fish management focus above mainstem barriers), average subbasin pHOS goals may eventually be achieved by having low pHOS above barriers, with greater levels in mitigation zones, but NMFS and ODFW should continue to study the adverse effects of high pHOS below the dams on natural productivity of each population. (Page 6-20)

"Ultimately, NMFS and ODFW think that the proposed hatchery pHOS at different extinction risk level goals (i.e., 30% for moderate risk, and 10% for low or very low risk, respectively, for within-ESU hatchery fish) are feasible for most populations, and when combined with other threat reductions outlined in the threat reduction scenarios, will contribute to fulfill delisting and broad sense recovery goals." (Page 6-20)

The agreement reached by NMFS and ODFW in 2011 is incorporated in the UWR Hatchery DEIS. Naturally spawning hatchery salmon and steelhead impose genetic and ecological risk to wild threatened fish at any level above zero. However, to continue the existing hatchery program affecting the viability of threatened wild spring chinook and winter steelhead, some level of risk is required. Missing is the evaluation program that verifies the assumption that some level of risk from naturally spawning hatchery fish actually supports recovery, recognizing that the hatchery program increases relative reproductive success, survival and contributes to genetic and ecological impacts on wild ESA-protected fish. Actual achievement of low risk is an average pHOS of <10%. This means that #25 risk levels of pHOS will fluctuate as if the impacts affect just one generation of species with multiple generations spawning in any one year. Therefore, pHOS will be higher than stated because it is an average. The pHOS level is not planned to be achieved below the dams in the hatchery mitigation management areas but may be achieved with successful reintroduction of wild salmon and steelhead above the dams. Therefore, pHOS will remain high below the dams so that the hatchery program can remain unchanged. Establishment of wild salmon and steelhead above the dams is uncertain at best and will depend initially on 100% hatchery fish for reintroduction (Alternative 2). In the meantime, the pHOS below the dams will continue to be a risk to wild ESA threatened spring chinook and winter steelhead and recovery will depend on future uncertain success of reintroduction above the dams. This planned rationale to escape recovery of threatened wild spring chinook and winter steelhead is both inventive and impressive, because it takes a lot of planned deception to make such a logical and unfounded argument.

An example of NMFS and ODFW failure to apply verifiable pHOS limits on hatchery spawners to protect ESA-threatened chinook and coho can be found in the lower Columbia River. Dr. Luikart in his declaration (2016) regarding impacts of hatchery operations in the lower Columbia River said, "the high proportion of hatchery origin

spawners (pHOS) in the Chinook and coho salmon populations in the lower Columbia River evolutionary significant unit (LCR ESU) will likely cause long lasting harm to those populations. Furthermore, the recovery objectives for the Chinook and coho salmon populations in the LCR ESU will not likely be achieved unless the currently high rates of straying by hatchery fish from isolated (segregated) hatchery programs is reduced to less than 5% to 10%, as recommended by the Hatchery Science Review Group (HSRG 2009). The percentage of hatchery origin fish on the wild spawning grounds is far greater than 10% in many of the populations of Chinook and coho, which constitutes a significant threat to the recovery of the entire ESU for each species. Reducing straying in all "primary" and "contributing" populations to 5% and 10%, respectively, will be helpful but potentially inadequate to protect against adverse genetic effects of hatchery fish in the extant wild Fall Chinook (and coho) populations in the LCR. At the very least, the pHOS (proportion of hatchery-origin spawners) in all primary and contributing populations should be rapidly brought into compliance with the standard 5% to 10% that has been recommended by NMFS (the National Marine Fisheries Service) and the HSRG (Hatchery Scientific Review Group)."

The NMFS Fisheries Science Center (1997) expert panel of scientists concluded: "The panel found no genetic justification for allowing gene flow from non-native fish at levels as high as 5%."

While Dr. Luikart addressed segregated hatchery populations, research conducted by Araki et al. 2007, 2008, 2009, 2010; Blouin 2003, 2009, and Chilcote et al. 2013 addressed impacts from native broodstock (integrated) hatcheries and found first generation changes in the survival and reproductive fitness of hatchery fish. The following quotes from scientific studies provide information on hatchery impacts not addressed in the UWR Hatchery DEIS alternatives and its justification for the Limit 5 of the 4(d) rule. #26

Blouin 2009: "If anyone ever had any doubts about the genetic differences between hatchery and wild fish, the data are now pretty clear. The effect is so strong that it carries over into the first wild-born generation. Even if fish are born in the wild and survive to reproduce, those adults that had hatchery parents still produce substantially fewer surviving offspring than those with wild parents."

Chilcote 2002: "Various genetic and non-genetic explanations for these results were explored, including the consequences of reduced genetic diversity in hatchery populations as a result of having fewer families than would be found for a wild population of similar size. The management implications of these results are that hatchery steelhead, regardless of their broodstock type, are poor substitutes for wild fish in their natural environments. The addition of hatchery spawners to the natural environment does not appear a useful tool for rebuilding depressed populations of wild steelhead. These results support the view that hatchery programs should be managed to minimize the number of hatchery fish that spawn and rear in natural habitats."

Chilcote et al. 2013: ". The magnitude of this negative relationship is such that we predict the recruitment performance for a population comprised entirely of hatchery fish would be 0.128 of that for a population comprised entirely of wild fish. The effect of hatchery fish was the same among all three species. Further, the impact of hatchery fish from 'wild type' hatchery broodstocks was no less adverse than hatchery fish from traditional, domesticated broodstocks. We also found no support for the hypothesis that a population's productivity was affected by the length of exposure to hatchery fish."

Christie et al. 2016: "…we measured differential gene expression in the offspring of wild and first-generation hatchery steelhead trout (Oncorhynchus mykiss) reared in a common environment. Remarkably, we find that there were 723 genes differentially expressed between the two groups of offspring… it is remarkable that a single generation of domestication can translate into heritable differences in expression at hundreds of genes.

Taken together these studies illustrate that genetic changes and heritable differences between hatchery and wild fish create a hatchery adapted animal rather than one adapted to the natural environment, causing hatchery fish to function in a mixed natural breeding population as a non-native stray spawner. The NMFS Science Panel (1997) concluded that there was no genetic justification for allowing gene flow from non-native fish at levels as high as 5**%."** Controlling the number of hatchery spawners to achieve a specific pHOS level looks good on paper but #27

accumulated scientific evidence does not support pHOS limits of 5 to 10 percent. Luikart (2016) said 5% to 10% hatchery pHOS is "potentially inadequate to protect against adverse genetic effects of hatchery fish in the extant wild Fall Chinook (and coho) populations in the LCR. Seamons et al. 2012 concluded "Controlling the behavior or breeding biology of captively reared animals released into the wild is one of the most significant issues for managers tasked with minimizing risks associated with captive rearing."

The accumulated scientific studies provide evidence that segregated and integrated hatchery programs do have a negative and degrading genetic effect on ESA-listed salmonids. This evidence runs counter to the claims made in Alternative 2 that impacts on wild salmon and steelhead would be "minimized." It is clear that assurances provided by NMFS and ODFW that hatcheries will be operated to protect wild native threatened chinook and steelhead are not realistic, cannot be believed, and are not supported by scientific evidence. #28

The scientific studies referred to in these comments prove that artificially produced salmon and steelhead have lower survival and reproductive success compared to wild salmonids spawning naturally in rivers. Limit 5 of the 4(d) rule would allow the eventual conversion of the UWR wild steelhead to a hatchery product. This would increase the cost of producing hatchery fish to minimize hatchery impacts on wild threatened steelhead and chinook based on measurable criteria for genetic and ecological impacts. Dr. Luikart (2016) and NMFS (1997) recommend a low pHOS of less than 5%. Limits on genetic and ecological impacts will have to be identified and Limit 5 of the 4(d) needs to be based on measurable criteria for impacts. The Hatchery DEIS does not provide information based on measurable criteria and protocols for protecting wild chinook and steelhead. These measurable criteria and conservation management of impacts of the hatchery program need to be explained and how they will be enforced to define what "minimized" impacts are and how they are applied to protect wild ESA-listed salmon and steelhead, because "minimized impacts on protected species is ambiguous and subjective. Alternative 2 (Preferred Alternative) would only contribute to the decline and eventual hatchery replacement of wild threatened spring chinook and winter steelhead in the UWR ESU in violation of the ESA. In addition, HGMPs do not address genetic impacts on wild populations in the natural environment outside the hatchery fence so they are totally inadequate to protect wild salmon and steelhead. #29

Alternative 2 (Preferred Alternative) does not address the genetic and ecological impacts of non-native non-ESU hatchery summer steelhead an wild chinook and winter steelhead so these impacts will continue as they have since their introduction in the 1970s under the unverified assumption there are no impacts. Recent evaluation of genetic impacts (Johnson et al. 2013) and ecological impacts (Harnish et al. 2014) have proven the assumption to be an error in management and inconsistent with ESA protection. Ecological impacts were identified by Kostow and Zhou (2006) in the Clackamas and this information resulted in ODFW and NMFS agreement to not release summer steelhead above North Fork Dam and prevent their access to the river through the fishway. This action is consistent with protection of wild threatened winter steelhead above the dam. #30

In contrast ODFW justifies the continued release of hatchery summer steelhead because it is a popular sport fishery and a source of fishing license sales and hatchery funding. NMFS has ignored hatchery summer steelhead impacts on wild protected winter steelhead and the science that validates them in Alternative 2. Therefore NMFS inaction on summer steelhead is inconsistent with the protection of ESA listed salmon and steelhead in the UWR. This casts doubt that NMFS will protect ESA-listed wild salmon and steelhead through Limit 5 of the 4(d) rule allowing hatchery production that will increase hatchery related impacts on wild winter steelhead and spring chinook in the UWR.

Cost Evaluation of Hatchery Programs

Cost effectiveness of hatchery programs is not evaluated. The result is the public funding of these programs is not provided so that the public can know how much it costs to produce a fish that is harvested and the cost of genetic and ecological impacts from hatchery fish. It is also necessary to evaluate the waste of public funds directed at habitat restoration in rivers where hatchery fish waste that investment. Because these are public resources managed in the public interest not just for the benefit of user groups, accountability for cost of hatchery programs and impacts #31

is necessary. In 2002 the Independent Economic Advisory Board (IEAB) for the N.W. Power Planning and Conservation Council concluded that the cost to produce a harvested salmon was $9,000 per fish (Phase One Report). Another economic study contracted by NMFS for the Mitchell Act Hatchery EIS concluded that these hatcheries were a deficit spending program. This resulted in the economics team being fired by NMFS and economists that could provide a more favorable outcome for the hatchery program was hired. The costs to produce a harvested salmon or steelhead from hatcheries, given their poor survival, require excessive smolt production. The IEAB proposal to evaluate the cost to produce hatchery fish for all hatcheries in the Columbia River basin was rejected without explanation. It is time for cost accountability of hatchery programs and the ecological costs they impose on the environment.

Reliance on hatchery production in the Columbia River Basin, including the UWR ESU, over the last 143 years has not increased the supply of salmon and steelhead or favored their recovery. Their abundance and fishery benefits have only declined. The N.W. Power Planning and Conservation Council adopted a goal to increase the runs of wild and hatchery fish to an annual return of 5 million fish, but in the span of 35 years this goal has not been achieved. In the meantime, more hatcheries have been built and more hatchery fish are being released at a cost that now is in excess of $17 billion for Columbia River basin salmon and steelhead recovery. Yet the same agencies that have benefited economically by this enormous funding for salmon recovery, using hatcheries as the primary source of fish, are again seeking approval through the Hatchery DEIS for the UWR to repeat the mistake with state and federal (public) funds. There is no scientific evidence that the Preferred Alternative 2 provides a conservation and recovery benefit for threatened wild spring chinook and winter steelhead. Alternative 2 (preferred alternative) repeats the same failures in a different wrapper. The result, if adopted, Limit 5 of the 4(d) rule will only increase impacts of hatchery programs on protected wild spring chinook and winter steelhead. The inevitable result is the replacement of what remains of wild salmon and steelhead with hatchery fish in the UWR. This conclusion is supported by Varanasi & Fox (2004) said "Species that require ongoing, intensive human intervention cannot generally be considered at low risk of extinction because of the ephemeral nature of human institutions. Empirical and theoretical considerations indicate that domestication associated with hatchery propagation can lead to a situation in which a natural population becomes unable to sustain itself in the wild without continual supplementation with hatchery fish. Salmon hatcheries require intensive and continual investment resources, but human history provides no examples of such complex systems being maintained over anything approximating the time period over which salmon population structure has evolved and persisted." The existing management direction and the proposed Alternative 2 would benefit the fishery agencies by supplying more funding regardless of the impacts on ESA-protected wild salmon and steelhead at least until administrators can retire and collect public funded retirement benefits. #32

Record for Threatened Wild Winter Steelhead: Oddly, this alternative 2 does not mention threatened wild winter steelhead, nor does it describe a NMFS program to recover this threatened species. Apparently wild winter steelhead have declined so rapidly and have been listed so long that it fell off the NMFS policy table. #33

Issues that relate to the summer steelhead hatchery program are:

1) Benefits include fishery harvest opportunities.

2) Risks include: genetic impacts (out of DPS), predation, and competition.

Issues that relate to the Rainbow Trout Programs are:

1) Benefits include fishery harvest opportunities.

2) Risks include: predation and competition, disease transfer, increased exploitation of natural-origin salmon and steelhead.

Early run hatchery winter steelhead were introduced in the UWR in 1964. Their origin was from Big Creek Hatchery on the lower Columbia River and is not a native stock. (ODFW Steelhead Data 1991) In this report ODFW district biologist and the public expressed concern about the hatchery program and the decline in wild winter steelhead.

Buchanan et al. (1983) "The ODFW changed to exclusive introduction of Skamania summer steelheads into the Willamette basin after our studies in 1974 documented the resistance of these fish to C. shasta. This introduction has been successful. Releases of marked smolts have produced adult returns of 7.5% and over 17,000 adult Skamania summer steelhead were caught in the Willamette basin during 1978 (ODFW, unpublished records)."

Clady (1971) said: "Another potential problem for native fish is posed by the introduction of exotic summer steelhead. It is possible that if summer steelhead become established they will compete harmfully with the winter fish. An understanding of the biology of the native fish is necessary before additional introductions are made so that resource agencies may assess such competitive effects or other new developments." The problems that concerned Clady 1971) have been confirmed by Johnson (2013) having determined genetic introgression between hatchery summer steelhead and wild threatened winter steelhead and by Harnish (2014) who identified ecological impacts from residualized summer steelhead juveniles. The continued sharp decline in wild winter steelhead in the UWR since 1971 from 19,000 to a few hundred fish in 2017 (French 2018) provides evidence of harm from introduced non-native summer steelhead. Kostow and Zhou (2006) concluded from their research on the impact of non-native hatchery summer steelhead on wild winter steelhead in Clackamas River that "The combined effect of poor hatchery fish fitness and depressed wild fish production due to competition with the hatchery fish poses a double jeopardy that could quickly erode natural production in any system."

"The concerns of some ODFW biologists for the future of wild winter steelhead in the UWR because of the introduction of non-native and non-ESU hatchery and summer steelhead for sport fisheries went unnoticed by state fishery managers but their concerns were prescient given the 54 year hatchery steelhead program in the UWR and the sharp steady decline in wild winter steelhead. "The complete elimination of the late winter stock, however, would be a tragedy, as is the extinction of any animal which has adapted and evolved in a given environment for thousands of years." (Clady 1971).

Upper Willamette River Conservation and Recovery Plan 2011

In 2011 the NMFS and ODFW published the UWR Conservation and Recovery Plan for Chinook and Winter Steelhead. This joint evaluation and resulting plan discusses problems with the introduction and annual release of non-native and non-ESU hatchery summer steelhead on native wild threatened winter steelhead.

The UWR wild winter steelhead were listed as a protected species under the ESA in 1999 and in the 2011 plan ODFW and NMFS registered a concern about the impact of hatchery summer steelhead on wild threatened winter steelhead, but this concern has never been acted upon.

In that plan the cooperating parties listed "Limiting Factors (pages 5-28 to 5-29) that acknowledged the following issues for threatened wild winter steelhead:

1. "Population traits (impaired productivity and diversity) Limiting Factor: hatchery fish interbreeding with wild fish on the spawning grounds. Affected Rivers: North Santiam and South Santiam.

2. "In-basin competition with naturally produced progeny of hatchery summer steelhead. Limiting Factor: Fry, summer parr and winter parr. Affected Rivers: North Santiam and South Santiam.

3. "In-basin competition with residualized hatchery summer steelhead smolts. Limiting Factor: summer parr and winter parr. Affected Rivers: North Santiam and South Santiam.

4. "Out-of-basin competition due to high density of juvenile hatchery fish in the estuary from composite Columbia basin hatchery releases: Affected Rivers: Molalla, North Santiam, South Santiam, Calapooia.

5. "Hatchery summer steelhead smolts released in the subbasin can prey on North Santiam Chinook fry and parr.

6. "Natural production resulting from hatchery releases of non-native South Santiam stock summer steelhead is a risk to the viability of the North Santiam steelhead population (NMFS 2004). This hatchery stock originated from Skamania stock and is not part of the UWR steelhead DPS. Releases of thousands of hatchery smolts annually result in competition with juvenile UWR North Santiam steelhead. While most adult summer steelhead in the basin are harvested by anglers or removed at the Minto trap, ODFW has observed summer steelhead spawning in the mainstem North Santiam River, and Rock, Mad, Elkhorn and Sinker creeks. The North Santiam River had the highest densities of summer steelhead redds observed in any of the indigenous steelhead populations in the DPS. Studies in the Clackamas River have shown adverse effects from non-native Skamania summer steelhead on native winter steelhead (Chilcote 2003, Kostow and Zhou 2006). One ecological factor that may impact juvenile winter steelhead is the earlier emergence of summer steelhead, which may impart a competitive disadvantage to native fish if choice feeding territories are already occupied by summer steelhead (Kostow and Zhou 2006)." (Page 5-52)

7. "Releases of non-native South Santiam stock summer steelhead also results in competition between juvenile North Santiam steelhead and residual hatchery summer steelhead smolts (Page 5-53).

8. "Hatchery fish breeding with natural origin spawners represents a key threat to the genetic characteristics of the wild Chinook and steelhead populations.

9. "The naturally produced progeny of non-native summer steelhead released in the subbasin are thought to compete with juvenile South Santiam steelhead for habitat and food (NMFS 2004). Summer steelhead have been observed spawning in the mainstem South Santiam River, Wiley, Crabtree, and Thomas Creeks.

10. "Releases of non-native summer steelhead in the basin also results in competition between juvenile South Santiam steelhead and residual hatchery summer steelhead smolts.

11. "*Hatchery Management. Key threat: CHS and STW:* Hatchery fish breeding with natural origin spawners continues to present a key threat to the genetic characteristics of the wild Chinook and steelhead populations.

Chinook: The large number of hatchery fish on natural spawning beds compared to the number of natural-origin spawning fish is a major concern for South Santiam Chinook. In recent years the proportion of naturally spawning Chinook in the South Santiam that are of hatchery origin has been over 80% (ODFW 2005a). The contribution of natural-origin fish to the broodstock is thought to be small (McElhany et al. 2007).

12. "The legacy of past hatchery operations in combination with the continued release of summer-run steelhead presents risks to the viability of the steelhead population. (Page 5-60 and 5-61)

13. "The fact that the wild populations have not improved in viability status after the substantial fishery harvest reductions have occurred suggests…other bottlenecks affecting these populations. Other recovery actions in the management of… hatcheries are now needed to improve population viability." (Page 6-19)

14. "NMFS and ODFW should continue to study the adverse effects of high pHOS below the dams on natural productivity of each population. In order to gain management flexibility for considering alternative ways to reduce pHOS, the State of Oregon, U.S. Army Corps of Engineers, and NMFS could review the hatchery mitigation agreements (Page 6-20)

15. "However, given this uncertainty and the relatively minor impact that juvenile competition is assumed to represent relative to the threats, decreasing competition mortality further may have relatively little effect on the status of UWR populations. Therefore no impact reduction is identified under the scenarios presented here. (Page 6-20)

NOTE: *The data is now available in studies that are related to the UWR hatchery summer steelhead genetic impacts in (Johnson et a. 2013) and previous studies Reisenbichler and McInyre 1977; Brannon et al 1999; Chilcote 2002, 2003; Ford 2002, 2010; IMST 2000; Knudsen 2008; Kostow 2008; Lynch, M., and M. O'Hely. 2001; McClure et al 2008; McLean et al 2004; Naish et al 2008; National Research Council. 1996; Nickelson, 2003; Reisenbichler, R.R. and S. P. Rubin. 1999; Steward, C. R., and T. C. Bjornn. 1990; Vincent, E. R. 1987; Waples, R. S. and Do, C. 1994; Araki et al. 2007, 2008, 2010; Blouin 2003,2009) impacts and ecological impacts (Harnish et al. 2014; Kostow and Zhou 2006; Peery, C.A. and T.C. Bjornn. 1993). Of course Kostow and Zhou 2006 and many other scientific studies predate the date of this ODFW and NMFS plan (2011). While Kostow and Zhou 2006 it is cited, along with many other studies by scientists some of which are employed by ODFW and NMFS yet they chose to not conclude these genetic and ecological impact evidence. These scientific results are not treated as an issue requiring a precautionary approach that would require a change in hatchery operations. This only reveals the bias in the fishery management agencies to ignore available and relevant science on hatchery impacts on wild salmon and steelhead.* #34

The UWR wild winter steelhead were listed as a protected species under the ESA in 1999 and in the 2011 plan ODFW and NMFS registered a concern about the impact of hatchery summer steelhead on wild threatened winter steelhead, but this concern has never been acted upon.

In **Alternative 2** the NMFS has not only ignored impacts of non-native, non-ESU hatchery summer steelhead it is promoting continued hatchery production along with hatchery trout releases which have genetic impacts (Johnson et al. 2013) and ecological impacts (Harnish et al. 2014) on wild winter steelhead. #35

In addition, Alternative 2 proposes to approve Limit 5 of the 4(d) rule to adopt a hatchery program for wild winter steelhead, exposing this threatened population to hatchery domestic selection that will reduce the survival and reproduction of ESA-protected steelhead in the UWR. #36

The only conclusion reviewers of the UWR Hatchery DEIS can come to is that the DEIS is ignoring the historical concerns for wild winter steelhead and at least 30 years of the best available science in producing a DEIS that is biologically incompetent and fails to protect threatened wild winter steelhead under the ESA.

The UWR Hatchery DEIS has overlooked or ignored the life history characteristics of summer steelhead compared to that of winter steelhead. Summer steelhead occupy streams that have hydrological barriers such as water falls that are barriers to winter steelhead but which summer steelhead can pass at lower summer flows, thus isolating the breeding population of both races of steelhead (Withler I.L. 1961). In the UWR summer steelhead are not native because there are no hydrologic barriers to separate them from winter steelhead. Therefore, it should be expected that summer steelhead and winter steelhead will interbreed and rear in the UWR, causing genetic and ecological impacts on winter steelhead. How this can be overlooked by the responsible management agencies can be explained only by their desire to create a summer fishery, based on an economic rather than ecological model for management which operates at the expense of threatened wild winter steelhead. #37

The preferred alternative (Alternative 2) punts to Alternative 1 where summer steelhead and trout will continue to be managed for fishery benefits, so Alternative 2 will not address the recognized genetic and ecological impacts identified by recent and earlier scientific evaluations. Even though specific problems have been identified by NMFS and ODFW in their joint recovery plan (2011), taking action resolve the problems associated with releases of summer steelhead is not be addressed by NMFS's Hatchery DEIS even though there is an obligation through the ESA to do so. #38

The primary purpose for Alternative 2 is to establish a hatchery program affecting wild threatened winter steelhead below the dams to introduce hatchery steelhead above the dams on a hunch that it may work and can be used to lower the average pHOS impacts of hatchery winter steelhead below the dams sometime in the future. The result of Alternative 2 is replacement of hatchery summer steelhead for a hatchery winter steelhead program that will increase the harm to ESA-protected wild winter steelhead because they are an indigenous population with similar #39

biological characteristics. This impact will increase the genetic and ecological impacts between hatchery and wild winter steelhead rather than promoting recovery of the ESA-protected wild winter steelhead.

Proposed Conservation and Recovery Alternative:

1) In order to achieve recovery of wild threatened spring chinook and winter steelhead protected through the ESA while being consistent with the best available scientific evidence the following is proposed.

2) Establish spawner escapement and egg deposition criteria by species and population for each spawning tributary in the UWR utilized by these protected species to fully seed the habitat available.

3) Prevent natural interbreeding between hatchery and wild salmonids.

#40

4) Since wild salmon and steelhead are sustained and supported by the ecological conditions of their spawning and rearing streams, the state and federal agencies have an obligation under state and federal law to protect these spawning and rearing habitats.

For protection and recovery of all wild spring chinook and winter steelhead to be successful attention to natural breeding populations is a primary obligation.

Rich, W. (1939) "In the conservation of any natural, biological resource it may, I believe, be considered self-evident that the population must be the unit to be treated. By population I mean an effectively isolated, self-perpetuating group of organisms of the same species regardless of whether they may or may not display distinguishing characters and regardless of whether these distinguishing characters, if present, be genetic or environmental in origin. Given a species that is broken up into a number of such isolated groups or populations, it is obvious that the conservation of the species as a whole resolves into the conservation of every one of the component groups; that the success of efforts to conserve the species will depend, not only upon the results attained with any one population, but upon the fraction of the total number of individuals in the species that is contained within the populations affected by the conservation measures."

Riddell (2009): "The health of Pacific salmon depends not only on their abundance but also on their biological diversity. That diversity includes the irreplaceable lineages of salmon evolved through time, the geographic distribution of these populations, the genetic differences and life history variations observed among them, and the habitats that support these differences."

Parkinson (1984) said: Based on research on steelhead diversity among rivers of British Columbia, "Adjacent populations should therefore be managed as separate stocks."

Chilcote (2013) provided evidence that all forms of hatchery intervention reduce the reproductive success of salmon and steelhead.

Brannon (1999) concluded "The three recent independent reviews of fish and wildlife recovery efforts in the Columbia River Basin addressed hatcheries. There was consensus among the three panels (National Fish Hatchery Review Panel, National Research Council, Independent Science Group), which underscores the importance of their contributions in revising the scientific foundation for hatchery policy." Those conclusions included factors important for recovery of wild spring chinook and steelhead and the UWR Hatchery DEIS: "Hatcheries generally have failed to meet their objectives, Hatcheries have imparted adverse effects on natural populations, Managers have failed to evaluate hatchery programs, Rationale justifying hatchery production was based on untested assumptions, and stock transfers and introductions of non-native species should be discontinued."

The ISAB (2002) "We believe that available empirical evidence demonstrates a potential for deleterious interactions, both demographic and genetic, from allowing hatchery-origin salmon to spawn in the wild. Because it is virtually impossible to 'undo' the genetic changes caused by allowing hatchery and wild salmon to interbreed, the ISAB advocates great care in permitting hatchery-origin adult salmon to spawn in the wild."

The ISRP (2011) "Concludes that a conservation benefit in terms of NOR abundance is unlikely from supplementation. Based on the analysis of productivity loss in the Imnaha River, the ISRP concludes that costs to population fitness are likely. The supplementation projects as they are currently conducted with high proportions of hatchery fish in the hatchery broodstock and on the natural spawning grounds are likely compromising the long-term viability of the populations."

Vaha (2008) said: "In order to regain the historical distribution of salmon and sustain the diversity of life-histories displayed among the populations, establishment of regular fine-scaled monitoring, incorporating both demographic and genetic methodologies, particularly of the tributary populations is recommended. We found remarkably high levels of differentiation between tributary populations and between tributary and the mainstem populations.

For at least 79 years, the individual salmon population in its natal habitat has been recognized as the basic management unit.

In order to provide the recovery escapement and egg deposition criteria by species and population for each tributary utilized by native wild spring chinook and winter steelhead has to be supported by regulation of harvest, control of hatchery impacts on natural wild populations, and habitat protection for each wild population spawning and rearing area. The UWR Hatchery DEIS sets all this aside, by not defining how the hatchery program is to be operated so that threatened wild salmon and steelhead are protected and recovered based on VSP criteria in their natural environment. The proposed alternatives, especially the preferred Alternative 2, is not integrated into conservation of natural system. Consequently, the hatchery alternatives impose genetic and ecological impacts on wild threatened populations of spring chinook and winter steelhead. A major problem with all alternatives is that the impact on harvest opportunity is the issue not whether the alternatives are consistent with recovery of ESA-protected species. The UWR Hatchery DEIS is treated as a standalone technology that is not integrated with recovery of wild locally adapted populations. Therefore, the UWR Hatchery DEIS must be rejected and rewritten so that it consistent with recovery of ESA-protected species. #41

These and a multitude of other scientific peer reviewed studies have important conclusion regarding management to recovery threatened wild spring chinook and winter steelhead in the Upper Willamette River. Unfortunately, the UWR Hatchery DEIS fails to develop an alternative that is responsive to science and the importance of its application in the Upper Willamette River to recovery ESA-listed fish. #42

For reintroduction of wild salmon and steelhead above the dams include additional egg take requirements used for reintroduction to prevent mining the wild run for an egg supply for reintroduction. #43

This approach would supply wild origin eggs for reintroduction. Steelhead and chinook fry rather than smolts would be used for reintroduction above the dams in an effort to reduce domestic selection and genetic change in the hatchery influenced population used for reintroduction. Returning hatchery influenced steelhead and chinook would have been exposed to less domestication selection and genetic change from the hatchery program that in turn would help reduce the genetic and ecological impact of the hatchery program on wild winter steelhead and chinook below the dams and as a source of reintroduction fish.

This would be evaluated to determine the effect of the hatchery program on wild steelhead reintroduction below the dams. The pHOS limit would set to be less than 5% below the dams in an effort to reduce genetic and ecological impacts from hatchery steelhead and chinook used for reintroduction above the dams. The pHOS limit for wild populations needs to be less than 5% for all wild steelhead and chinook below the dams by eliminating marked hatchery fish in the natural breeding populations below the dams.

Unlike the operation of hatcheries the wild salmon and steelhead have not been managed for adult spawners and egg deposition criteria by spawning stream. To accomplish this approach fisheries including ocean harvest, needs to be regulated to achieve the adult spawner criteria for each spawning stream by species and population to achieve egg deposition requirements.

Release of hatchery trout above the dams must end in order to remove associated fishery mortality, competition and predation from these fish on reintroduced wild steelhead and chinook.

A primary reason for the failure to maintain wild self-sustaining spring chinook and winter steelhead is they have never been managed since Willamette Hatchery was established in 1911 for spawner escapement. The primary objective for the hatchery program has always been based on adult numbers for the fishery and to supply the eggs needed to fill each hatchery facility. The wild salmon and steelhead were mined for eggs initially and there was no thought given to the adult spawner and egg deposition needs to sustain the wild runs. #44

Since wild salmon and steelhead are also sustained and supported by the ecological conditions of their spawning and rearing streams, the state and federal agencies have an obligation under state and federal law to protect these spawning and rearing habitats. The hatchery program has been used to duck this issue thus promoting the blockage and degradation of habitats needed for self-sustaining wild salmon and steelhead. #45

The fishery management agencies have also turned away from protection of the public trust represented by wild self-sustaining salmon and steelhead and their ecologically productive river habitats and assumed that the only public that matters are those user groups that pay a fee to fish and serving their interest with hatchery production and the funding it provides. The transition from serving the public trust to serving only user groups has resulted in continuing extinction and depletion of wild salmon and steelhead including damage and blockage of their natal streams.

The proposed replacement alternative addresses all these issues and would require NMFS to enforce the federal Endangered Species Act. None of the proposed alternatives in the NFMS Draft EIS for hatcheries accomplishes recovery of protected species. #46

References to support the assertions in this comment begin on Page 21 (below).

Sincerely,

Bill M. Bakke **(via email)**

Bill M. Bakke
Director of Science and Conservation

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NMFS responses to the public comments submitted on the DEIS.		
Author	**Comment #**	**NMFS Response**
Bakke	1	Noted. NMFS considers the information obtained from the public in both its responses to comments here and in its biological opinion, where we provide a more detailed analysis of the impacts of the proposed action, approval of the hatchery programs, on threatened and endangered species. NMFS understands that much of the public's interest in this action, an ESA approval, is focused on our analysis of effects on ESA-listed species. The Biological Opinion is where we determine whether an action jeopardizes ESA-listed species, while in the NEPA process we examine a wider range of potential impacts to the human environment. We appreciate the detailed input we have received in this letter as we gather all relevant information and ideas for that Opinion, and we look forward to sharing that Opinion with the public when it is complete. NMFS expects to make its Opinion available concurrently with the release of the Final EIS, and prior to signing our Record of Decision.
Bakke	2	Noted. There are risks with naturally-spawning hatchery fish that are evaluated in the EIS through measures of pHOS (the proportion of hatchery-origin fish spawning in the wild). This is the primary metric NMFS uses to assess the risk of hatchery fish in the wild population.
Bakke	3	The cited studies listed prior to this comment are noted. It is unclear what the substance of the comment is, particularly the last sentence. A range of alternatives are evaluted in the EIS, including status quo management of the hatchery programs. Alternative 1 is the no action alternative, which is a required element of every NEPA document.
Bakke	4	Noted, the potential impacts of hatchery programs are discussed in Section 4.4.
Bakke	5	Noted. The effects of this alternative on salmon and steelhead are discussed in section 4.4.2.
Bakke	6	Noted. We have taken into account the long-term risks of continual hatchery-induced selection on natural populations. In the UWR, most salmon populations are at a high risk of extinction due to loss of historic habitat. By increasing abundance, hatchery supplementation has reduced VSP risks in the near term for these populations, benefitting recovery.
Bakke	7	Disagree regarding the purpose of the alternative. Alternative 3 exists for the same reason as all NEPA alternatives, to provide a range of actions as well as of potential impacts, in order to place the impacts of the preferred alternative into a fully-informed perspective. Moreover, it is possible to manage hatchery risks so that the ESU can be conserved and recovered, while still providing some harvest opportunities on hatchery fish. The two purposes are not mutually exclusive.
Bakke	8	The EIS evaluates the risks and benefits of hatchery supplementation. The comment regarding risks of integrated hatchery programs is noted. However, this is one of the potential threats to the species analyzed in the EIS. See sections 4.4.2 and 4.4.3 of the EIS for an evaluation of integration.
Bakke	9	Noted. The risks and benefits of the hatchery summer steelhead program are evaluated in the EIS. The commentor asserts that terminating the hatchery program would recover ESA-listed winter steelhead. While reducing threats from hatchery production can be a factor in species recovery, the outcomes of eliminating hatchery programs varies with the specific circumstances. For example, several hatchery programs have been eliminated in the Upper Willamette River 20 years ago and winter steelhead in the populations have still declined. Our approach is focusing on the key limiting factors/threats affecting each population, including populations where hatchery risks occur and continuing to lessen these risks.
Bakke	10	Noted. See response to comment #7. NMFS does not speculate about the feasibility of an alternative if we believe that considering the effects of that alternative will aid in informing our decision.
Bakke	11	This comment is mistaken where it states that "viability" only applies to natural-origin salmonids. "Viability" is an assessment of a population and/or ESU and DPS, which in the case of many salmonid species includes both wild and hatchery components. This is the case with Upper Willamette Chinook salmon. Moreover, the discussion of viability cited by the comment can and should be understood to be referring to the effects of the action on the viability of the ESU.
Bakke	12	Disagree. The best available data, including genetic pedigree analyses from the Upper Willamette River, show hatchery supplementation increasing the abundance of natural-origin salmon in the ESU.
Bakke	13	Noted. In the EIS, section 4.4 of the EIS describes the spatial and temporal ecological effects of the summer steelhead hatchery program for each of the alternatives.
Bakke	14	Noted.
Bakke	15	Disagree with the commenter's characterization of Alternative 5. See responses to comments #7 and #10.
Bakke	16	NMFS disagrees with the comment. The alternatives chosen were selected to provide a reasonable range of choices and whose impacts to salmon and steelhead were likely to vary in meaningful ways. See responses to comments #7 and 10.
Bakke	17	Disagree. The hatchery salmon programs are currently providing substantial benefits to VSP parameters of the Upper Willamette ESU, as discussed in the EIS.

Bakke	18	Noted. NMFS would add that one of the key factors limiting recovery of spring Chinook salmon in the Molalla River is the lack of sufficient freshwater habitat.
Bakke	19	Noted.
Bakke	20	Noted.
Bakke	21	Disagree. The comment assumes if adult and egg criteria are established, then the criteria would be met with reforms in hatchery and harvest management. This is not necessarily the case. The ESA recovery plan (ODFW and NMFS 2011) defines recovery goals for each population and above the federal dams where applicable. Eliminating all harvest on hatchery and natural fish would not result in the goals being met. Recovery will only occur when the key limiting factors/threats are addressed in each population.
Bakke	22	Disagree. Notwithstanding the data presented here, which comes from studies conducted in Idaho, NMFS has presented relevant information which does not necessarily support the commenter's conclusions.
Bakke	23	Noted.
Bakke	24	Disagree. There are many performance indicator metrics specified in the HGMPs (see sections 1.9 through 1.11) that evaluate the effects of hatchery fish "outside the hatchery fence." For example, pHOS (the proportion of hatchery fish spawning in the natural environment) measures hatchery fish spawning in the wild.
Bakke	25	Noted. Refer to section 4.4 of the EIS where the DEIS discusses the factors mentioned here.
Bakke	26	Noted.
Bakke	27	Noted.
Bakke	28	Noted. It is important to understand that using best management practices to minimize an impact does not mean that the impact is reduced to zero; "minimized" means reducing the impact to the lowest point possible, given all of the constraints and issues regarding the impact, prior to the application of best management practices.
Bakke	29	Disagree. Section 4.4 of the EIS extensively addresses effects of the hatchery programs including at the hatchery facilities and traps, and effects of hatchery fish in the natural environment ("outside the hatchery fence") above and below the dams. Also see responses to comments #24 and #28. Also, as stated in the response to comment #1, the biological opinion will provide further detail on the impacts of the proposed action on listed species.
Bakke	30	Noted. Please see section 4.4 of the EIS for our evaluation of the genetic and ecological effects of the hatchery summer steelhead.
Bakke	31	Noted. Please see section 4.7 of the EIS for our evaluation of the socioeconomics of the hatchery programs.
Bakke	32	Noted. See previous responses addressing this same comment.
Bakke	33	Noted. The commenter is reminded that this is a statement of the environmental impacts associated with the hatchery programs in the proposed action. To the extent that the commenter seeks information beyond the scope of this document, additional information can be obtained from ODFW or NMFS, for example, the recovery plans for ESA-listed species which can be accessed on the NMFS website. For effects of this action to listed species including UWR steelhead, please refer to section 4.4 of the EIS.
Bakke	34	Noted. Please see section 4.4 of the EIS for our evaluation of the genetic and ecological effects.
Bakke	35	Disagree. See the evaluation of the alternatives in the EIS. NMFS is evaluating hatchery plans submitted by ODFW and the Corps of Engineers to determine if they meet the standards of 50 CFR 223.203. NMFS is not promoting hatcheries by conducting these determinations; NMFS is reviewing the proposed hatchery operations and making disclosures of impacts as required by law.
Bakke	36	Disagree. See the description of the alternative in section 2.2 of the EIS and evaluations in section 4.4.
Bakke	37	Noted. See section 4.4. of the EIS.
Bakke	38	Noted. The genetic and ecological effects of the hatchery programs are evaluated for each alternative in section 4.4 of the EIS.
Bakke	39	Disagree. See previous responses pertaining to this same comment.
Bakke	40	Noted. The alternatives assess different management objectives for the hatchery programs. The Recovery Plan and HGMPs specify escapement objectives for each population. Alternative 4 evaluates the effects of no interbreeding between hatchery and natural fish.
Bakke	41	Noted. Section 2 describes the range of alternatives considered, including implementing different goals for the hatchery programs other than status quo. Section 4.4 evaluates the effects of these different management strategies.
Bakke	42	Noted. NMFS incorporated the best available information, including many studies conducted in the Upper Willamette River, in the evaluation of the alternatives in the EIS.
Bakke	43	Noted. Alternative 3 evaluates hatchery production solely for reintroduction needs.
Bakke	44	Noted.
Bakke	45	Noted. See response to comment 40.
Bakke	46	Noted.

May 28, 2018

National Marine Fisheries Service
Oregon Coast Hatchery DEIS
2900 N.W. Stewart Parkway
Roseburg, Oregon 97471

Re: Proposed Spring Chinook Hatchery and Genetic Management Plans

Dear Sir/Madam:

Thank you for the opportunity to comment on the draft Environmental Impact Statement ("DEIS") prepared by the National Marine Fisheries Service ("NMFS") related to four proposed Hatchery and Genetic Management Plans ("HGMPs") for spring Chinook in the upper Willamette River basin ("UWR") in Oregon.

I live in Polson, Montana. I have 33 years of professional experience of field research and review of conservation planning and management with trout, salmon and steelhead in western North America. For 15 years, from 1985 to 2000, I held research faculty appointments at Oregon State University and the University of Montana Flathead Lake Biological Station. For 12 years, from 2000 to 2012, I held the position of Senior Staff Scientist and later Director of Science and Conservation for a nonprofit conservation organization, the Pacific Rivers Council. Presently, I work as a fishery and watershed science consultant and hold an Affiliate Research Professor position at the University of Montana Flathead Lake Biological Station.

I received a Bachelor of Arts (B.A.) degree in Zoology with High Honors at the University of Montana in 1982, and Master of Science (M.S) and doctoral (Ph.D.) degrees in Fishery Science from Oregon State University in 1986 and 1992, respectively.

In the course of my work, I have conducted and directed numerous field studies of salmon, steelhead and trout behavior in response to habitat features, both natural and man-made or man-influenced. I am familiar with the scientific literature on wild fish response to aspects of habitat, natural and man-made. I am also familiar with the scientific literature on how hatchery fish and hatchery operations, particularly in the contexts of behavioral and genetic alterations, but also simply by overwhelming numbers and artificially-selected locations of release, can adversely affect wild fish and their overall population dynamics. I have spent considerable effort reviewing in detail listing determinations and recovery plans for salmon and trout species under the federal Endangered Species Act (ESA), and in review of fishery management and conservation and species recovery programs by state and federal agencies. In 1998-2000, I served as a member of the Northwest Power Planning Council Ecological Work Group, which developed the Multi-Species Framework as a template and for fishery and wildlife planning, including assessment of hatchery management options, in subbasins of the Columbia River Basin.

From about 2004 until 2010, I helped prepare the scientific analysis of the state-wide effects of the State of California's hatchery programs under the California Environmental

Quality Act. This work required me to engage in comprehensive and ongoing review of the literature pertaining to all aspects of salmon and trout hatchery operations and their environmental impacts on naturally occurring fishes and other species, and it necessitated my review of numerous specific hatchery operations in California and how their impact on wild fish and other biota might be minimized or avoided.

I have published more than 30 articles in scientific journals and symposia proceedings, served as primary or co-author on twelve books or book chapters, and written more then 25 research reports all concerning how salmon, trout, and other native species survive and prosper in freshwater ecosystems, and how management can be successfully shaped to protect and restore threatened and endangered trout and salmon species. I append to these commentsa list of my authored, co-authored, and supported publications.

I am very familiar with the McKenzie River in Oregon. During my years working in Oregon, I frequently visited the McKenzie River and its tributaries, particularly on scientific field trips focused on protecting and recovering wild fish populations and stream and river ecosystems. I have angled for steelhead trout in the vicinity of the McKenzie Hatchery, when adult spring Chinook were present and easily observed. In 2009, I visited the hatchery and witnessed its infrastructure, including its pools and ladder. I am familiar with spring Chinook salmon that comprise the Upper Willamette River Evolutionarily Significant Unit ("ESU") listed as threatened with extinction under the ESA.

I prepared these comments drawing from several sources. First, I draw upon my knowledge, experiments, field work, and other professional and personal experience. Second, I have reviewed the documents I cite in the body of these comments, and provide a list of those documents at the end. Third, I have reviewed many documents that are part of the administrative record in this case, including:

Endangered Species Act Section 7(a)(2) Consultation Biological Opinion & Magnuson-Stevens Fishery Conservation & Management Act Essential Fish Habitat Consultation, Consultation on the Willamette River Basin Flood Control Project, Willamette Project Biological Opinion (July 11, 2008).

Hatchery and Genetics Management Plan (HGMP) for the McKenzie River spring Chinook salmon (Feb. 2016).

Assessment of Alternatives to Reduce Effects of Hatchery Origin Spawners on the McKenzie Natural-Origin Spring Chinook Population (USACE and BPA, 2013)

McKenzie Hatchery Technical Workgroup, 2012. Draft Assessment of Specific Actions to Reduce the Natural Spawning of Hatchery Chinook in the McKenzie River Draft. NMFS, second draft (March 28, 2012).

The McKenzie River and Leaburg Hatcheries Reconnaissance Study and Pre-Design Report. R2 Resource Consultants. (April 2012).

A valid HGMP for the McKenzie Hatchery must provide measures to ensure that any capture or collection of wild spring Chinook at the McKenzie Hatchery, and all releases of hatchery-bred spring Chinook from the hatchery, are consistent with the recovery of wild spring Chinook in the McKenzie River basin as a whole. The greatest risk from hatchery operations is that hatchery-origin adults that fail to return to the hatchery (*i.e.*, "stray") will mix with wild salmon on spawning grounds and behaviorally interact and interbreed with them, thereby reducing the genetic fitness and survival of the progeny in the wild. The HGMP must include measures that will keep intermixing of hatchery salmon spawners with wild salmon spawners below the maximum level specified by federal hatchery guidelines or, from a scientific perspective, well below this level if possible. #1

Section 9.6, RPA 6.1.4 of the 2008 BiOp requires measures to reduce the proportion of hatchery origin spawners ("pHOS") in the McKenzie River to <10% (that is, 90% or more of the spring Chinook salmon spawning in the wild in the McKenzie River should be the offspring of matings in the wild, not matings in a hatchery). The proposed HGMP describes several possible actions to reduce pHOS in the McKenzie River basin, but fails to provide sufficient detail as to any of those actions, referring instead to other documents. The proposed HGMP derives from *Assessment of Alternatives to Reduce Effects of Hatchery Origin Spawners on the McKenzie Natural-Origin Spring Chinook Population (USACE and BPA, 2013)* (hereafter "Alternatives"), which in turn refers to two other documents: *McKenzie Hatchery Technical Workgroup, 2012. Draft Assessment of Specific Actions to Reduce the Natural Spawning of Hatchery Chinook in the McKenzie River Draft. NMFS, March 28, 2012, second draft* (hereafter MHWG), and second, *The McKenzie River and Leaburg Hatcheries Reconnaissance Study and Pre-Design Report," R2 Resource Consultants, 27 April 2012, funded by BPA* (R2 2012). #2

A critical issue at the McKenzie Hatchery concerns the relative proportions of two sub-groups of returning hatchery spring Chinook adults: those that return *all the way* to the hatchery and are collected (removed) there, and those that return to the *vicinity* of the hatchery but remain in the river to potentially spawn with wild salmon. The fate of other sub-groups of hatchery spring Chinook adults—such as those that return to any point downstream of, but not to the McKenzie River—are irrelevant to pHOS, because they have no potential to contribute to pHOS in the river. If these hatchery Chinook are not in the vicinity of the spawning areas used by wild spring Chinook salmon in the McKenzie River, they cannot interbreed or otherwise interfere with wild Chinook in the McKenzie River basin. But it is important to recognize that hatchery fish spawning anywhere within the McKenzie River and its tributaries, and the offspring of those fish, are likely to interact ecologically and genetically with natural-origin Chinook in spawning and rearing areas, and during biologically crucial times of downstream migration, therefore they contribute to pHOS in the river and need to be calculated as such. #3

A large number of hatchery Chinook (as well as some Chinook of natural-origin) remain in the McKenzie River below Leaburg Dam and never cross it and, accordingly, are not counted there. The number of hatchery Chinook that remain in the McKenzie River below Leaburg Dam has been estimated to be 18% of all hatchery Chinook. Nonetheless, not counting the hatchery Chinook that do not cross the dam means that the hatchery collection rate stated in Alternatives and MHWG yields a significant overestimate, and the stray rate yields a significant underestimate, because the estimates do not account for the large number of hatchery fish that

are in fact spawning in the wild. As an example, ODFW estimated that for 2012, two-thirds (542 of a total 821) hatchery-origin spawners in the McKenzie remained downstream of Leaburg Dam. Thus, the true average annual proportion of stray hatchery fish remaining in the McKenzie River, after some of them are collected at the hatchery, may be considerably higher than 18%, and the collection rate at the hatchery lower than 82%. This means that any modifications to operations or the infrastructure at the hatchery will have to be more effective to increase the homing rate and reduce pHOS to <10%.

The HGMP proposes releases of 604,750 smolts. In my view this figure is excessive to reduce pHOS to mandated or even safe levels. #4

The proposed HGMP at 11 notes that a purpose of releasing 604,500 hatchery Chinook into the McKenzie River is to have enough returning adults to meet ODFW's harvest goal of having 1000 available for a sport fishery. To generate at least 1000 adult hatchery-origin salmon returning to the river for a harvest fishery, more than 309,000 hatchery smolts need to be released. In other words, more than half of the roughly 604,750 smolts proposed for release are for the fishery, not for a conservation purpose. The DEIS fails to consider or disclose that the best available science (*e.g.*, Good et al. (2007)) of life cycle modeling of natural-origin spring Chinook in the McKenzie that shows that eliminating harvest—presumably including incidental take and hooking mortality of wild fish in the in-river fishery targeting hatchery fish—could substantially reduce declines in natural-origin Chinook population. The DEIS also fails to consider or disclose that the best available science (*e.g.*, Lusardi et al. (2017)) notes that hatcheries used in conjunction with translocation (outplanting) programs, such as the McKenzie Hatchery, must be "operated with established genetic protocols to increase survival of progeny in the wild and decrease artificial selection."

Related to increasing homing of hatchery fish back to the hatchery, it will take years before any apparent changes to hatchery attraction rates can be judged. Recent changes to the ladder were made during August, 2014, which is near the end of the run of the majority of returning adult Chinook. Sufficient data do not yet exist to legitimately determine whether the changes to the ladder will have a substantial or a persistent effect. Fish returns and ladder and trap efficiency commonly vary across days and weeks within a season, so that selectively reported results from a small portion of the run can produce apparent anomalies, low or high. *See*, *e.g.*, Noonan, et al. (2012). #5

River systems are complex and often dissimilar, and assumptions about one cannot simply be extrapolated to others. For example, the thalweg (the streamline of deepest water and major current flow) of the McKenzie River is on the opposite side of the river from the McKenzie Hatchery. Adult Chinook generally tend to follow and remain in the thalweg when migrating upstream to seek spawning areas; they tend to avoid shallows and river margins. Hence, the location of the McKenzie Hatchery fish ladder entrance is ill-suited to the current morphology of the river channel. Modifications that might be effective in attracting fish to a hatchery in a different river, where there is no issue related to where fish tend to migrate because of the location of the thalweg, may be ineffective at McKenzie Hatchery, because of vagaries in channel morphology and the response of fish to it (both of which also change over time as river #6

beds shift). Unique, incompletely known, and time-varying circumstances at each river and hatchery make extrapolation of any success at one location speculative for another.

The HGMP proposes to redistribute water from Cogswell Creek within the hatchery to attempt to increase homing and the hatchery collection rate at the McKenzie Hatchery. Following any such completed operational changes at the hatchery, it will take another year to raise and release the first brood of smolts that will experience any "improved" conditions. The first few returning adults from that brood would be expected at earliest two years later (at age three) with the majority of those adults returning at ages four and five. Assuming 1-2 years to fund and make changes to operations at the hatchery, it will thus take in the neighborhood of 7-8 years before the first indicators of success or failure of redistributed water may begin to become apparent. The initial results will, however, be insufficient to allow a statistically valid assessment of the effects of the modifications. It will take several additional years of returns to make that judgment; realistically, at least 10-12 years from now. #7

Given the high degree of uncertainty of the efficacy of the prospective structural and operational changes to the McKenzie Hatchery, the extended time required to determine their success or failure, and the continuing high pHOS in the McKenzie River in the meantime, it is unreasonable to wait until efficacy of changes can be finally determined before taking certain measures to reduce pHOS. The most certain way to reduce pHOS to meet the standard is to reduce the number of released hatchery fish.

The HGMP at 54 proposes to trap up to 100 hatchery adults at a ladder at Leaburg Dam each year beginning in "early July" to remove them from the river to reduce pHOS. This plan poses significant risks to natural-origin Chinook. Although on a mean seasonal basis, the number of natural-origin Chinook migrating through the Leaburg Dam beginning on July 1 may be less than in previous weeks, it can still be a considerable number of fish. For example, in July, 2010, 441 unclipped adult Chinook were reported to pass Leaburg Dam out of the total 1,357 unclipped adult Chinook reported to pass the dam that year. Wild fish including Chinook do not migrate upstream with any predictable number or timing during any time of any particular day; they may in fact migrate upstream in significant numbers in a short period of days or even hours. Trapping natural-origin Chinook even for a short time can cause significant harm, in terms of delaying their upstream migration, or causing them to avoid the path to migration (the ladder) altogether. Murauskas *et al*. (2014); *see also* Lusardi et al (2017) (noting 100% mortality among spring Chinook captured in Butte Creek, California, and moved only a short distance). Indeed, high physiological stress that remains evident even after trapped fish are released. Clements *et al*. (2002). Finally, trapping at Leaburg Dam risks further exacerbating pHOS in the river below the dam, as well as imposing ancillary harm to later-migrating natural-origin Chinook navigating the ladder to spawn upstream of Leaburg Dam. Natural-origin Chinook trapped at the dam and later released to migrate above it may, because of confinement, delay, handling, or other factors, are likely to have reduced reproductive success and even experience pre-spawning mortality. It is biologically irresponsible to operate a trap at Leaburg Dam to remove hatchery Chinook. #8

Thank you for the opportunity to comment.

/s/ Dr. Christopher Frissell

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NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Frissell	1	Noted. The HGMP specifies the pHOS limits for the McKenzie River and actions and timelines to attain reductions in pHOS. NMFS is evaluating these actions in this consultation.
Frissell	2	Noted. NMFS does not agree that the information provided is insufficient to begin analysis of the proposed hatchery, but agrees that the documents referred to provide useful supplemental information.
Frissell	3	Noted. Any naturally spawning hatchery fish is considered in the pHOS calculations. However, it is realized some locations have a higher likelihood of spawning with natural-origin fish.
Frissell	4	Noted. The EIS evaluates a range of hatchery production in the McKenzie River from terminating all hatchery releases to increased production (see section 2). The effects of these alternatives on the natural population is assessed in section 4.4 of the EIS. Harvest of hatchery fish must be taken into account because these fisheries occur and ultimately affect returns back to the hatchery. Of particular note is the lower Willamette River fishery, which harvests the most hatchery fish, and catching fish from all of the hatchery programs (not just the McKenzie program). These fisheries were taken into account in specifying the proposed hatchery production level. See the HGMP for further details on the certainty of getting the number of hatchery fish needed for broodstock and reintroduction objectives.
Frissell	5	Noted. The modifications made to the hatchery ladder in 2014 resulted in immediate improvements for adult attraction of hatchery fish back to McKenzie Hatchery, and have improved collection in subsequent years. Other fixes to increase hatchery fish homing will take more time until the result is manifested, such as the re-plumbing of the hatchery water supply. The McKenzie HGMP describes when adults will return back to the hatchery from these improvements (ladder improvements, hatchery production reductions, water supply fixes).
Frissell	6	Noted. ODFW has observed improvements in fish migration into the ladder after modifications have been made in recent years.
Frissell	7	Noted. NMFS would add that the modification has been made to the water supply at McKenzie hatchery and it is expected this change will increase the homing of hatchery fish back to the hatchery in the coming years.
Frissell	8	Noted. NMFS is evaluating trapping at Leaburg Dam as part of the proposed action.

NATIVE FISH SOCIETY

Advancing the Recovery of Wild Native Fish in Their Homewaters

May 29, 2018

To: Barry A. Thom, Regional Administrator, NOAA Fisheries West Coast Region

From: Conrad Gowell, Fellowship Program Director, Native Fish Society
Jennifer Fairbrother, Campaign & Columbia Regional Director, Native Fish Society
Andrew Chione, Native Fish Society Yamhill River Steward
Dave Carpenter, Native Fish Society N. Santiam River Steward
Chris Daughters, Native Fish Society McKenzie River Steward
Dave Thomas, Native Fish Society McKenzie River Steward
Barrett Ames, Native Fish Society Clackamas River Steward
Nick Rowell, Native Fish Society Clackamas River Steward
Tom Derry, Native Fish Society Molalla River Steward
Terre Rogers, Native Fish Society Molalla River Steward
Jeremy Lees, Native Fish Society Tualatin River Steward
Bart Mills, Native Fish Society Johnson Creek River Steward

Re: Native Fish Society comments on the Draft Environmental Impact Statement (DEIS) to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 4(d) of the Endangered Species Act

Dear Administrator Thom,

Thank you for the opportunity to provide comments on the Draft Environmental Impact Statement (DEIS) to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 4(d) of the Endangered Species Act. The Native Fish Society (NFS) is a 501(c)3 conservation non-profit dedicated to utilizing the best available science to advocate for the protection and recovery of wild, native fish and promote the stewardship of the habitats that sustain them. NFS has 3,300 members and supporters and 90 River Stewards and grassroots advocates who help safeguard fish across the Pacific Northwest. In the Willamette basin, we have 10 locally based River Stewards covering the Tualatin, Yamhill, Clackamas, Molalla, North Santiam, Johnson Creek, and McKenzie watersheds.

Despite a century and a half of use, fish hatcheries (hereafter referred to as fish factories to distinguish from fish hatching in the natural environment) remain an unproven method to sustain the viability and biodiversity of native fish populations, preserve the culture of commercial and recreational fishing, and uphold treaty obligations and subsistence fishing for indigenous peoples and sovereign nations. There is an overwhelming scientific consensus that fish factories have a myriad of direct negative consequences for fish including **infrastructural**, **ecological,** and **genetic** #1

impacts, although these categories interact considerably. There is also a growing public awareness of the **indirect** impacts fish factories cause within the socio-ecological interface within watersheds and socio-economic dimensions of fisheries. The aesthetic and emotional state of communities who are impacted by factory fish and the ways in which fish factories detract from the protection of the natural environment also threaten the recovery and protection of wild fish throughout the Pacific Northwest.

In the Upper Willamette Watershed, there are two native fish species that are listed under the Endangered Species Act: Upper Willamette Spring Chinook and Winter Steelhead. First listed in 1999, the viability of these fish populations is considered to be in decline as determined in the most recent status review, the *2016 5-Year Review: Summary & Evaluation of Upper Willamette River Steelhead Upper Willamette River Chinook, National Marine Fisheries Service.* Regardless of this trend, fish factories in the Upper Willamette Basin continue to rear Summer Steelhead, Spring Chinook, and resident Rainbow Trout in spite of the numerous, documented, negative consequences resulting from these programs.

The negative impacts resulting from fish factories can occur within facilities at the species level, on the natural environment within and beyond the fish factory, and to ecosystems far beyond where those factory fish are reared and released. The negative effects of factory fish are severe enough that courts have recognized "stray [factory] fish as low as one or two percent...may pose unacceptable risks to natural populations".

In light of the condition of these fish threatened with extinction, and the continued impacts fish factories cause, we request that the National Marine Fisheries Service certifies they are following all applicable federal, state, and local environmental laws when taking action, including, but not limited to the: #2

- Endangered Species Act
- National Environmental Policy Act
- Administrative Procedure Act
- Clean Water Act

Within these policies there is a clear standard to incorporate the best available science and to consider cumulative impacts, socioeconomic, and environmental justice concerns. In light of the following considerations, we recommend the agency adopt Action Alternative 3 (Reduce Hatchery Production to Reintroduction Needs) to minimize adverse impacts to naturally produced fish. We also recommend that NMFS develop an exit plan to terminate the existing artificial production facilities and programs in the Upper Willamette.

In these comments, we detail four main impact/risk categories that have been previously recognized, studied, and reviewed. Within each of these four areas, we also detail subcategories and cite specific examples of how those impacts have contributed to increased extinction risk for fish.

1. Infrastructural impacts

Infrastructural impacts arise from the captive rearing of fish in a factory setting including the (a) *physical location of the facility*, (b) *operation and resource consumption of the facility*, (c) *potential for general facility failure,* and (d) *demographic and collection impacts.*

(a) *Physical location of the facility*. Often fish factories are located in or adjacent to important floodplain habitat, causing ongoing impacts to fluvial geomorphological processes including preventing active channel migration. Many fish factories also rely upon weirs, traps, or other infrastructure within the stream channel that negatively impacts downstream habitats, impedes aquatic organism migration and negatively effects spawning and rearing behavior. #2b

(b) *Operation and resource consumption of the facility*. In order to rear fish, factories withdraw water from the stream channel or local groundwater sources to use in the facility. Factors such as flow reductions, displacing other stream-dwelling organisms crucial to the aquatic food web, and dewatering the spawning and rearing areas can all occur from extracting water from the environment surrounding the artificial propagation infrastructure. If water is returned to the stream, effluent discharges consisting of modified water temperature, pH, suspended solids, ammonia, organic nitrogen, total phosphorus, and chemical oxygen demand in the receiving stream's mixing zone can all negatively affect fish (Kendra 1991). It is also possible for Bacteria, parasites, and viruses to be introduced through this effluent discharge. Fish factory operations are required to comply with the Clean Water Act, and specifically be covered under a National Pollutant Discharge Elimination System permit. The Clean Water Act accomplishes this regulation by requiring a permit for each and every point source discharge, with effluent limits based on the more stringent of technology-based standards and standards necessary to protect water quality and existing water uses. If hatcheries are permitted with an NPDES, their permits are often administratively continued and no longer reflect current federal and state water quality standards as the Clean Water Act requires. Frequently, it is unknown how a fish factory impacts water quality, and often the magnitude of impacts depends upon the flow volume of the hatchery effluent relative to the total flow of the stream. In some circumstances, relatively small amounts of toxic discharges from fish factory effluent can cause significant harm stemming from residual chemical reagents, salts, and chlorinated water. If permits do reflect current standards, data is not presented to verify the claim that "303(d) listings are not affected in any way by the operation of the [factory] programs" (DEIS Page 30). These water quality permits are intended to protect aquatic life and public health and ensure that all artificial propagation facilities adequately treat their wastewater. Regardless of the cause of water quality impairments, fish factories may not exacerbate water quality problems in impaired watersheds.

(c) *Potential for general facility failure*. Time and again, fish factories have been subject of artificial propagation failures that cause massive die-offs in captive populations. Risks exist in water intake screens becoming plugged, the facility losing electrical power, or catastrophic loss of fish through environmental disaster such as fire, debris torrent, and flooding. Additionally, poor artificial propagation and facility maintenance is a common reason fish are unintentionally killed in fish factories.

(d) *Demographic and collection impacts*. Injury can be caused to fish populations through the collection of fish for artificial propagation in the hatchery. Usually, this impact is imposed on adult fish returning to the stream to spawn, but these impacts can also be imposed through the collection of eggs, emerging fry, and juvenile fish. By taking fish into captivity, the phenology of their upstream migration and subsequent life history is disrupted. This disruption in timing occurs primarily through the use of weirs, fish traps, and seines, which contribute to wild fish falling back into less preferable spawning and rearing areas and fish

becoming injured while trying to jump barriers within and mandated by the artificial propagation facility (Hevlin and Rainey 1993, Spence *et al.* 1996). Harm is also imposed on wild fish by the need to continually extract natural-origin individuals from the population to counteract domestication effects caused by the fish factory. This removal of individuals from the population removes nutrients from upstream reaches (Kapusinski 1997) and contributes to the decline in abundance, productivity, diversity, and spatial distribution of the threatened and endangered populations.

Infrastructural impacts are often assumed to be offset through investments in equipment or changes in artificial propagation procedures. However, the physical existence of the factory represents a permanent, negative impact on the surrounding environment and can also impose serious harm on fish populations both in and outside of the facility. In addition, the cost it takes to offset these impacts into the indefinite future is always greater than the cost of restoring watershed function and further delays investment in the root causes of decline for natural fish.

2. **Ecological Impacts**

Ecological impacts occur on an inter- and intra-species basis both inside and outside the artificial production facility. Ecological interactions occur whether or not inter-breeding occurs and are magnified if resident life histories are being produced. Ecological impacts include: (a) *disease*, (b) *competition*, (c*) behavioral modification*, and (d) *marine-derived nutrients*. Review papers by Pearsons (2008) and Kostow (2009) document numerous, serious, negative ecological consequences as a direct result of the artificial propagation of fish.

(a) *Disease:* Common diseases within hatcheries of the Northwest include Furunculosis (*Aeromonas salmonicida), Saprolegnia spp.,* Cold Water Disease *(Flavobacterium psychrophilum), Trichodinids,* bacterial kidney disease (*Renibacterium salmoninarum),* among others. Bartholomew *et al.,* 2013 is often cited as a source claiming hatcheries do not pose a risk to surrounding watersheds from artificially amplifying pathogens and parasites. However, through regular monitoring conducted by state and federal agencies, we know that disease is a constant problem when artificially rearing fish in high densities (Saunders 1991). Rearing facilities expose captive fish to increased risk of carrying pathogens because of the increased stresses associated with simplified and crowded environments. It is safe to assume that fish transferred between facilities, adult fish carcasses being out-planted into watersheds, and other fish released from factories have acted as disease vectors to wild fish and other aquatic organisms. These diseases, amplified within the factory, contribute to the mortality of fish at all life stages and can travel rapidly to areas well beyond where effluent pipes are discharged. The out-planting of juvenile and adult fish can transfer disease upstream of the rearing site, and there is the potential for lateral infection through the travel of avian, mammalian, and other terrestrial predators which overlap with the distribution of artificially propagated fish.

The release of artificially produced factory fish into the wild also poses a risk of introducing pathogens and parasites to wild populations that can result in temporary epidemics or permanent reductions in wild populations. While this risk is more difficult to quantify than genetic and competitive effects, they are unlikely to be negligible. Even an individual fish released from a pathogen-laden factory environment can transfer the infection to areas where wild fish are susceptible leading to devastating consequences. This is especially of concern with regard to local wild populations, including the majority of threatened fish

populations, that are already at depressed levels of abundance. These dynamics contribute to disease driven mortality at all life stages in wild fish populations.

(b) *Competition:* In watersheds which have a diminished fish population, competition for resources limits the abundance, productivity, diversity, and spatial distribution of wild fish populations. Competition occurs when the demand for a resource for two or more organisms exceeds that which is available. Negative impacts result from direct interactions (i.e. interference of wild fish foraging by artificially propagated fish) and through indirect means (i.e. factory fish diminish the availability of aquatic insects available as forage to wild fish). Direct and indirect impacts may arise through competition for: food resources within the stream, juvenile rearing habitat, food resources within the estuary and ocean (Levin et al. 2001), and competition for spawning sites (Buhle *et al.* 2009). These impacts are especially significant between steelhead, chinook, and coho (on an interspecific and intraspecific basis) because of the considerable overlap in habitat and foraging preferences between these species (SWIG 1984). Of great concern are the competitive ecological interactions where wild fish are displaced by artificially propagated and reared fish introduced into the same habitat.

(c) *Behavioral Modification:*

(1) *Predation by other fish & wildlife:* Fish produced in factories also bear maladaptive behaviors due to the strong selection within the artificial production facility. Due to the food distribution and rearing strategies necessary to make artificial production cost-effective, factory fish become hyper-aggressive and surface oriented, causing them to become more susceptible to predators (Hillman and Mullan 1989). Artificially produced fish also exhibit less diversity in their behaviors and life histories, allowing for predators to key in on migration timing. Especially during *en masse* factory smolt releases, wild fish can be preyed upon by pinniped, avian, and other piscivorous predators attracted to the high number of factory fish concentrated in a given area. The modification of wild fish behavior can increase vulnerability and susceptibility to predation. This dynamic can occur during juvenile releases in the freshwater environment, during estuary rearing phases, and especially when adult factory fish return to spawn and congregate in restricted areas such as below dams and partial migratory barriers.

(2) *Predation by factory fish:* Factory fish have also been documented directly preying upon smaller wild fish. This direct consumption of fry and fingerlings is highest in areas where artificially produced fish and wild fish commingle. Direct predation of wild fish by factory fish is likely highest when artificially produced smolts encounter naturally produced, emerging fry or when they are disproportionately larger than wild fish. Cases of direct predation have been documented where factory fish consume wild fish one half of their total size once they have been released (Pearsons and Fritts 1999). Hawking and Tipping (1998) observed artificially produced age 1 coho salmon and steelhead trout predating on other salmonid fry appearing to be chinook. Seward and Bjornn (1990) have also documented substantial predation impacts by artificially produced chinook preying upon their own species. If this is occuring, factory fish preying directly upon wild fish results in the direct take of ESA listed species.

(3) *Residualization:* In steelhead trout, and to a lesser extent within Chinook and coho, modified feeding behavior can affect residualization, meaning that they will not migrate to salt water, but will instead remain in the river as resident fish. Residualization is a common occurrence with artificially produced steelhead (Naman 2008, Hausch and Melnychuk 2012, Melnychuk *et al.* 2014). The addition of these residualized factory fish constitutes a significant modification to the habitat of wild salmonids. These residualized factory fish will harm, displace, and most likely prey upon other juvenile salmonids. In some areas of the Northwest, residualization rates are as high as 20-80% (Snow and Murdoch 2013, McMichael *et al.* 2014). Residualized factory fish are also not limited to the areas surrounding the factory—Schuck *et al.* (1998) reported residualized factory steelhead approximately 20 kilometers below and 10 kilometers above release sites.

(d) *Marine-derived nutrients:* As noted in the Upper Willamette Watershed [factory] genetic management plan, fish are managed solely for harvest opportunity and are not intended to provide conservation benefits to natural populations from intentional supplementation or captive breeding with the exception of factory produced Spring Chinook which are listed as threatened under the Endangered Species Act. Fisheries that meet management objectives will result in the harvest of as many factory fish as possible to limit genetic and ecological interactions. If adhering to pHOS performance targets, factory fish do not naturally contribute marine-derived nutrients. It is estimated that just 6-7% of the marine-derived nitrogen and phosphorus once delivered to rivers of the Pacific Northwest currently reach watersheds (Gresh et al. 2006). Artificial propagation has been shown to negatively influence the spatial distribution, productivity, diversity, and abundance of wild fish populations and thus also continues to exacerbate the deficit of marine derived nutrients to watersheds throughout the Northwest. The long-term reliance of out-planting post-mortem factory fish is expensive, unable to predict and account for how nutrients are naturally distributed throughout the watershed, and constitutes a dangerous vector for fish factory borne diseases to spread. As noted in Kohler *et al.* (2013), nutrient fluxes are not always unidirectional, and especially in cases with poor juvenile survival, nutrient exports through emigration to the ocean can be greater than marine-derived nutrients returning through adult anadromous fish migrations. The poor survival of artificially reared fish during outmigration to the ocean contributes to the likelihood that there will be a net export of nutrients to the ocean, rather than nutrients being delivered back to watersheds.

Overall, the ecological risk of artificial propagation is the replacement of wild fish by factory fish (Hilborn & Eggers 2000). When fish produced through artificial production interact with wild fish in a limited carrying capacity, factory fish may replace, rather than augment, wild populations (Hilborn 1992).

3. Genetic Impacts

Wild fish throughout the Northwest are defined by their sense of place, or their high fidelity to return to their birthplace. Their ability to migrate to the ocean and return to their natal stream has profound implications on population structure and has encouraged fine-scale genetic adaptations to specific habitats used throughout their lifecycle and geographic range. The genetic risks that artificial propagation poses to wild populations can be broken down into: (a) *loss of genetic variability,* (b) *outbreeding and inbreeding effects,* (c) *domestication selection,* and (d) *epigenetic impacts.* These genetic effects

are caused by removing the ability of natural mate selection when gametes are artificially inseminated in the factory.

(a) *Loss of genetic variability:* The loss of diversity occurs both within populations and between populations. Within populations, loss of genetic diversity occurs when mass artificial insemination reduces the quantity, variety, and combinations of alleles present (Busack and Currens 1995). Genetic diversity within a wild population changes from random genetic drift and from inbreeding depression. The process of genetic drift is governed by the effective population size, rather than the observed number of breeders. Although many fish might be present on the spawning grounds the effective population size is smaller than the census size. Artificial propagation has been found to reduce genetic diversity and cause higher rates of genetic drift due to small effective population sizes (Waples *et al.* 1990). Negative impacts of artificial propagation on population diversity often manifest as changes in morphology (Bugert *et al.* 1992) and behavior (Berejikian 1995).

(b) *Outbreeding and inbreeding depression:*

(1) *Inbreeding depression:* the interbreeding of individuals related to one another, occurs in the wild when populations experience significant declines due to habitat destruction, overharvest, or other factors that limit the number of fish. In fish factories, the practice of artificial insemination does not differentiate between related individuals during the fertilization process, so the likelihood of inbreeding depression is increased regardless of the population size. Inbreeding depression does not directly lead to changes in the quantity and variety of alleles but instead homogenizes the population which is then acted upon by the environment. The fish factory rearing environment, consisting of either concrete raceways or circular tanks, likely contrasts significantly to the natural selection in the stream environment, thus leading to an increase of deleterious alleles and a reduction in the fitness of the population (Waldman and McKinnon 1993). There is substantial data on the effects of inbreeding depression in rainbow trout (Hard and Hershberger 1995, Meyers et al. 1998) and in steelhead trout—this factor alone has been attributed to a 1-4% decline in productivity (Christie *et al.* 2013).

(2) *Outbreeding depression*, or the fitness and/or diversity loss associated with gene flow from other, genetically distinct fish populations, can also pose significant consequences for native fish. Fine-scale local adaptations occur through random genetic drift and natural selection (Taylor 1991, McElhany *et al.* 2000). Even with a high degree of homing behavior, some fish do return to spawn in watersheds other than where they were born. When fish successfully reproduce in watersheds in which they were not born, they are considered to have "strayed." Stray fish result in gene flow between populations. Outbreeding depression impacts natural fish populations when artificially produced fish stray at rates many times higher than natural fish, leading to interbreeding with distant wild population and causing their offspring to exhibit a lower fitness in the natural environment. Outbreeding depression is exacerbated by the factory setting because the artificial infrastructure inhibits olfactory (Dittman *et al.* 2015) and geomagnetic (Putman *et al.* 2014) imprinting on a home stream. Straying in native fish populations is a natural process which counteracts the loss of genetic diversity and helps to recolonize vacant habitat but usually occurs at very low levels (Quinn 2005). Fish artificially raised in factories can

create unnatural gene flow in terms of the sources of stray fish and the high proportion of fish that stray. The more outbreeding depression acts associated with an increase of exogenous spawners, even if immediate consequences are concealed, populations will possess less adaptive capacity to face new environmental challenges (Gharrett *et al.* 1999). It is important to note that effects arising from the interbreeding of artificially and naturally raised individuals from within the same population arise from domestication selection, which impacts act differently than outbreeding depression.

(c) *Domestication Selection* occurs when fitness loss and changes occur due to differences between the factory and natural environments. The process of domestication occurs, intentionally or unintentionally, when there are changes in the quantity, variety, and combination of alleles between artificially inseminated fish and naturally produced fish as a consequence of captivity. The National Marine Fisheries Service defines domestication as the selection for traits that favor survival within a [factory] environment (Busack and Currens 1995). Domestication selection impacts natural fish when they interbreed with artificially produced fish adapted to the factory environment and suffer a reduced fitness (Ford 2002). This can occur in three principal ways: intentional or artificial selection, biased artificial propagation, and relaxed selection:

(i) Intentional or artificial selection is the attempt to change the population to meet management needs, such as spawning time, return time, out outmigration time. Natural populations are impacted when artificially produced adults spawn with wild fish and the performance of the population is reduced. This is also a form of outbreeding depression.

(ii) Biased artificial propagation is caused during the selection and rearing of captive fish. Factory operations are always a source of biased sampling when groups of fish are fed, reared, sorted, and treated for disease.

(iii) Relaxed selection occurs through artificially high juvenile survival rates during early life stages. Factories are a simplified, sheltered environment that is meant to increase survival relative to the natural environment and allows deleterious genotypes to move into later life history stages and future generations which wouldn't otherwise be expressed.

(d) *Epigenetic change* has also recently been pinpointed as another impact causing the depletion of biological diversity associated with fish factories. Epigenetics is the study of changes in organisms caused by modification of gene expression rather than alteration of the genetic code itself. It is now well-known that the vast share of an organism's DNA remains latent and unexpressed as the organism develops and lives its life. Epigenetics is the means to study which portions of an organism's DNA are in fact expressed, and what environmental, physiological, behavioral, and other factors cause differences in gene expression as organisms develop (Gavery and Roberts 2017). The DNA of the genome confers to an organism its potential capacity to express variation and range of traits; epigenetic study provides us with the tools to understand how environmental influence controls the realized expression of DNA-determined traits, thus determining the actual health, survival, and fitness of the organism. Le Luyer at al. (2017) and Gavery and Roberts provided compelling

evidence for epigenetic changes in factory-reared fish and shellfish compared to their wild counterparts.

Given the overwhelming evidence of genetic impacts factories cause on wild fish, we also cite numerous studies showing the intersection between the four factors outlined above: Reisenbichler and Rubin (1999) reference five other studies which find that hatchery programs that captively rear fish for over 1 year (i.e. steelhead, stream-type chinook, and coho salmon) genetically change the population and consequently reduce survival for natural rearing. In the study, the authors found substantial genetic change in fitness resulting from traditional artificial propagation when fish were held in captivity for more than 25% of their lifespan. Building off of these findings, morphological and behavioral changes were found in artificially produced, adult, spring Chinook including a reduced number of eggs relative to wild fish (Bugert *et al. 1992)*. Leider *et al.* (1990) reported diminished survival and reproductive success for the progeny of artificially produced steelhead when compared to naturally produced steelhead in the lower Columbia River. The poorer survival observed for the naturally produced offspring of factory fish was likely due to the long-term artificial and domestication selection in the factory produced steelhead population as well as mal-adaptation of the fish population within the factory to the native stream environment. In a paper on the reproductive success of factory fish in the wild, it was reported that factory fish did not produce fish that could match the survival or reproductive success of wild fish even with the use of predominantly wild-origin broodstocks (Christie 2014). These findings were consistent despite differences in geographic location, study species, artificial propagation methods, and artificial rearing practices. Recent research has also documented an epi-genetic impact fish factories pose on wild fish through reduced recruitment on populations that consist of artificial production (Christie 2016). Even within a single generation, domestication selection altered the expression of hundreds of genes to rapidly favor the artificial spawning and rearing environment. Moreover, these traits could be passed along to wild populations if factory fish spawned with natural fish.

4. Indirect impacts

Because factory fish intersect considerably with naturally produced fish, they also pose indirect impacts from activities and decisions stemming from their presence. These impacts include: (a) *direct and indirect take through fisheries*, (b) *monitoring,* and (c) *opportunity costs.*

(a) *Direct/Indirect take:* Fisheries directed on artificially produced fish can also harm and/or cause wild fish mortality. Depending on how the fishery is structured, the commercial and recreational pursuit of artificially produced fish can lead to a taking of wild populations in excess of what would be compatible with their minimum viability.

(b) *Monitoring:* Under the endangered species act, monitoring and evaluation of artificial production is mandated to ensure that activities associated with captive rearing do not limit the recovery of listed populations. Monitoring activities themselves are identified as actions associated with various levels of take on listed species.

(c) *Opportunity costs:* The opportunity costs for funding factory fish programs instead of other fish creating investments like habitat restoration continue with integrated as well as segregated broodstock programs. Ogston *et al.* (2015) found that habitat restoration opportunity costs in natural fish versus artificial production were comparable on a single

brood year basis. However, habitat restoration proceeds to facilitate the natural reproduction of fish in subsequent generations while artificial rearing practices require indefinite, continued funding to support themselves.

Environmental Justice

Environmental Justice and its principles (Taylor 2000) has been largely ignored while considering the impacts of artificial production programs as they relate to fish. One example of this is the apparent role such programs play in facilitating and justifying the continued degradation of the natural environment and control of minority peoples. Fish factories concentrate power within limited government systems (agencies, decision-making processes, and knowledge banks). The condensed number of voices deciding these issues continue to reinforce the status quo without regard to other interests and perspectives—those of which would both alleviate pressures on the environment as well as open enjoyment and use of public resources to more than the fishing community. In general, the public often considers fish factories to be beneficial, rather than harmful, to naturally produced fish populations. The current rhetoric maintains that fisheries are not possible without continued factory operation. Every year, $5.7 million is spent in the Upper Willamette alone on artificially producing, captively rearing, and releasing fish because of the loss of naturally produced fish associated with human-caused habitat loss, overharvest, and hydropower development. Disproportionately, the artificial production of fish has benefited recreational and commercial fishers in stark contrast to tribal fishers, who have lost the ability to access fish, while the impacts (1-4 above) and funding burden have been externalized to all members of society (non-fishers included). However, if this type of investment in public resources currently being funneled into factory operation was reallocated to habitat restoration and reintroduction, these fisheries as a whole would be healthier and self-sustaining and more beneficial to all members of our society, eliminating the "need" for fish factories.

#3

#4

Communities of color that value fish and the habitats that support them for non-extractive direct use (tourism), for indirect values (ecosystem services), and for non-use purposes (existence, intrinsic, and bequest values) have and continue to be displaced. Continuing to operate fish factories in the Upper Willamette for fishery augmentation purposes adds an additional biological impact which contributes risk to threatened wild Chinook Salmon and winter steelhead. Adding additional risks for these species by bombarding them with artificially mass produced fish (which carry disease and weakened genetics) detracts from the transition towards a sustainable wild fishery and exacerbates the ongoing inequity disadvantaged communities experience (as discussed in Phedra, Pezzullo and Sandler 2007). The financial resources fish factory facilities require to operate also allocates resources away from solving the root problem of species and ecosystem decline, including, but not limited to, habitat restoration and pollution abatement.

#5

In the case of the Upper Willamette, hunting, foraging, and fishing were traditionally conducted by members of the Confederated Tribes of the Grand Ronde, Siletz, and Warm Springs. Many other nations not considered here likely intercepted the fish of the Upper Willamette Basin in the Lower Willamette River, Lower Columbia, estuarine, and ocean habitats, and this catch constituted a significant portion of tribal people's diets. In addition, fish represented, and continue to represent, significant spiritual meaning. Tribal participation, as sovereign nations, in decision making is important to artificial fish production considerations. To some peoples, fish factories are an expression and representation of exploitative capitalist tactics that have contributed to undermining species integrity and further contributing to the oppression of minorities.

Non-fishers should also be provided the ability to assert decision-making power on fisheries, as significant public financial resources are allocated to factory production that only benefits a few.

Place-Based Experiences

Chris Daughters, NFS McKenzie River Steward

> For the past 35 years of my life, I have fished and guided the McKenzie River. For the last ten years I have spent most of my time in the wild fish sections, below Hendricks Bridge and above Blue River. These sections have fantastic wild fish populations and offer anglers a great opportunity to catch and release wild fish.
>
> The section of river that is most adversely affected by the release of hatchery trout is the section between Blue River and Hendricks bridge. The population of wild trout is considerably smaller in this section. Dumping thousands of hatchery fish and allowing bait angling tactics in this section does significant damage to existing wild stocks (Impacts 2(a)-(d)).
>
> There are a considerable number of users on the McKenzie and many who consider the current hatchery management plan to be beneficial to local guides, businesses, and community members. While there is certainly some truth to this, I would suggest that making the beautiful McKenzie River an all wild fishery would have a greater benefit to the local economy. Opportunity would remain and more anglers would seek out the McKenzie for a "destination" fishery enhancing purveyors of all types of services success. Allowing hatchery salmon to be released over an endangered species of wild salmon in the McKenzie is absolutely baffling. I have seen zero gains in wild salmon populations on the McKenzie. They are an absolutely critical cog in nature's natural wheel of aquatic biomass on the McKenzie and rather than inhibit their success with hatchery fish we should look to other measures (Impact 2(d)). Rather than spending dollars on hatchery fish production, we should look at more habitat enhancement in the upper reaches of the McKenzie basin (Impact 4(c)). #6

Andrew Chione, NFS Yamhill River Steward

> I am a fisheries student at Oregon State University and a volunteer for the Greater Yamhill Watershed Council. For three years, I have performed volunteer spawning surveys for threatened Upper Willamette steelhead on Willamina Creek of the South Yamhill River to monitor where and when the threatened fish spawn. I still remember the first steelhead I saw. It leaped the six-foot Lower Willamina Creek falls, and the memory was forever etched into my mind. The lower waterfall was previously assumed to be a barrier to steelhead migration but when the watershed council started surveying this unmonitored native population, the spawning distribution was discovered to stretch much farther upstream, including several miles of quality spawning habitat characterized by steep, densely forested canyons and wide meadows. Much of Willamina Creek is owned by the Bureau of Land Management and the forest is managed less intensively than on private land. Remnant old-growth cedars and Douglas firs shade the stream in some areas where the steelhead spawn.

While snorkeling in my free time, I observed juvenile steelhead in Willamina Creek, Coast Creek, Agency Creek, Rock Creek, and the North Yamhill River. The Confederated Tribes of Grande Ronde monitor steelhead on Agency creek and record the number of returning fish every spring.

#6b

The mainstem Yamhill River, South Yamhill River, and some tributaries of the South Yamhill River, including Agency Creek and Rock Creek, are designated as critical habitat for Upper Willamette River steelhead. While Willamina Creek is not designated, it offers high quality, essential spawning and rearing habitat for the Yamhill river steelhead population. The Yamhill steelhead population was assigned a conservation value of low to medium by the National Marine Fisheries Service. There is uncertainty regarding the numbers of fish that returned to the Yamhill River historically and whether the population is demographically independent. However, a run of steelhead has always existed on the Yamhill and fish still returned to spawn in 2017 and 2018, when the number of Upper Willamette steelhead was critically low. This may suggest that a self-sustaining population does exist on the Yamhill River and that the watershed offers significant conservation value for these threatened fish.

The Oregon Department of Fish and Wildlife stocks hatchery rainbow trout in the Upper South Yamhill, within designated critical habitat for Upper Willamette River steelhead. The Upper South Yamhill and adjacent Willamina Creek, Agency Creek, Rowell Creek, Cosper Creek, and Rock Creek are all accessible to the hatchery trout. These tributaries all have rearing habitat for threatened Upper Willamette River steelhead. The hatchery rainbow trout are 8-14 inches, much larger than juvenile steelhead rearing in the South Yamhill and its tributaries. With 1,900 trout stocked every year between the towns of Willamina and Grande Ronde, the possibility exists for competition with and predation upon juvenile steelhead (Impacts 2(b) & 2(c)(3)). #7

None of the anglers I have met who fish the South Yamhill River fish for the hatchery rainbow trout. The river section where the fish are planted is relatively inaccessible. There are few public access points and most are steep and have an abundance of poison oak. For this reason, public turnout for hatchery rainbow trout fishing is low. The most popular sport fish on the South Yamhill River and its tributaries are coastal cutthroat trout. They are widely distributed in the watershed, fight hard, and are legal to retain from May 22 to October 31. These fish provide an excellent angling opportunity without the need for hatchery supplementation (Impact 4(a)).

There is also the very real possibility of competition between the hatchery trout and the native coastal cutthroat trout (Impact 2(b)). Nearby Huddleston Pond in the town of Willamina and Sheridan Pond in Sheridan are stocked annually with thousands of hatchery rainbow trout by ODFW. These ponds offer public bank access and a safer fishing environment for families. The opportunity for members of the public to catch and harvest trout is available at the ponds without stocking the South Yamhill River. The river with its wild cutthroat trout and the ponds with hatchery rainbow trout offer the best of both worlds for anglers. There is simply not the need for hatchery rainbow trout to be stocked in the South Yamhill River and risk competition with threatened Upper Willamette River steelhead and coastal cutthroat trout. #8

Upper Willamette River steelhead face a number of threats. The unfavorable conditions in the ocean, commercial fishing pressure, sea lions at Willamette falls, interactions with hatchery fish, degraded spawning habitat, and dams that prevent fish from reaching their historic spawning habitat. Unlike other tributaries of the Willamette River, the Yamhill River has no dam impeding fish passage. With steelhead still spawning in the Yamhill River watershed when the number of steelhead in the entire Willamette basin is critically low, eliminating threats like hatchery fish has substantial benefit for their conservation.

Barrett Ames, NFS Clackamas River Steward

I am a professional fishing guide, one of the Clackamas River stewards for the Native Fish Society, and I have a degree in Fisheries science from Virginia Tech. As a guide, I spend a majority of my time from December through June working on the Clackamas River. I have also spent many days, both professionally and personally, on the North Santiam.

I have reviewed the Upper Willamette River HGMP and my first-hand experience on these rivers makes one concern in particular jump out at me. This is the interaction between Hatchery summer steelhead smolt and the wild native winter steelhead. For nearly the entire month of April, it was difficult to impossible to fish the Clackamas river due to the extremely high density and aggressive behavior of these hatchery smolts (Impact 2(b) & 2(c)(1)). This occurred from top to bottom of the river, McCiver Park to Riverside Park. #9

During this time, my anglers caught hundreds of smolt. Only two were wild winter steelhead smolt, the rest hatchery summer smolt easily identified by the missing maxillary and larger size. Coinciding with these smolt releases, there is a temporary boom in the Merganser and Osprey populations on the lower river, greatly increasing predation (Impact 2(c)(1)). Whether coincidence or not, I found a half dozen or so dead wild chinook smolts along the shoreline in this same time period, much smaller in size than the hatchery summer steelhead smolt, and I would assume they had been outcompeted (Impact 2(b)).

On the Clackamas, this exceedance of the localized carrying capacity during smolt release seems less localized than the HGMP would lead you to believe. The consequences of this may be fairly limited on the Clackamas, with newly upgraded and effective adult and smolt passage through the River Mill dam project. It would clearly have an effect on lower mainstem and lower tributary spawning success and smolt survival, however.

And that is my concern; all of the upper Willamette waterways have higher percentages of spawning below their dams, with a much higher interaction rate between wild winter and summer hatchery smolt. Outdated or nonexistent passage systems, as well as better habitat and conditions below some of these dams (as compared to the Clackamas) all contribute to more spawning in the lower rivers and therefore more interactions (Impacts 2(b) and 3(b)(2)). #10

Experience fishing the upper half of the North Santiam has also shown me that a sizable population of residualized summer steelhead smolts inhabit this stretch (Impact 2(c)(3)). At times this can be a viable fishery for larger than average trout (all clipped smolt)! Better habitat and cooler water temperatures are probably to blame for this increase compared to the Clackamas. These residualized smolts may be the most detrimental, contributing to #11

increased competition with as well as direct predation of wild fish (Impacts 2(b) & 2(c)(2)), and increased ability to interbreed in the lower river due to their presence during wild spawning times (Impact 3(b)(2)).

Following the alarming decline of Upper Willamette River Winter steelhead and Spring chinook, I have to wonder about the continuation of the hatchery summer steelhead program. I realize it is a popular sport fishery, one I have taken part in many days. However, the real threat of extinction for these two species is not to be taken lightly! Until fish passage improves and populations increase, it doesn't seem justifiable. #12

Dave Carpenter, NFS North Santiam River Steward

North Santiam Species Source Information:

Hatchery-raised Spring Chinook in the North Santiam are comprised primarily of historical North Santiam Broodstock and descendants thereof. Hatchery-raised juveniles have their adipose fin removed or "clipped" prior to release. They are raised at the Marion Forks Hatchery upstream of the Big Cliff/Detroit complex and are transported to the Minto Facility for acclimation and release.

Wild Spring Chinook in the North Santiam hatch and rear naturally in the North Santiam Basin primarily in the mainstem, but also in some of the major tributaries of the North Santiam River.

Wild Coho Salmon hatch naturally in the North Santiam Basin primarily in the tributaries of the North Santiam River. A very large percentage hatch and rear in the unimpeded Little North Santiam and in Stout Creek, near Mehama, where one of the old hatchery operations was located. They are primarily descendants of a hatchery program operating during the 1960's. Their return numbers have increased significantly in the past 10-15 years despite not being actively managed since 1972.

Hatchery-raised Summer Steelhead are Skamania Broodstock, raised at the South Santiam Hatchery, clipped and transported to the Minto Facility for acclimation and release. Wild Winter Steelhead hatch and rear naturally in the North Santiam Basin in either the mainstem or one of the tributaries of the North Santiam River. A very large percentage hatch and rear in the unimpeded Little North Santiam River.

General Observations on the North Santiam:

Historical (pre-dam) estimates claim that the North Santiam Basin produced 60% of the Willamette Basin Spring Chinook and 35% of the Willamette Basin Winter Steelhead. Those numbers are quite a bit lower in recent years and in 2015 specifically when comparing counts at the Bennett Dams to those of Willamette Falls. It is safe to assume that some fish are harvested (or otherwise expire) from the first 16 miles of river prior to reaching Bennett Dams after leaving the Willamette Basin (and Santiam Mainstem). It's difficult to quantify those numbers.

Once fish enter the North Santiam and pass Bennett, the data shows that the majority (60%) of Spring Chinook Salmon show up at the Minto Facility – both hatchery and wild. This indicates that the remaining 40% are harvested, expire, or are left to spawn and complete their lifecycle in the mainstem North Santiam or one of the tributaries.

For Summer (hatchery) Steelhead, a similar percentage (53%) return to the release point and the remaining 47% are harvested, expire, or complete their lifecycle in the mainstem or tributaries. This is a major concern as it provides the opportunity for interbreeding of the wild and hatchery fish of both species. For Spring Chinook, this concern is slightly less because both wild and hatchery fish originate from North Santiam Broodstock. However, in the case of Steelhead, the hatchery and wild fish are completely separate strains – one being Skamania Summer Run Stock and the other being Native North Santiam Winter Run stock – vastly different from a historic and genetic perspective. (Impact 2(b)(2)). #13

I suggest the termination of the Skamania Summer Steelhead Program here on the North Santiam. In my mind, intentionally placing an introduced (invasive) species on top of an ESA listed species is outrageous. Skamania fish are proven to naturalize and not migrate (basically becoming riverine rainbow trout) (Impact 2(c)(3)). They are as proven to stray into unintended waters (Little North Santiam) and compete with native Winter Steelhead at every stage of the life-cycle (Impact 2(b)). With our Winter Steelhead in such a dire situation, continuing this program is a death sentence for our wild fish.

The hatchery fish are expensive, not just because of the millions of dollars it takes to raise, rear and release them each year, but also because of capital investment of millions of dollars to build and maintain the facilities to support the programs. Spend hatchery funds on something that really benefits wild fish. It would be a win-win. You stop putting an invasive species on top of an ESA listed species and have money going towards real improvement (Impact 4(c)). #14

<u>Observations on Cumulative Impacts related to climate change:</u>

It is my opinion that the 2015 drought conditions had some impact on anadromous fish returns in the North Santiam Basin. The impact on returning Spring Chinook adults in the North Santiam was minimal, as the bulk of the run moved through the lower (warmer) reaches of the system fairly quickly and were in cooler locations prior to July. For returning Summer Steelhead adults, the impact was far greater, as those fish take longer to reach the North Santiam after passing Willamette Falls. The Summer Steelhead are typically more evenly distributed throughout the basin, rather than race to the upper reaches like the Spring Chinook do. I assume a good number were still in the lower reaches in July when river temperatures reached into the 70's. However, since those fish were hatchery raised Skamania stock, it is likely a positive thing as it resulted in fewer of those fish around to stray and spawn with the native winter run stock.

I have more concerns about the juveniles from all species – those that were rearing and migrating out to the Pacific during the drought year. Downstream of Mehama, river temperatures climbed in the 70's from July through early September. In the Little North Santiam, where the majority of Winter Steelhead and Coho juveniles hatch and rear, the temperature reached 82 degrees at the mouth on July 2nd. We won't know for sure how

much of an impact that had on those two species in particular until that generation of fish return. I fear it will be significant.

Climate change and the prospect of future droughts occurring more often bring up serious concerns not only for anadromous species but also for the local native species populations. There was little to no snowpack in the spring of 2015. There was significantly less spring rain. Flows in the North Santiam for the 1st half of the year were 30–40% of the norm, meaning 30–40% less habitat for fish species to use. It resulted in a very condensed environment. Occurring at the same time, was the release of hatchery-raised fish into the river system. Using an analogy a fellow river steward is known to make – if the river is essentially one big aquarium – then we not only had an aquarium that was only 30-40% full, but we also dumped an additional 800,000 fish into it! Some scrutiny of this practice needs to be addressed, especially in forecasted drought years. To me, adding a typical number of hatchery fish to a system that is far less than typical capacity will lead to serious negative impacts to all species–anadromous and local population alike. (Impacts 1(b) & 2(a)-(c)). #15

***

If last year wasn't a wakeup call that hatchery management systems are a failure, then I don't know what is. Allowing ESA species to blink out on our watch, two in particular that are Pacific Northwest icons, is criminal.

I hope that you will give considerations to my concerns and ideas. We have a crisis here on our river. I am doing everything in my power to save these fish, to the detriment of my licensed fishing guide service and personal recreational angling here on the North Santiam.

Tom Derry & Terre Rogers, NFS Molalla River Stewards

Years of summer and winter hatchery programs took a huge toll on Molalla River wild winter steelhead. In 1998 Bob Hooten with ODFW discontinued both winter and summer steelhead hatchery programs. In Hooten's estimate there were 150 wild winter steelhead remaining in the Molalla at that time. Wild spring Chinook had been managed to extinction in the Molalla and wild winter steelhead came very close to suffering the same fate. The Molalla being one of the few rivers without a dam should have been a top priority for ODFW and NOAA to monitor recovery after the hatchery programs were removed. Instead, the agencies had little interest in the Molalla even though it had the best chance of recovery above Willamette Falls (Impact 4(c)).

As Molalla River Stewards our first goal was to hold on to habitat, we defeated a proposed gravel mine in the five-year floodplain. We sued the City Of Molalla for ten years of clean water act violations and won; we were awarded $130k for mitigation. We improved side channel habitat in the North Fork with four hundred pieces of large wood. We founded the Molalla River Alliance with the goal to end dispersed camping in the corridor. We secured state scenic waterway status and are working on federal wild and scenic designation. We campaigned for regulation changes that would protect native fish—no use of bait except Chinook window, no limit on bass, and moved the angling deadline down to create more sanctuary spawning water for winter steelhead along with posted signs to represent these changes. We did rapid bio assessments for 2 years to find out watershed limiting factors, paying for a portion of these assessments with SEPP funds from our lawsuit with the city. #15b

We performed spawning surveys, creel counts, and put thousands of Chinook carcasses in the river to help with nutrient shortfalls (Impact 2(d)).

Conclusions

The continued use of fish factories in the analysis area to augment fisheries cannot operate indefinitely because of their dependence on declining naturally produced fish. Due to the numerous impacts of artificially producing fish and substantial environmental justice concerns, we encourage the agency to conduct a throughout viability analysis, such as that done in the AHA model, to determine how threatened fish in the Upper Willamette are affected by the proposed alternative and make that analysis available to the public before a decision is made. #16

Thank you for the opportunity to voice our concerns about this critically important issue. We hope that NMFS values the comments raised in this letter and heeds our strong recommendation to develop an exit plan for artificial production facilities in the Upper Willamette.

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NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Gowell et al.	1	The commenter's opposition to hatcheries is noted. NMFS disagrees with the notion that hatchery programs are universally and solely harmful to salmon and steelhead; the extent to which a hatchery program may cause positive or negative effects (or both) on a receiving population of salmon or steelhead varies in each instance. In this case, as disclosed by the EIS, the hatchery salmon programs under consideration pose risks to natural-origin fish, but are also helping to increase the viability of the UWR Chinook salmon ESU by increasing natural-origin abundance through hatchery supplementation above the federal dams, and increasing the productivity and spatial structure of affected populations. In terms of preserving fishing opportunities, the hatchery programs are sole source of harvest opportunities in the Upper Willamette River. The EIS evaluates the ecological and social benefits and risks of the hatchery programs.
Gowell et al.	2	Noted. All of the agencies involved in this hatchery consultation are required to adhere to applicable laws and statutes governing their actions.
Gowell et al.	2b	Hatchery effects are noted.
Gowell et al.	3	Noted. In the EIS, section 4.8 evaluates the effects on minority populations.
Gowell et al.	4	Noted. Section 4.7 and 4.8 evaluate the effects of fisheries and minority populations.
Gowell et al.	5	Noted. Section 4.4 of the EIS evaluates effects on salmon and steelhead. Section 4.8 evaluates effects on minority populations.
Gowell et al.	6	Noted. Alternative 4 examines a scenario where all hatchery production is discontinued.
Gowell et al.	6b	Noted. As described in the Upper Willamette Recovery Plan, steelhead populations on the westside of the UWR (including the Yamhill River) are not the primary populations needed for recovery and delisting. NMFS' focus for steelhead recovery is on the eastisde of the UWR.
Gowell et al.	7	Noted. Section 4.4. of the EIS evaluates the ecological effects of the hatchery programs.
Gowell et al.	8	Noted. As mentioned in our previous response, the DEIS considers the ecological effects of the hatchery programs, including competition between various species.
Gowell et al.	9	Noted. During the period of time when hatchery fish are released, there are thousands of smolts emigrating to the ocean and therefore anglers can catch these fish. The ecological interactions between hatchery and natural fish are evaluated in section 4.4 of the EIS. The overlap in space and time is relatively limited, especially for winter steelhead.
Gowell et al.	10	Noted. Federal dams have impacted the spatial distribution of spawning in the respective population. In general, spawning habitat is of lower quality directly below the federal dams compared to historic habitat above the dams. Interactions between summer and winter steelhead is fully evaluated in the EIS. These interactions will be further reviewed in NMFS' biological opinion.
Gowell et al.	11	Noted. Section 4.4. of th EIS evaluates the ecological effects of the hatchery program in the North Santiam River. We have included studies of residual summer steelhead in the Santiam River.
Gowell et al.	12	Noted. The effects of the summer steelhead hatchery program has been evaluated in the EIS and will be scrutinized in accordance with section 7 of the ESA to determine whether it jeopardizes Upper Willamette River Chinook and steelhead. Once this consultation is completed, our analysis and conclusion of this program will be available for the public to review.
Gowell et al.	13	Noted. Please see section 4.4 of the EIS for recent percentages detailing the distribution of returning adult hatchery fish.
Gowell et al.	14	Noted. Section 4.7 of the EIS evaluates the socioeconomics of the hatchery programs.
Gowell et al.	15	Noted. Regarding juvenile salmonids, hatchery smolts emigrate downriver rapidly over a short period of time, and thus the effect is relatively short-lived in space and time. The vast majority of habitat where natural-origin salmon and steelhead reside is not affected at all. Section 5 (Cumulative Impacts) evaluates all factors affecting salmon and steelhead, including climate change.
Gowell et al.	15b	Noted.
Gowell et al.	16	Noted. The purpose of the EIS is to evaluate the risks and benefits of the hatchery programs under a range of alternatives. We have evaluated terminating the hatchery programs and it's effects. We have also evaluated increasing hatchery production and those effects. The EIS shows the risks and benefits of the hatchery programs. Our forthcoming biological opinion will conduct a more focused analysis of the effects of the proposed action on ESA-listed salmon and steelhead.

May 28, 2018

National Marine Fisheries Service
Oregon Coast Hatchery DEIS
2900 N.W. Stewart Parkway
Roseburg, Oregon 97471

Re: Proposed Spring Chinook Hatchery and Genetic Management Plans

Dear Sir/Madam:

Thank you for the opportunity to comment on the draft Environmental Impact Statement ("DEIS") prepared by the National Marine Fisheries Service ("NMFS") related to four proposed Hatchery and Genetic Management Plans ("HGMPs") for spring Chinook in the upper Willamette River basin ("UWR") in Oregon.

I am a Professor of Fish and Wildlife Genetics at the Flathead Lake Biological Station, University of Montana. I have 20 years of professional experience researching and teaching at the university level. Since 2000, I have specialized in research and teaching in the area of animal conservation, ecology, and population genetics/genomics. From 1997-2000, I was a postdoctoral research scientist in Europe working on large (five country) animal genetics projects funded by the European Union and also the National Science Foundation and the North Atlantic Treaty Organization. I received a Ph.D. in Organismal Biology and Ecology in 1997 and a M.S. in Zoology in 1992, both from the University of Montana (including a year at two Australian universities on a Fulbright fellowship). I received a Bachelor of Science degree in Biology from Iowa State University in 1988, with a minor in Animal Ecology.

Since 2005, I have spent part of my years researching and teaching as a visiting professor and senior research scientist at the Center for Investigation of Biodiversity and Genetic Resources at the University of Porto in Portugal. For the last four years, I have spent the majority of each year researching and teaching as a professor at the University of Montana's Flathead Lake Biological Station. I teach courses including advanced graduate level and undergraduate level conservation ecology, conservation genetics, and fish and wildlife genetics/genomics (population genetic data analysis; http://www.popgen.net/congen2013/).

I have conducted genetic research on fish and wildlife populations in several different countries in addition to the United States and Portugal, including in Australia as a Fulbright Fellow, and in France as a government scientist, where I won the bronze medal as a top researcher with the Centre National de la Recherche Scientifique (CNRS). I have researched a wide range of species, including goats and other ungulates, carnivores, fish, and other aquatic species. My research and teaching embraces various topics related to animal genetics/genomics, including disease diagnostics (via pathogen DNA testing), population genetics theory and modeling, adaptation in captive and domesticated populations, endangered and threatened species recovery, effects of gene flow and hybridization (introgression) on individual fitness, population size and structure, local adaptation in natural environment, and monitoring of the

genetically-effective population size and the effective number of breeders using genetic markers in natural populations.

I have conducted numerous research investigations on these subjects. I have served as a principal or co-principal investigator on more than 40 scientific research projects, and my work has produced chapters in four books, all relating to animal population genetics (one on animal domestication), and over 100 scientific papers in peer-reviewed international journals. In 2007, I co-authored a major textbook on conservation genetics, the second edition of which was published in 2013, and contains updated sections relevant to salmon hatcheries, introgression, and their effects on effective population size and fitness in wild stocks.

My recent research projects involved developing a computer program simulator to model landscape level gene flow for aquatic species in complex river systems, and peer-reviewed publications on DNA sequencing and gene flow in trout and salmon, and in wild and domestic populations (including development of novel estimators of the number of breeders (spawners) per generation from genetic marker data). My scholarship includes service on the editorial board of the journal *Conservation Biology* and as an associate editor for both *Molecular Ecology Resources* and the *Journal of Heredity*. In 2014, I was recognized as "one of the world's most influential scientific minds" by Thomson Reuters, for my research and publications over the past decade (see report at http://sciencewatch.com/sites/sw/files/sw-article/media/worlds-most-influential-scientific-minds-2014.pdf.).

I have been a member of the American Fisheries Society, the Ecological Society of America, the Society for Conservation Biology, the Society for the Study of Evolution, the Wildlife Disease Association, and the Wildlife Society. I attach my curriculum vitae, which include a list of peer-reviewed publications I have authored since 1996. I have substantial familiarity with the genetics of animal domestication, adaptation to captivity (i.e., domestication), the effects of gene flow and introgression on fitness and population persistence in fish and wildlife, local adaptation in salmonids, and statistical and molecular empirical genomics.

I have reviewed relevant portions of the DEIS and of the proposed spring Chinook HGMP for the McKenzie Hatchery. It is my professional opinion that the McKenzie Hatchery spring Chinook salmon program significantly harms wild spring Chinook salmon in the McKenzie River basin and significantly reduces the ability of the wild spring Chinook salmon population to recover. Hatchery-bred salmon and their offspring likely have significantly reduced fitness compared to wild salmon due to decades of strong domestication selection for adaptation to captivity and the hatchery environment. Adult hatchery-bred Chinook cross-breed with wild Chinook, and it is likely that the resultant offspring have reduced fitness (i.e., survival and reproduction) in the wild. This expectation has been recently confirmed by several studies of spring Chinook in the Upper Willamette Basin ("UWR"). For example a study of spring Chinook returning to the base of Cougar Dam has shown that progeny of hatchery to hatchery, or hatchery to wild, matings showed reduced fitness compared to offspring from wild origin parents (Sard, et al. 2016). Some maladapted genes introduced by hatchery-bred Chinook into the wild Chinook population could persist for many generations in the wild population. This harm is especially problematic and worrisome in the context of the McKenzie River basin, because the McKenzie #1

River wild Chinook population is a "genetic legacy" population, critical to recovery of the ESU. The McKenzie Hatchery spring Chinook program should be eliminated or greatly reduced so that it causes take of far fewer wild spawners for broodstock (<30 individuals, including mainly or only males), and avoids causing take that results from the genetic effects of large-scale hatchery smolt releases. This take caused by smolt releases should be limited (or eliminated) by releasing fewer smolts into the wild in the basin (≤77,000; assuming a return rate to the hatchery of ~0.59% and the HSRG's baseline of 5% pHOS), which will maximize the opportunity for the wild Chinook population to begin to recover its productive capacity in the context of current and future environmental selective regimes. Finally, more powerful genomic monitoring is crucially needed for all McKenzie River spring Chinook to accurately quantify the amount of introgression from hatchery fish into wild populations (including introgression of maladaptive genes) in the basin, and to quantify the effects of this introgression on the fitness (reproductive success, survival and growth) of the wild fish, in the wild.

The Genetic Importance of Wild Spring Chinook in the McKenzie River Basin.

Spring Chinook salmon in the McKenzie River basin comprise the sole "genetic legacy" population in the UWR, and are designated a "primary" population, meaning they are "of the highest biological significance" among spring Chinook salmon in the ESU. As a geneticist, these determinations mean to me that the McKenzie River wild Chinook population is the most important population within the ESU to conserve in order to maintain the adaptive potential and ensure the persistence of the ESU. #2

These determinations should be put in context not only of the ESU, but also in context of the habitat for, and status of, wild salmonids in the lower forty-eight states. Studies show that by building dams we have eliminated nearly one-half of once-accessible habitat for wild salmonids in the Pacific states. Because of dams and other factors, in the Pacific Northwest alone, some 37 genetically distinct salmon runs have been lost forever, include wild coho salmon in the Snake, Grande Ronde, Yakima, Walla Walla, and Bull Run Rivers; wild sockeye salmon in the Metolius and Wallowa Rivers; wild fall Chinook salmon in the Willamette and Umatilla Rivers; and wild spring Chinook salmon in the Lewis, White Salmon, and Klickitat Rivers. In my view, any remaining genetically distinct or viable population of wild salmon or steelhead trout is indispensable not just in the context of any ESU or DPS in which it is listed, but in the broader context of the species' range as a whole.

Broodstock Used in the McKenzie Hatchery.

The proposed HGMP for the McKenzie Hatchery at 6.2.1. states that since 1990, broodstock for the hatchery program has been derived entirely from Chinook salmon collected at McKenzie Hatchery and occasionally at Leaburg Dam on the McKenzie River. However, the earlier history of the broodstock is mixed and less certain. The HGMP notes that other Willamette River stocks have been incorporated into the broodstock at the McKenzie Hatchery over the years, and there is evidence that strays from other hatcheries were incorporated into the broodstock. The HGMP notes Oregon Department of Fish and Wildlife ("ODFW") documents with unknown authors and dates that incompletely describe a series of out-of-basin, in-and-out transfers on many occasions during the lengthy period of 1908-1993. As a result, the McKenzie #3

Hatchery fish genetic origins are diverse and uncertain but mainly from the adult returns to the McKenzie River basin. This is a critical issue as these uncertainties as to origin make the impact of interactions between hatchery and wild origin fish questionable, and likely damaging to the genetics of wild fish.

The proposed HGMP at 9 states that the McKenzie Hatchery is an "integrated program," meaning it is intended to use both wild and hatchery spring Chinook in the broodstock. The proposed HGMP at 58 states that the hatchery has a goal of integrating 5%-10% wild Chinook into the broodstock annually. The current goal is to collect 450 fish for broodstock for releases of 604,750 (this figure would change to 600 fish for broodstock if releases increase to 787,000). Between 2002 and 2012, a range of 1.2% to 10.1% (with an average of 4.1%) of the hatchery broodstock were reported to be wild (non-fin-clipped) spring Chinook. More recent analyses of salmon returning to the hatchery show that up to 80% of the fish previously assumed to be wild, and incorporated into the broodstock, were actually mismarked hatchery fish, as the proposed HGMP acknowledges at 62. This information indicates that the characterization of the McKenzie Hatchery program as an "integrated broodstock" is far outside of any appropriate use of this designation, as established below. #4

In 2000, Congress established the Pacific Northwest Hatchery Reform Project. The project led to the formation of the Hatchery Science Review Group ("HSRG"), which reported on the best available science as to how to properly manage hatcheries in the context of recovering ESA-listed salmonids. The HSRG report categorizes hatchery stocks and associated hatchery programs as either "segregated" stocks (and programs) or as "integrated" stocks and programs, depending on the origins of the hatchery stocks, the manner in which the broodstock program is managed, and the intent of the hatchery program. A segregated program is one in which the hatchery stock is founded from a non-local population, receives no regular broodstock infusions from the local wild population, and is usually managed for the purpose of harvest. An integrated program is one in which the hatchery stock is founded from and regularly includes substantial additions of local wild fish as broodstock and, as a result, may be intended to assist in the rebuilding of wild populations. In its 2004 report (Hatchery Scientific Review Group. April 2004. Principles and Recommendations of the Hatchery Scientific Review Group. p. B-4), the HSRG stated: "In practice, all hatchery programs must fall into one of the two categories; 'intermediate' programs cannot exist without imposing significant risks to natural populations because of fundamental differences in the biological principles underlying the two types of programs."

The HSRG has established guidelines for managing segregated programs due to concerns related to genetic introgression. These guidelines call for limiting maximum pHOS to less than 5%. In my opinion, even levels of zero to 5% of potential interbreeding between hatchery and wild salmon may be too high to limit or minimize negative fitness effects. The HSRG has also established guidelines for managing integrated programs. These guidelines attempt to minimize the genetic differences between the hatchery and wild populations by prescribing that a large proportion of the hatchery broodstock will be replaced each year with wild, natural-origin broodstock; that the pNOB will be kept high; and that the pHOS of the naturally spawning population will be kept low, according to a sliding scale. In my opinion, even these difficult-to-meet provisions may be insufficient to limit or minimize negative fitness effects on the wild fish.

Regardless, the McKenzie Hatchery Chinook program does not meet the HSRG definition of either a segregated or an integrated program. It is instead an "intermediate" program the HSRG correctly asserts should not exist at all, because it can have the most severely negative effects on wild fish fitness and recovery (Baskett and Waples 2013). The HSRG report states that the proportion of wild fish used in broodstock for integrated hatcheries with "primary" populations should exceed the proportion of hatchery fish that spawn among wild fish (the proportion of hatchery-origin spawners, or pHOS) by at least a factor of two, corresponding to a proportionate natural influence ("PNI") value of 0.67 or greater. It also states that the maximum allowed pHOS depends on the percentage of natural origin broodstock ("pNOB") in the hatchery broodstock, but in any case pHOS should never exceed 30%. In contrast, the proposed HGMP does not mention a PNI standard or goal for the McKenzie Hatchery program. Instead, it states the standard of < 10% pHOS, which was not listed by the HSRG as a standard recommended for integrated hatcheries, and whose origin is obscure and unexplained by documents I have reviewed. #5

It should also be recognized that the remaining number of wild spawning Chinook salmon and steelhead in the UWR are so reduced that to create a truly integrated broodstock meeting HSRG standards, the number of wild fish that would be taken from the spawning grounds would be unacceptable by any standard and likely result in the destruction of the wild population. This dilemma is presumably why the DEIS at 98 states that "Managers are planning to reduce the percentage of hatchery origin fish once natural-origin fish abundance increases (Table 26)." Neither the DEIS nor any of the HGMPs provide a basis or time-frame for this expansion of the wild salmon population.

The Johnson and Friesen Study.

The proposed HGMP at 6.2.4. states, in a discussion entitled "Genetic or ecological differences": "Using genotypic data for 13 microsatellite markers, Johnson and Friesen (2012) found no significant genetic difference between hatchery and natural-origin spring Chinook sampled in 2011 from the McKenzie River (H_0: $\theta = 0$; $p > 0.05$)." Similarly, *Reintroduction Planning: Management of Spring Chinook Salmon above Cougar Dam South Fork McKenzie River 2013 (Dec. 2012 draft)*, cites the Johnson and Friesen study, and states: "[T]here may be domestication genetic risks of using hatchery fish. McKenzie hatchery and natural spring Chinook salmon are very similar genetically (Figure 3); so the risk of using hatchery fish for reintroduction should be very low in terms of impacting the genome." #6

Neither of these broad presumptions is supportable. Johnson and Friesen "used multilocus microsatellite genotype data from 813 spring Chinook salmon *Oncorhynchus tshawytscha* to investigate patterns of genetic diversity within and among wild and hatchery populations from the Willamette River. An analysis of genetic divergence (θ) revealed little or no differentiation between hatchery and local wild populations within Willamette River subbasins." However, the authors state: "We emphasize that these results reflect changes predicted for neutral microsatellite loci, and simulations did not incorporate potential effects from selection on allele frequencies and overall population genetic diversity." The authors caution: "We again emphasize that the models of genetic change we have presented represent dynamics that might

be expected for neutral loci. Allele frequencies for genes subject to selection can be expected to respond not only to demographic variables such as migration and population size, but also to the direction and magnitude of selection. Though we found no evidence for selection having influenced GAPS or *TKU* microsatellite allele frequencies among Willamette River spring Chinook populations, it is possible that other genetic loci, not considered in this study, could be subject to disruptive natural or artificial selection."

It is improper to use solely microsatellite ("DNA") allele frequencies to determine whether significant differences exist between hatchery and wild fish, because the genetic structures that are assayed are not generally relevant to the important adaptations of the stocks in question. My conclusion in this respect is supported by the Independent Scientific Review Panel ("ISRP") report 2011-26, at 12 (Dec. 2011), which states: "In one of the FY 2012 proposals (AP-6 spring Chinook genetic diversity), microsatellite allele frequencies in hatchery and wild fish were going to be used to infer whether hatchery management was preserving life-history variation. That is, if the hatchery stocks contained the variation extant in the wild fish and allele frequencies were similar, then the implication is that genetic attributes responsible for life history variation were being preserved. This argument is not supported by empirical or theoretical justification. Allele frequency variation could be used to evaluate genetic drift, inbreeding, effective population size, and such. *But important selection could be taking place at loci not being tracked by the neutral loci*." (emphasis added.)

As far back as 1995, NMFS convened a panel of experts to consider effects of genetic introgression in salmonids. The experts expressed similar concerns about genetic interpretation of allele frequencies, finding: "More modest genetic differences may not result in such large, short-term reductions in productivity, but persistent gene flow would probably cause the replacement of local genes with non-native ones. Genetic distances derived from molecular genetic data may not reflect adaptive differences between hatchery and natural populations." (NMFS 1997. NOAA Tech Memo NMFS-NWFSC-30: Genetic Effects of Straying of Non-Native Hatchery Fish into Natural Populations. Proceedings of the Workshop June 1-2, 1995).

Johnson and Friesen found no evidence for positive selection on four immune-relevant loci (Tonteri et al. 2008), as allele frequencies at these markers were similar for the hatchery-bred and wild Chinook populations in the McKenzie River basin. It is not surprising that there is genetic *similarity* between the hatchery-bred and wild spring Chinook populations, given that: 1) the hatchery broodstock was founded by local spawners; 2) wild fish have been integrated into the hatchery broodstock and; 3) a proportion of hatchery-origin fish spawn in the wild. Since it is conceded there is no reason to believe the microsatellite DNA loci are subject to natural selection, the results of Johnson and Friesen reveal little regarding any similarities between the wild and hatchery stocks related to these adaptations. #7

The proposed HGMP and DEIS do not adequately discuss or consider all of the results of the Johnson and Friesen study, or of other important studies. Instead, the HGMP and DEIS suggest integration with wild fish could maintain heterozygosity and allelic richness in hatchery Chinook populations. The HGMP and DEIS fail to consider or discuss the likely negative fitness effects of introgression from hatchery-bred into natural-origin Chinook. In fact, the HGMP at 61 concedes: "[B]rood stock integration may not fully mitigate negative effects of hatchery fish on #8

the natural population. Chilcote et al. (2011) found no difference between integrated brood stock programs and segregated brood stock programs in terms of their relative impact on population intrinsic productivity, leading the authors to conclude that *integration may not be an effective means to eliminate the impact of hatchery programs on natural populations*." (emphasis added).

Levels of Introgression In the Context of Recovering Wild Fish Populations.

According to the McKenzie Hatchery Straying Technical Workgroup ("Assessment of Specific Actions to Reduce the Straying of Hatchery Chinook in the McKenzie River, McKenzie Hatchery Straying Technical Workgroup" (Jan. 27, 2012)), approximately 82% of the hatchery Chinook that return to the McKenzie River are collected at the hatchery, with the remaining 18% staying in the river and available to spawn with wild Chinook. This number is estimated by assuming that stray hatchery Chinook that remain in the river cross Leaburg Dam fish ladders about two miles upstream of the hatchery, where they are counted, and ignores any stray hatchery fish that do not cross the dam. *Id*., figure 3. However, large numbers of hatchery Chinook remain in the river below Leaburg Dam, and so are not counted there. For instance, in 2012, ODFW estimated that 542 of a total 821 hatchery-origin spawners in the McKenzie River, or 66% of these spawners, were downstream of Leaburg Dam. Thus, the true proportion of stray hatchery fish remaining in the McKenzie River, after collection of some of them at the hatchery, can be assumed to be much higher than 18%. #9

pHOS, which is the number of hatchery origin spawners divided by hatchery origin plus natural origin spawners, is used as a proxy for introgression of hatchery genes into wild fish populations. Measures to reduce potential genetic introgression usually focus on pHOS as the relevant metric. The proposed HGMP at 39 table 2.2.2-4 states that the weighted average pHOS for Chinook in the McKenzie River (excluding the population above Cougar Dam and Trail Bridge Dam) during the years 2005 through 2013 was 36%. McKenzie Hatchery Chinook return to spawn between two and six years after they smolt and move into the ocean, with the largest contingent returning in the fourth and fifth years. Therefore, the number of returning adult salmon in a particular year is a function primarily of the number of smolts released 4-5 years earlier. From 2001 through 2008, the average number of hatchery Chinook smolts released into the McKenzie River basin was approximately 1,193,000. Given that 1,157,000 hatchery smolts were released in 2009, approximately 1,000,000 in 2010, just over 800,000 in 2011 and 2012, and 604,750 in 2013-2017, and into the future, it is likely that the current pHOS is currently about the same as the recent average pHOS and that it will remain in this range for at least the next several years.

Hatchery Fish Harm Wild Fish.

Hatchery domestication results from a process analogous to natural selection, but it occurs under unnatural conditions—the individual fish that are "selected" are those better adapted to live in unnatural conditions (high density, no predators, no disease or different disease, unnatural food, artificial spawning). The process results in loss of the ability to avoid predation, loss of disease resistance, and loss of ability to forage and spawn efficiently (Allendorf and Hard 2010). This artificial selection pressure is strong; it results in rapid adaptation to captivity with loss of the ability to survive and reproduce effectively in the wild

(Allendorf et al. 2013). The genes underlying these maladaptive traits will likely become fixed (or increase to high frequency) in hatcheries (even after only a few months of differential survival of embryos to smolts). These domestication effects occur even when the hatchery fish are derived from the nearby local wild population and the hatchery operations regularly incorporate local wild fish into the hatchery broodstock.

Maladaptive genes from the hatchery fish will likely be transmitted to wild fish and thereby reduce the fitness of wild fish if the hatchery fish are allowed to spawn in the wild, as will occur when returning hatchery-produced adults stray onto the spawning grounds of local wild populations. Such straying has been documented as having occurred regularly in the past and is inevitable given the large number of smolts that have been released. The negative fitness effects of hatchery fish derived from local natural populations on those same natural populations are widely documented in the scientific literature (e.g., Araki et al., 2007a,b, Araki et al. 2009, Christie et al. 2011, Christie et al. 2012, Christie, et al 2014, Normandeau et al. 2009; Theriault et al. 2011; Grant 2012). This reduced fitness of wild fish from the release of hatchery fish into the habitat of wild fish and the introgression of maladaptive genes into wild fish manifests in several ways. For example, reduced fitness likely is manifested as *reduced survival* of embryos, juveniles, and adults, which results from increased susceptibility to predation, disease, and stress in general (*e.g.*, from pollution, climate warming, or variation in precipitation and stream flow associated with climate change or dams). Reduced survival likely also results because hatchery ancestry can reduce competitiveness and ability to acquire quality habitat, shelter, food resources. This reduced fitness likely is also manifested as *reduced reproductive success* in adults due to lower mating success, lower fecundity, and reduced viability of offspring, for example. Introgression into wild salmon from McKenzie Hatchery salmon likely results in many hybrid (F1) individuals that fail to survive to reproduce, thereby wasting the genetic and reproductive resources of the wild parent. #10

Given the many decades long period of domestication, a history that includes out-of-basin broodstock incorporation and low continuing incorporation of wild broodstock into the hatchery stock, McKenzie Hatchery Chinook are expected to have a substantially reduced return rate compared to wild salmon. McKenzie Hatchery Chinook spawning with wild salmon would be expected to have fitness intermediate between these. Consequently, interbreeding between local wild Chinook and stray McKenzie Hatchery Chinook throughout the McKenzie River can be expected to reduce the fitness of wild salmon that spawn with hatchery salmon by a likely biologically significant amount. This imposes a substantial genetically-based fitness burden on already depressed local populations of wild Chinook. Some of the negative effects from hatchery gene introgression can persist for many years (generations) in the wild population, however few empirical data exist on duration of effects.

The deleterious effect of hatchery introgression on wild fishes' ability to reproduce has been documented in other salmonids such as steelhead trout. These findings of these studies apply equally to Chinook, because selection for adaptation to captivity has been strong in Chinook (like in steelhead), and because empirical data from Chinook also show hatchery introgression reduces reproductive success in wild Chinook (Christie et al. 2014; see also Appendix of Hess et al. 2013). In fact, Christie et al. (2014) found a consistent reduction in reproductive success among "51 estimates from six studies on four salmon species, showing that

early-generation hatchery fish averaged only half the reproductive success of their wild-origin counterparts when spawning in the wild" and that "all species showed reduced fitness due to hatchery rearing." Importantly, this reduced fitness was for hatchery fish created with local- and predominantly wild-origin parents, with little time (generations) in the hatchery.

One study was of a wild winter-run steelhead supplementation program in the Hood River, Oregon, which was started in 1991. Conditions there allow the program to control the collection of adults for broodstock and the numbers of hatchery-produced steelhead that spawn naturally. It is important to note that such ideal conditions (bringing in new wild parents into the hatchery to reduce adaptation to captivity) are not present for most salmonid programs. The success of the Hood River program has been studied intensively by Dr. Michael Blouin and his colleagues at Oregon State University, with key results reported in numerous peer-reviewed scientific publications (including Araki et al. 2007a,b, Araki et al. 2009, Christie et al. 2011, and Christie et al. 2012). Araki et al. have shown that on average first-generation hatchery fish produced from native wild broodstock have only 60% to 80% of the reproductive success in the wild compared to the native wild fish themselves. Araki et al. have also shown that when second-generation supplementation hatchery fish (i.e., the offspring of wild-spawning first-generation hatchery fish) spawn in the wild, they also produce fewer surviving adult offspring than pure wild fish (W x W). The fact that the loss of fitness is a genetic effect (i.e., has a genetic basis), and was not an effect of the hatchery rearing environment, was demonstrated. It is likely McKenzie Hatchery Chinook introgression would cause even more severe reduction in fitness in natural-origin Chinook than was observed in Hood River, because McKenzie Hatchery Chinook have not had large regular infusions (if any recent) of wild broodstock, and have been more strongly adapted to captivity. #11

In addition to the genetic impacts from the interbreeding of hatchery Chinook with natural-origin Chinook on the natural spawning grounds in the McKenzie River basin, there is a separate demographic effect on the number of wild spawners that occurs due to the lower fitness of wild fish that interbreed with hatchery fish instead of with other members of the wild population: each generation fewer pure wild adult fish will return because fewer wild fish bred with one another than in the previous generation. If any of the progeny of the interbreeding of hatchery and wild fish do survive to return, the total returning adult population will still be smaller than if only wild fish bred with one another because each hatchery-wild mating will produce fewer returning adults than a wild-wild mating would have. If wild-hatchery matings produce no returning adults the returning adult population will be made up of only the offspring of wild-wild matings, but the total, purely wild, population will be lower in number still. Consequently, even in the extreme case where wild-hatchery matings result in no gene flow from hatchery spawners to the local wild population, the lower fitness of wild-hatchery matings in the preceding generation still produces a serious negative, though purely demographic, impact on local wild populations. This effect thus constitutes an additional threat to the viability of wild McKenzie River Chinook salmon population, along with existing and emerging disease threats (Roberts 2012; Krkosek et al. 2011). Hatcheries hold fish at high densities which increases risk of high disease prevalence and transmission. The negative demographic impacts of hatchery and disease risks also threaten the viability of the entire UWR spring Chinook ESU. #12

Introgression into natural-origin Chinook in the McKenzie River is likely to result in hybridized individuals that either fail to survive to reproduce—thereby wasting the genetic resources of the wild parent—or produce offspring whose reproductive fitness is lower than pure wild fish, resulting in offspring that contribute to a gradual lowering of the average fitness of the wild population. This type of introgression might not manifest itself as a hybrid swarm (at least initially) whereby most individuals in the wild/hybrid/hatchery population contains a mixture of genetic material from the wild and hatchery populations. Rather, introgression will likely initially result in a small to moderate number of individuals with a proportion of hatchery genes accompanied by the gradual depression of the fitness of the surviving members of the wild population. #13

Detecting and quantifying the extent of introgression will depend on several factors, including the frequency of cross-breeding, the manner by which genetic samples from the wild population are obtained, the type and genome position of genetic markers employed, and the number of genetic marker loci employed. To detect introgression, it is now standard procedure to genotype 100 to 1000 population-diagnostic or informative markers (Hohenlohe et al. 2012 and 2013; Amish et al. 2012). Tests for introgression among hatchery-bred and wild Chinook in the McKenzie River basin should include many tens of population-informative markers, rather than a dozen markers of relatively low population-diagnostic informativeness (e.g., low genetic differentiation, i.e., *F*st), such as the microsatellite DNA markers that have been used. Use of many tens of such (informative) DNA markers is the only way to ensure detection and reliable quantification of admixture, especially in cases where only a small proportion of the genome from the maladapted population (e.g., hatchery fish) is likely to introgress (Hohenlohe et al. 2013). #13b

The risks posed by the McKenzie Hatchery program are exacerbated by the lack of informative genetic markers but also the lack of sufficient monitoring for introgression of hatchery genes into wild fish populations (*e.g.*, maladaptive genes that are driven to fixation or high frequency in hatcheries). It is essentially unknown how much harmful introgression has occurred whether or not the hatchery programs will be properly monitored, nor whether sufficient funding exists for timely monitoring and evaluation of the likely harmful effects of hatchery actions. Rigorous monitoring and evaluation of hatchery programs and of their impact on wild salmonids are essential to preventing unwarranted and severe harm to wild fish populations. Improved and continual monitoring is especially important given the rapidly improving ability of biologists to use molecular and computational tools to monitor gene flow and the effects of hatchery introgression on individual fitness and population performance (*i.e.*, on population growth rate and the probability of population persistence). #14

A particular concern with introgression among hatchery and wild Chinook in the McKenzie River basin is the likelihood that a large proportion of progeny from matings between them may die at young juvenile ages before they can be included in genetic samples. This is problematic because these negative (early life stage) effects of hatchery introgression would not be detected. This would produce another deleterious demographic impact on wild populations distinct from genetic impacts; however, loss of progeny of hatchery-wild matings at young juvenile ages will considerably complicate the detection of this interbreeding by genetic methods. It is very important that a sampling study design aimed at detecting the genetic signals #15

of interbreeding between hatchery and natural-origin Chinook in the McKenzie River include acquiring samples of fertilized eggs deposited in spawning nests (redds), or at least of juveniles during the first month or two following emergence of fry from the gravel. Reliable detection of cross-breeding and assessment of negative effects of introgression requires sampling many tens or 100s of redds and/or fry and genotyping with many tens or 100s of DNA markers.

Even low rates of interbreeding in the wild between hatchery and natural-origin Chinook in the McKenzie River basin will likely have a harmful impact on the wild population, and on its long-term fitness and adaptive capacity, *i.e.*, its ability to survive, breed, and produce viable offspring in future environments. Such impacts will further threaten the viability and potential for recovery the UWR spring Chinook ESU. The ESU would best be protected from this threat by terminating releases of hatchery Chinook into the McKenzie River basin. Interbreeding of hatchery with natural-origin Chinook harms the wild population and poses a threat to its viability and adaptive potential. Short of terminating releases of hatchery-bred fish, reducing their threat to a low level is essential and will require significantly reducing the number of hatchery-bred smolts that are released. #16

The proposed HGMP and DEIS provide no reliable, hard data showing that recent levels of introgression are low. In fact, they include figures demonstrating recent average pHOS of 77% below Leaburg Dam and 26% above it. Based on the data in the HGMP and DEIS, it is likely that the amount of gene flow from hatchery to wild salmon is significant and of a magnitude to cause significant harm to the natural-origin Chinook population in the McKenzie River, given the number of recent, annual hatchery smolt releases, and the level proposed for the future. #17

These levels of hatchery smolt releases result in matings between wild and hatchery salmon with likely significant harmful effects to wild Chinook in the McKenzie River basin. These harmful effects include reduced abundance of wild adult salmon, due to the failure of the offspring of many of the hatchery-wild matings to survive to adulthood. They also include lowered reproductive performance of the progeny of hatchery-wild matings that did survive to return to reproduce in the wild. The latter would have resulted in the introgression of hatchery genes into the wild population. These individuals, progeny of hatchery-wild matings, would not have missing adipose fins like their hatchery parents, but rather would appear to be wild fish (indeed, they would be "natural-origin" fish). Some of these individuals would likely have been included in adult samples used to estimate the genetic composition of wild Chinook, and this would increase the odds that introgressed individuals would be very difficult to distinguish from true wild adults by the recent genetic tests described in the Johnson and Friesen study.

Recent introgression, as well as introgression that occurred further in the past as a result of very large hatchery smolts releases for many decades, (approximately 24 million just during the period 1978-2008 (Johnson and Friesen (2010) table 3.8) would have lowered the productivity of the wild population. Thus, the current productive capacity of the wild Chinook is in part likely a legacy of the past decades of hatchery smolt plants, among other contributing factors. This impaired productivity makes it even more critical that opportunities for introgression of McKenzie Hatchery Chinook genes into the wild Chinook population be eliminated or greatly reduced in order to maximize the opportunity for the wild salmon

population to begin to recover its productive capacity in the context of current and future environmental selective regimes (natural selection in the wild).

Another harmful impact of hatchery Chinook on wild populations is that supplementation often reduces the genetically effective size of the overall population. This is called the Ryman–Laikre effect, whereby hatchery fish supplementation leads to a reduced overall effective population size (N_e) due to increased variance in reproductive success among individuals, e.g., relatively few hatchery adults produce many offspring (Ryman and Laikre 1991). This reduced N_e increases the rate of loss of genetic variation over time (in the hatchery and the overall hatchery-wild population) and also reduces the efficiency of natural selection for local adaptation, even if the census size of the population increases from hatchery supplementation. As one example, Christie et al. (2012) found that, in the wild, "the addition of hatchery fish doubled the total number of adult fish on the spawning grounds each year, but cut the effective population size of the total population (wild and hatchery fish combined) by nearly two-thirds." The only way to know the effective size of the wild population and to know if hatchery supplementation reduces the N_e, is to use genetic markers to estimate and monitor the N_e (e.g., Luikart et al. 2010; Waples et al. 2014). Thus, it is important that the effective population size of the wild populations (e.g., in the Mainstem McKenzie, and above Cougar Dam) and also the hatchery population be estimated and monitored using genetic markers (e.g., Schwartz et al. 2007). Unfortunately, the set of genetic markers in the HGMP (10-20 microsatellites), and statistical approaches are insufficient (and insufficiently explained) to ensure reliable early detection of the negative effects of supplementation on the wild and overall effective populations size of spring Chinook salmon in the basin. #18

In spite of these facts and findings, the DEIS at 111-112 states that "hatchery fish spawning in the wild is likely providing demographic (increasing numbers of natural spawners and genetic benefits to natural populations (Johnson and Friesen 2014)." The DEIS also states: "Since short-term resiliency and long-term adaptive potential depends on genetic heterozygosity, the current hatchery programs are benefitting the conservation and recovery of natural spring Chinook populations in the UWR (Johnson and Friesen 2014)." There are at least two significant issues with this bold statement: there is no evidence of a loss of genetic heterozygosity (reduction in genetic variants) in the natural spawning spring Chinook and, despite any hypothetical benefit, their numbers continue to decline. More important, the damage to wild stocks created by introgression with hatchery fish is well documented, including in the McKenzie River. *Cf.*, *e.g.*, Sard, et al. 2016.

In sum, the McKenzie Hatchery spring Chinook program significantly harms the natural-origin spring Chinook population in the basin and its ability to recover. Hatchery Chinook (and their offspring) most likely have substantially reduced fitness compared to natural-origin Chinook due to decades of domestication and strong selection causing genetic adaptation to a hatchery environment. Some adult hatchery Chinook likely cross-breed with natural-origin Chinook, and it is highly likely that the resultant offspring have reduced fitness (*i.e.*, survival and reproduction) in the wild, especially when considering the millions of hatchery smolts released over decades. Some maladapted genes introduced into the natural-origin Chinook population may persist for many generations even after the returns of hatchery fish have ceased, thereby causing long-lasting harm to the populations. This harm from hatchery introgression, along with #19

the negative demographic effects, increased disease threats and a potential reduction of the effective population size is meaningful because the McKenzie River spring Chinook population is a "genetic legacy" population, critical to recovery of the UWR spring Chinook ESU.

Thank you for the opportunity to comment.

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Boyer, M., G. Luikart, R.F. Leary, and F.W. Allendorf. Comparison of the reliability of non-diagnostic versus diagnostic loci for estimating the proportion of admixture in individuals and populations using a Bayesian approach. In prep.

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Amish, S., Y. Hoareau, C. Almendra, N. Anderson, P.R. Clark, H. Edwards, R. Frey, M. Gruber J. Henningsen, R. Wallen, G. Luikart. Sensitive pathogen detection in nonlethal and noninvasive ungulate samples using PCR. In prep.

SELECTED GRANTS AND CONTRACTS AWARDED OR CONTINUED (Selected recent grants & contracts):

Grants Awarded or Continued as Principal Investigator/Project Director:

NSF–EID (Ecology of infectious diseases): Effects of land-use and predation risk on wildlife contact networks and Brucella transmission in the Yellowstone Ecosystem. 2010-2014.

NSF-EID: Microparasite-Macroparasite Interactions: Dynamics of Co-infection and Implications for Disease Control. V. Ezenwa, A. Jolles, G. Luikart, E. Nunn. 2007-2011.

NSF-IGERT: Montana Ecology of Infectious Diseases: Integrative Graduate Training on Multi-scalar Computational, Mathematical and Empirical Approaches to Complex Biological Problems. Added as co-PI with Bill Holben, Jesse Johnson, Jonathan Graham. 2006-2012.

NSF-OPUS: Evolutionary genetics and the conservation of exploited populations. DEB0639770. Co- PI Gordon Luikart with Fred Allendorf (PI). 2008-2011.

USGS-PNW Climate center: Predicting Climate Change Impacts on River Ecosystems and Salmonids across the Pacific Northwest: Combining Vulnerability Modeling, Landscape Genomics, and Economic Evaluations for Conservation. Funded 2012-2014. $208,000.

ARC (Australian Research Council) Linkage grant funding for a research project entitled "Genomics for persistence of Australia freshwater fish". P. Sunnucks et al. 2010-2015.

USFWS: Development and application of SNPs for estimating the number of breeders in lake trout following suppression. 2012-2013.

MFWP: New DNA Markers to assess hybridization, local adaptation, and restoration success in bull trout. 2011-2014.

MFWP: Hundreds of new SNP markers to detect hybridization in westslope cutthroat trout. 2011-2014.

MFWP: Development and Validation of Q-PCR Tests for Early Detection of Dreissenid mussels. 2011-2012.

USFS: Admixture and diversity assessments in westslope cutthroat trout of the Swan River drainage: SNP-chip analyses, 2011-2013.

POBS (Park Oriented Biological Research): Developing non-invasive techniques for bighorn sheep population estimation using fecal DNA. Kathryn A. Schoenecker, et al. 2009-2010.

NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Luikart	1	Noted. Genetic pedigree analyses, with one report cited by the commentor, evaluates the fitness of hatchery and natural salmon. In this EIS NMFS is disclosing and considering the various risks, such as fitness, pHOS, etc., as well as any benefits this hatchery program is providing to the recovery of salmon above Cougar Dam or elsewhere. For the mainstem McKenzie River, where natural production still occurs, NMFS agrees that it is prudent to manage hatchery-related risks. Actions are being implemented to reduce pHOS which will likely reduce hatchery impacts.
Luikart	2	Noted.
Luikart	3	Noted. Since ESA listing, this hatchery broodstock has been managed within the population, with no intermixing among broodstocks.
Luikart	4	Noted. The broodstock is to be managed as an integrated stock with the natural population. The appropriate levels of integration (excluding known hatchery fish that have an adipose fin) are being evaluated in this consultation.
Luikart	5	Noted. NMFS adds that the HSRG report is a guide to sound management, but it is not a rule that applies equally in every instance. Moreover, NMFS' task is to review hatchery programs as received and to determine if they meet the regulatory criteria for an exemption from §9 of the ESA. The impacts of the broodstock management aspects of this HGMP are discussed in section 4.4. of the EIS.
Luikart	6	Noted. This study helps inform management and evaluation of the broodstocks. However, NMFS relies on all available scientific information to evaluate hatchery-induced selection risks to natural populations. Since hatchery fish experience different selection pressures while in a hatchery compared to natural populations, the potential always exist for genetic differences whether we know about them or not. Our approach considers the operators' management of these risks using the best available science.
Luikart	7	Noted.
Luikart	8	Noted. It is not clear from the comment whether the statements are aimed at the HGMP or the EIS itself. Regarding the EIS, there is a wealth of science evaluating hatchery-related risks and benefits that has been considered and included in the EIS. The primary metrics being used for this program is pHOS, pNOB, and PNI. Since this program includes a goal of reintroducing Chinook salmon into historic habitats, the broodstock would need to be integrated. This consultation is evaluating the appropriate levels of integration.
Luikart	9	Hatchery salmon spawning naturally in the wild (pHOS) is accounted for throughout the entire McKenzie River in all areas. The risks, however, are not equal across all areas. Intentional hatchery supplementation is occurring above Cougar Dam. Naturally-spawning hatchery salmon occur in the lower river near the hatchery, where risks are reduced because few natural-origin fish were produced there. NMFS has evaluated all of these risks in the EIS. Also, NMFS will further analyze these effects in our forthcoming biological opinion, which will rely on the best available science, including information presented by this and other EIS comments.
Luikart	10	Noted. Research and monitoring specific to salmon in the McKenzie River through genetic pedigree analyses has evaluated the fitness of hatchery and natural salmon. We have included this information as well as other sources outside the McKenzie River in section 4.4 of the EIS.
Luikart	11	It is important to note that relative reproductive studies have found varied results, and applying the results from one population to another, and especially between species, may not be a robust comparison (see Christie et al. 2014).
Luikart	12	Noted. Available information, including ODFW's annual spawning ground surveys included in the HGMP, indicates the upper headwater areas in the McKenzie River, where the majority of natural-origin salmon spawn, have had the lowest levels of pHOS. This is good, as the spawner pairs are mostly wild x wild crosses for many generations.
Luikart	13	Noted. Section 4.4 reports the fitness of hatchery and natural salmon in the McKenzie River.
Luikart	13b	Noted.
Luikart	14	Noted. Section 4.4 of the EIS reports the best available information currently available evaluating the genetics and fitness of hatchery and natural salmon in the McKenzie River.
Luikart	15	Noted. No information is available evaluating the genetic pedigree of juvenile salmon in the McKenzie, except for some limited sampling above Cougar Dam. We have relied upon pHOS (as a measure of hatchery fish interbreeding with natural-origin salmon), and genetic pedigree analysis of returning adult salmon to inform our evaluation. NMFS believes this information provides a reasonable evaluation of the effects of hatchery salmon spawning in the wild, using the best available information.
Luikart	16	Evidence from nearby areas in the South Santiam River and Fall Creek have shown local adaptation to occur rapidly after cessation of hatchery supplementation. Results may vary, but there is no reason to expect different results in the McKenzie River as actions are implemented to reduce pHOS in this population.

Luikart	17	Noted. In section 4.4 of the EIS, the best available information is disclosed on the fitness of hatchery and natural salmon through genetic pedigree analyses. pHOS, pNOB, and PNI are reported based upon current and future expectations.
Luikart	18	Noted. Information on the effective population sizes of Chinook salmon and fitness of hatchery and natural salmon is only available from genetic pedigree analyses. NMFS believes generating this data is a high priority for funding.
Luikart	19	Noted.

NMFS Sustainable Fisheries Division

2900 NW. Stewart Parkway, Roseburg, OR

97471

April 30, 2018

RE: Comments on Draft Environmental Impact Statement (DEIS) to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for Spring Chinook salmon, steelhead and rainbow trout in the Upper Willamette River Basin Pursuant to Section 4(d) of the Endangered Species Act.

Dear Sir(s):

In this memo you will find my comments on the Willamette River HGMP DEIS.

Of most concern is the continuation of the summer steelhead program as part of Alternative 2. The DEIS clearly lays out the high impact potential this program has on ESA listed winter steelhead. Although ODFW must be commended in making changes (Table 1.16.1-2 of the HGMP) to the program overtime to reduce program effects to winter steelhead the abundance of this species continues to drop to levels that are substantially below critical levels. The last two years of late winter steelhead counts have been less than 900 adults at Willamette Falls compared to the early 2000's when run size was closer to 10,000. #1

The DEIS identified the following effects of the summer steelhead program to winter steelhead:

1. 10% of unmarked juveniles at Willamette Falls were summer –run (evidence of natural production)
2. 10% of samples were summer/winter crosses (evidence of introgression)
3. Hybridization is likely to decrease population productivity
4. Medium genetic risks
5. High residualization rate-
    a. Note that the HGMP call for the residualism rate to be less than 10%. Thus, with a release of 547,500 smolts, there could be as many 54,750 residualized summer steelhead juveniles.
6. Predation and competition effects
7. Temporary exceedance of habitat carrying capacity due to release numbers
8. Overlap in habitat usage with winter steelhead
9. Apparent competitive advantage hatchery steelhead have over naturally produced steelhead increases potential for negative interactions that could have negative population level effects
10. Displacement of naturally produced juveniles from high quality habitat
11. Ecological risks of the program is rated Medium/High
12. Predation on a variety of native species – including ESA listed Chinook

Given these effects, and current late winter steelhead abundance, it's difficult to see the logic in maintaining a hatchery program that the DEIS and the HGMP state provides no conservation benefit.

If the summer run release is included in Alternative 2 in the FEIS, then more analysis should be provided on program effects. Data provided by Kostow and Coulter on different conclusions regarding summer steelhead effects to winter steelhead would be informative.

(https://www.psmfc.org/steelhead/2016/Courter_2016_PSMFC.pdf)

Citing the performance metrics proposed in the steelhead HGMP and the actions to be taken if these metrics are not achieved would also help to illustrate how program risks are to be managed:

From the summer steelhead HGMP:

Indicator 3.4.1: A current annual hybridization rate of less than 2% in each sub-basin for three consecutive sampling years, as a measurable proxy of pHOS.

> **Monitoring and Evaluation:**
>
> Redd counts and estimates of hatchery spawners on spawning grounds are difficult to obtain during the steelhead spawn due to high flows and distribution across subbasins. Therefore random, unbiased genetic sampling of juvenile *O. mykiss* will take place in major UWR subbasins in 2018 to determine success of hatchery fish spawning in the wild and thereafter subject to funding.

Indicator 3.5.1: Specific interactions to look for are: Evidence of residualism or delayed migration that could result in competition for food and space; disease prevalence in hatchery fish that could be transferred to naturally produced fish, and risk of hatchery smolt predation on natural-origin steelhead/Chinook fry.

> **Monitoring and Evaluation:** Conduct studies evaluating interactions, subject to available funding.

Establishing clear performance metrics for indicator 3.5.1 needs to be added to the analysis as well. #2

Finally, the Steelhead HGMP states that elimination of the summer steelhead was not chosen for implementation because:

"…it has not been clearly shown that these hatchery programs are having a significant impact on the wild winter steelhead populations in these basins." (pg. 20 of Steelhead HGMP).

Thus, the HGMP is of the opinion that combined, the 11 effects of the Steelhead program presented above are insignificant. If correct, it seems dubious that the State would put a large emphasis on funding M&E activities, or achieving performance metrics.

Additional comments on the DEIS are provided below.

Comments:

Purpose and Need

The final should clarify the Purpose and Need for the Action as it is confusing. The description in the summary section states: #3

Purpose and Need

The purpose and need of the Proposed Action is two-fold: (1) for NMFS to evaluate the submitted HGMPs to ensure the hatchery programs are not jeopardizing ESA-listed salmon and steelhead, and (2) for the co-managers to operate the hatchery programs for the conservation and recovery of ESA-listed salmon and steelhead, while providing hatchery-origin fish for recreational and commercial fisheries in the Willamette River, lower Columbia River, and ocean.

In section 1.0 the Purpose and Need states:

Before these HGMPs can be approved under the ESA, NEPA requires NMFS to evaluate how proposed determination on the submitted HGMPs may affect the natural and physical environment and the relationship of people with that environment. The NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with wise use of affected resources and other legal and policy mandates.

What is not clear from the above write-ups is whether the action results in the approval of the HGMPs as submitted, or if they will undergo additional analysis under ESA once the NEPA analysis is completed. The DEIS use of HGMP target performance values in Table 2 seem to imply that no changes are proposed to the HGMPs as submitted…if this is the case it should be so stated.

Additionally, this is made more confusing because the HGMPs do not show up in the list of references, and the Steelhead and rainbow trout HGMPs are not on the NMFS web site. http://www.westcoast.fisheries.noaa.gov/hatcheries/hgmp/willamette_deis.html #4

It is suggested that a clear timeline of events and actions to be undertaken before the HGMPs are approved be included in the FEIS.

Summary of Outcomes

A table should be added to the FEIS clearly identifying the expected outcomes for each alternative. Data on total adult production, pHOS, PNI, harvest numbers, residualism, predation and number of fish available for nutrient enhancement etc. Providing this data in an easily accessible form would allow the reader to check conclusions reached by the analysis. For example, the DEIS states: #5

Since Alternative 3 would provide hatchery production only for broodstock and reintroduction purposes, other beneficial uses of the surplus adult spring Chinook salmon would be eliminated compared to the No-action alternative. No surplus adult salmon would be available for Tribal ceremonial and subsistence use, sales of fish carcasses would be eliminated, salmon provided to local food banks would be eliminated, and nutrient enhancement to the ecosystem would be eliminated from surplus hatchery carcasses. Of particular interest and value would be the loss of spring Chinook salmon provided from the Middle Fork Willamette River hatchery program to the Burns-Paiute Tribe for their ceremonial salmon

The data in Table 2 of the DEIS shows that total spring Chinook hatchery production is only reduced by ~35%; yet the DEIS claims that there would be no surplus fish, no salmon provided to food banks etc. This conclusion seems highly unlikely as there will always be high survival years when large numbers of hatchery fish return that exceed broodstock and reintroduction needs. A more accurate statement would be that the number of surplus fish would be reduced and the priority of their distribution possibly altered. Note that even at reduced production the programs provide harvest benefits. #6

Additionally, the decrease in spring Chinook production varies by subbasin so the outcome also varies. North Santiam spring Chinook production according to Table 2 is reduced by only 10%. Is a 10% reduction in hatchery production sufficient to eliminate the carcass program for example?

To illustrate that surplus fish are available:

The HGMP for the North Santiam states that they have a goal (target) of releasing 1,500 fish upstream of the dam, a broodstock need of about 500 for the smaller release and an expected SAR of 0.44%. The release of 630,000 juveniles would therefore produce an average of 2,772 fish. Broodstock needs and reintroduction account for 2,000 of these, with 772 available for harvest and other purposes.

Table S-1 Analysis

Table S-1 is supposed to provide a summary of predicted resource effects under each of the five alternatives. The text before the table seems to imply that impacts will be described using five different terms (e.g. negligible, low, high). While these terms are used for resources such as water quantity, they are not for Salmon and Steelhead and Their Habitats.

It would also be helpful if some type of numeric scale was added to the definitions. For example, summer steelhead genetic effects to winter steelhead were deemed to be medium. However, the text above Figure 18 in the DEIS indicate that 10 percent of unmarked steelhead juveniles at Willamette Falls were summer steelhead, 10 percent were summer/winter crosses and that percentages were higher in the McKenzie where most (>50%?) fish collected fit into these #7

categories. If nothing else, given the large difference in summer steelhead effects between the two sample sites, effects should be presented by population.

Residualism

Although discussed in the DEIS, the effects of juvenile summer steelhead residualism is not presented in Table S-1. Text states that residualism rates can range from 0-17%, and average 5.6% based on studies conducted regionally. For a release of 547,000 summer steelhead this means that anywhere from 0 to 90,000 (average 30,000) juveniles could be present in the system. Given the release timing of these 180-220 mm steelhead juveniles, predation risks to naturally produced spring Chinook fry may be quite high. #8

If the effect of these residuals is incorporated into the predation and competition evaluation maybe it could be footnoted?

The DEIS concludes that competition between hatchery and natural fish is expected to be low but provides little analysis to support the assumption. It also seems to be somewhat inconsistent with the data in Table 27 which rates relative magnitude of potential hatchery fish interaction with natural salmon as ranging from Low to Very High (note that the effects definition does not include Very High). #9

The Low effect conclusion is based on the small area of interaction (27% of critical) but ignores that for the near future this area constitutes the majority of the area where natural production occurs.

Under the DEIS logic, the impact should be rated as High in the short-term (15 years) due to the extensive overlap in natural and hatchery production and possibly as Low/Medium in the long term (15+ years) as fish passage facilities are developed.

Note that if the percent critical habitat overlap is used as the criterion then competition risk is the same regardless of the number of fish released. That is a release of 10 million fish has the same risk as that of a 1,000 fish release. The DEIS should consider using a hatchery fish per mile of critical habitat as an indicator of risk. It appears that a fish per mile type of approach may have been incorporated into the relative magnitude scores in Table 27, but the numbers are not presented so it is impossible to tell. #10

The table below has the number of **fish per mile** of potential overlap for each species and combined by area based on data provided in the DEIS.

	North Santiam	South Santiam	McKenzie	Middle Fork
All	15,000	24,635	26,324	88,460
Chinook	12,800	21,271	23,147	85,185
Steelhead	2,200	3,365	3,176	3,275

This data indicate that relative magnitude of interaction varies by both species and basin. The DEIS should present the data in this manner as well.

Harvest

The impacts fisheries targeting hatchery fish have on wild fish should also be included in the risks along with level of effect in Table S-1. #11

Disease

The DEIS states there is low risk of disease transference from hatchery fish to wild fish. However, it appears that C. Shasta is a concern in the Willamette River.

Infected hatchery adult fish release C. Shasta spores after death that can increase parasite abundance in future years, resulting in increased infection rates and mortality on both hatchery and wild fish. #12

Cape Cod origin rainbow trout are also susceptible to C. Shasta.

<u>NMFS 4(d) Regulations</u>

From the DEIS:

> NMFS's 4(d) regulations do not provide NMFS with the authority to order changes of this magnitude as a condition of approval of the HGMPs. NMFS's 4(d) regulations require NMFS to make a determination that the HGMPs, as submitted by the USACE, either meet or do not meet the standards prescribed in limit 5 of the 4(d) Rule. Nonetheless, NMFS supports analysis of this alternative to assist with a full understanding of potential effects on the human environment under various hatchery management scenarios.

That NMFS lacks authority to make changes to the HGMPs of a certain magnitude is surprising and should be clarified with more detail (citation?). How large a change can be made to the HGMPs and why? Can NMFS reduce hatchery production levels to protect ESA listed stocks? #13

In regards to Limit 5:

Limit 5 of the 4(d) rule has the following standards for HGMPs:

A -The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results….

E- The HGMP evaluates, minimizes, and accounts for the propagation program's genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by the straying of hatchery fish.

It is difficult to see how the Chinook and Summer Steelhead HGMPs meet the standards for competition and predation.

The Chinook HGMPs identify performance standards and indicators for a range of genetic and ecological effects but for the most part do not propose M&E activities to determine if they are being met or the actions taken if they are not achieved. #14

For example the McKenzie HGMP proposes the following:

Task 3. Conduct biological monitoring of fish rearing in hatcheries and at release.
This task involves monitoring of fish performance both in-hatchery (survival, growth) and post-release (migratory performance). The purpose of this task is to ensure that UWR hatcheries release the programmed number of fish at a size and time intended to facilitate rapid emigration. Methods for this task include compilation of growth and survival records maintained at each hatchery including representative "pre-liberation" samples for each hatchery release where size distribution and QA/QC metrics of marks and tags are recorded.

No numeric criterion (performance target) is provided for "rapid migration" nor does the HGMP state what actions would be taken if migration was determined to not be rapid. #15

The HGMP also doesn't have M&E for determining residualism rates or determining predation effects as called for in the following standards from the HGMP: #16

Standard 3.3: Reduce potential for negative ecological interactions between hatchery and naturally-produced juvenile Chinook salmon.

Indicator 3.3.1: Specific interactions to look for are: residualism or delayed migration that could result in competition for food and space, disease prevalence in hatchery fish that could be transferred to naturally-produced fish, and risk of hatchery smolt predation on natural-origin fry.

Standard 4.2: Rear and release hatchery CHS to minimize impacts to naturally-produced juvenile CHS.

Indicator 4.2.1: Hatchery fish will be released as smolts from McKenzie Hatchery in the lower McKenzie River and in time and space, and in a condition that minimizes the interaction with listed fish.

Standard 4.3: Release hatchery fish that are ready to migrate.

Indicator 4.3.1: Timely migration of all hatchery fish released as indicated by: residualism rates, rates of outmigration, precocial rates, and proportion of fish that migrate per day.

In regards to release timing and reduction in interactions, Table 1.9-1 of the McKenzie HGMP states that migration timing of hatchery juveniles will be similar to naturally produced fish; Thus, it appears the document is inconsistent as to interaction objectives (Indicator 4.2.1). #17

Because of the difficulty in actually measuring predation and competition effects, it is suggested that NMFS use their PCD-Risk Model to at least develop "indices" of predation and competition risks the hatchery programs pose to ESA listed species. #18

Summer Steelhead Program

According to the DEIS, the summer steelhead program provides no conservation benefit to ESA listed Willamette River steelhead. Its only purpose is to provide fish for harvest in primarily sport fisheries. #19

The DEIS states that summer steelhead impacts to ESA listed steelhead and Chinook can be significant due to both genetic and ecological impacts (predation and competition).

Effects identified include:

1. 10% of unmarked juveniles at Willamette Falls were summer –run (evidence of natural production)
2. 10% of samples were summer/winter crosses (evidence of introgression)
3. Hybridization is likely to decrease population productivity
4. Medium genetic risks
5. Possible high residualization rates (up to 17%) (based on hatchery release numbers possibility of 90,000 residualized summer steelhead)
    a. Note that the HGMP call for the residualism rate to be less than 10%. Thus, with a release of 547,500 smolts, there could be as many 54,750 residualized summer steelhead juveniles.
6. Possible predation and competition effects
7. Temporary exceedence of habitat carrying capacity due to release numbers
8. Overlap in habitat usage with winter steelhead
9. Apparent competitive advantage hatchery steelhead have over naturally produced steelhead increases potential for negative interactions that could have negative population level effects
10. Displacement of naturally produced juveniles from high quality habitat
11. Predation on a variety of native species – including ESA listed Chinook

Overall genetic risks of the summer steelhead program were rated as medium and ecological risks medium/high. Viability risks were rated as low to medium.

The DEIS then recommends that managers investigate and manage interactions and overlap of summer and winter steelhead on the spawning grounds (which is an opinion and should be removed). However, no performance objectives for ecological or genetic effects are described in the DEIS for summer steelhead programs (yet some are found in the HGMP). According to the Limit 5 criteria the HGMPs for summer steelhead must have: #20

5(i)(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results.

It is apparent from the analysis that the summer steelhead program as currently designed should not be implemented due to impacts to ESA winter steelhead. This is especially true given that winter steelhead counts at Willamette Falls were 822 (543 late) and ~900 in 2017 and 2018 (through April 27), respectively. #21

Possible actions that should be considered to improve the summer steelhead program:

1. Releasing fish only in those basins or areas where winter steelhead were not historically present.
2. Releasing fish only in basin where winter steelhead will not be introduced upstream of dams. #22
3. Reducing hatchery production based on wild winter steelhead abundance (i.e. sliding scale broodstock management).
4. Selecting one basin for hatchery production and eliminating or reducing in all others.

Scientific Foundation

It is not clear as to the scientific foundation the hatchery programs will be operated under. The DEIS, at least for Alternative 2, notes that metrics such as pHOS and PNI can be used as indicators of genetic effects. These are metrics that for the most part were developed/adopted by the Columbia River HSRG (www.hatcheryeform.us) and the California HSRG (www. http://cahatcheryreview.com/). The DEIS cites the HSRG in stating that the PNI should be greater than 0.67 if the desire is to have the natural environment rather than the hatchery environment influence the genetic diversity of the combined population (hatchery and natural). The DEIS states that PNI will range from 0.3 to 0.8 under Alternative 2, but does not provide data by population, nor provide any analysis of effects if PNI is less than 0.67. This data is available from the HSRG 2014 report and is shown in that reports' Table 3-2 below[1]. #23

The data in Table 3-2 indicate that the fitness (defined as the ability of salmon to survive and produce offspring) decreases as PNI decreases or as pHOS increases for segregated programs. For a PNI of 0.5, the effect to fitness is large and if this metric is used in the DEIS the impact to salmon should be rated as High in Table S-1. #24

For the segregated summer steelhead program it appears that pHOS is currently closer to 10% (High Effect) but has a goal to decrease it to 2% (Medium Effect?) based on genetic analyses.

[1] HSRG 2014. On the Science of Hatcheries. (www.hatcheryreform.us)

Table 3-2. Predicted long-term effect on fitness as a function of PHOS and PNI for segregated and integrated hatchery programs. Shading indicates HSRG standards for Primary (green) and Contributing (blue) populations.

Segregated		Integrated		
			Fitness Factor	
pHOS	Fitness Factor	PNI	pHOS=10%	pHOS=30%
2%	0.85	0.77	0.92	0.91
3%	0.76	0.75	0.91	0.9
4%	0.68	0.71	0.89	0.87
5%	0.62	0.67	0.86	0.83
6%	0.57	0.60	0.81	0.77
10%	0.20	0.50	0.74	0.67

The effect the different pHOS values have on adult abundance is shown in Table 1:

Table 1. The effect pHOS has on equilibrium adult abundance (100 generations) for various levels of pHOS for a segregated program. The analysis uses a Beverton-Holt productivity of 2.0 and capacity of 5,000. Numbers in red use the pNOB and pHOS targets identified in the HGMPs.

Segregated Hatchery Program				
Introgression Rate	Fitness	Adult Abundance	Percent Change Adult Abundance	Decrease in Adult Abundance #
0%	100%	2,500	0	0
2%	85%	2,066	-17%	434
3%	76%	1,718	-31%	782
4%	68%	1,347	-46%	1,153
5%	62%	972	-61%	1,528
6%	57%	600	-76%	1,900
10%	50%	48	-98%	2,452

In regards to integrated programs, the effect PNI has on adult abundance over 100 generations as modelled by the HSRG is shown in Table 2. As can be seen from the data operating hatchery programs at a PNI of 0.5 or 0.33 reduces theoretical adult abundance by 36% and 60%, respectively (a High Effect?).

Table 2. The effect PNI has on equilibrium adult abundance (100 generations) for various levels of pNOB and a pHOS of 10% (Integrated). The analysis uses a Beverton-Holt productivity of 2.0 and capacity of 5,000. Numbers in red use the pNOB and pHOS targets identified in the HGMPs.

Integrated Hatchery program						
PNI	pNOB	pHOS	Fitness	Adult Abundance	Percent Change Adult Abundance	Decrease in Adult Abundance #
1.0	1.0	0.0	100%	2,500	0	0
0.90	0.90	0.10	98%	2,450	-2%	50
0.80	0.40	0.10	94%	2,329	-7%	171
0.70	0.23	0.10	88%	1,976	-21%	524
0.60	0.15	0.10	81%	1,907	-24%	593
0.50	0.10	0.10	50%	1,611	-36%	889
0.33	0.05	0.10	63%	988	-60%	1,512

The DEIS also cites work done by other researchers that support assumptions that hatchery programs provide demographic benefits and increase heterozygosity as a rationale for having large numbers of hatchery fish spawning naturally. The analysis doesn't define at what NOR abundance levels which metric (PNI, spawner abundance) is more important to achieve. #25

It would improve the analysis if a rationale was provided for which metrics (PNI, pHOS, reproductive success, inbreeding, heterozygosity etc.) were prioritized for each population and why. Clear performance standards should also be provided for each of the metrics and these presented. Note that this information is not well described in the Draft HGMPs. #26

The analysis should consider prioritizing metrics in a similar manner as the HSRG (see Table 3-3

Table 3-3. Biological phases of restoration and objectives for different ecosystem conditions.

Biological Phases	Ecosystem Conditions	Objectives
Preservation	Low population abundance; habitat unable to support self-sustaining population; ecosystem changes pose immediate threat of extinction	Prevent extinction; retain genetic diversity and identity of existing population
Re-colonization	Underutilized habitat available through restoration and improved access	Re-populate suitable habitat from pre-spawning to smolt outmigration (all life stages)
Local Adaptation	Habitat capable of supporting abundances that minimize risk of extinction as well as tribal harvest needs; prevent loss of genetic diversity; and promote life history diversity	Meet and exceed minimum viable spawner abundance for natural-origin spawners; increase fitness, reproductive success and life history diversity through local adaptation
Full Restoration	Habitat restored and protected to allow full expression of abundance, productivity, life-history diversity, and spatial distribution	Maintain viable population based on all viable salmonid population (VSP) attributes using long-term adaptive management

The phases are generally based on natural origin returns to the basin with the preservation phase occurring at lowest abundance and full restoration at high abundance.

pHOS and PNI

Although discussed in the DEIS, the HGMPs either have no criteria for PNI or do not discuss the term (see North Santiam HGMP for example). Thus, the HGMPs seem to discount the importance of the criterion when operating hatchery programs. This approach may be fine but given that two scientific hatchery review groups seem to support its use as a management target…the lack of inclusion in the HGMPs need to be explained in the DEIS; especially since the objective of Alternative 2 is to use more NORs for broodstock. If not PNI, what metric is being used to determine how many NORs are needed to achieve what purpose? #27

pHOS targets are clearly defined but little information is provided on why having low pHOS is important and under what conditions. The DEIS seems to conclude that high pHOS is okay to maintain or increase heterozygosity. The question then being what is the NOR abundance break point (or genetic results) for decreasing pHOS?

The pHOS targets seem to be consistent with HSRG pHOS standards, but the link is not clearly made.

PNOB

The proportion of natural origin fish used as broodstock is referred to as pNOB. The DEIS and HGMPs state that pNOB will range from 5-10 percent once NOR run size back to the subbasins reach an identified threshold (from about 500-1,000 natural origin fish). Until this level of natural production is achieved, it appears NORs will not be included in broodstock? If this the case, then this means that in these years the programs would be run as segregated programs (i.e. no NOR fish used as broodstock). #28

Both the Columbia River HSRG and California HSRG have different pHOS guidelines for segregated and integrated programs. The Columbia River HSRG is of the opinion that pHOS for segregated programs should be less than 5% for primary populations and 10% for contributing populations. The California HSRG does not support the use of segregated programs as they are of the opinion that it is impossible in most cases to keep hatchery origin fish from spawning naturally. A segregated program is synonymous with an isolated program as defined in the DEIS. Note that the definition for this term states that an isolated program does not contribute to conservation or recovery of populations included in an ESU or DPS.

Thus, it is suggested that pNOB be greater than 0 in all years.

The DEIS should clarify if risks to natural spawning populations is higher for segregated compared to integrated programs. #29

pNOB is also used to calculate PNI:

PNI = pNOB/ (pHOS + pNOB)

The DEIS states that pNOB will range from 5-10% and that at best pHOS will be kept to below 10% (exception of above Fall Creek). This means that PNI will likely not exceed 0.5 in the majority of the populations and will be closer to 0.33 when pNOB is 5%. Both values are substantially below the 0.67 identified by the HSRG and if the data from Table 3-2 is correct results in a High decrease in population fitness and abundance (Table 2). Again, the DEIS should describe the possible effect to spring Chinook "viability" of having PNI values at these levels.

The DEIS on page 129 states that pNOB may be as high as 100%. It is not clear which program this applies to or when it will occur. Most programs state that no more than 2% of the NOR run will be used as broodstock when a run size threshold is observed.

What is the maximum number of NORs that each hatchery can use as broodstock? The take tables in the HGMPs indicate that the number of NORs used for broodstock is never sufficient to meet broodstock needs alone (i.e. 100% pNOB) and in fact is set at a maximum of 10%.

Sliding Scale pNOB

From the DEIS:

For Alternative 2, integration of natural-origin Chinook salmon into the hatchery broodstocks would be on a sliding scale basis; meaning when returns of natural-origin salmon are poor, no fish would be taken for broodstock purposes and when natural-origin salmon returns are high, a larger percentage of fish could be taken for broodstock purposes. The strategy of sliding scale broodstock integration management is to protect natural-origin salmon to the greatest extent possible when returns are low, but allow some natural-origin fish to be taken from the population for broodstock purposes when returns are higher. In

The DEIS then goes on to state that pNOB could range from 0.05-0.20, with the lowest pNOB occurring in the Middle Fork and the highest in the McKenzie. However, the McKenzie HGMP states that pNOB will range from 5-10%. The 20% value is not presented in the HGMP, nor

reflected in the take table unless it is assumed that release numbers are to be reduced. The HGMP does state that pNOB may be increased to maintain run characteristics…but no value is presented.

Additionally, the McKenzie HGMP states that no more than 2% of the NOR run will be taken for broodstock and no NORs will be collected when run size is less than 650 adults. To achieve a pNOB of 5% will require ~25 NORs based on broodstock needs of 523 adults. Given a 2% limit, then the pNOB target of 5% will not be achieved until NOR run size is 1,250 and the 10% target at 2,500.

Interaction Area

Does the title for Table 27 needs to be changed to state that these are the miles of interaction for each tributary? Interactions would occur from point of release to the ocean as evidenced by the data in the figures. #30

The DEIS states that 27% of critical habitat is affected by juvenile hatchery fish in the spring Chinook salmon ESU. However, data are not provided so that the reviewers can confirm this assumption. The number appears low given that the length of the mainstem Willamette River and Columbia River downstream of the confluence with the Willamette River (unless these reaches are not considered critical habitat?).

The DEIS states that juvenile hatchery fish are not present in 73% of the critical habitat. But as noted, naturally produced fish are not present in most of this area either…and when present are not sustainable (exception Fall Creek and Foster?). Thus, the overlap between where natural production currently occurs and hatchery releases is much higher than 27%. This may change in the future with the implementation of fish passage facilities at multiple hydro/flood projects but the implementation of these passage facilities are many years out, require congressional funding which cannot be guaranteed, and their effectiveness unknown.

Instead of using critical habitat overlap in the analysis, the overlap between natural and hatchery production/abundance should instead be used. Such a comparison provides a much more direct measure of hatchery risks. The DEIS can show how this overlap is expected to change with the implementation of foreseeable future actions such as fish passage.

Additionally, using the percent critical habitat overlap is somewhat misleading in regards to hatchery effects. For example, naturally produced spring Chinook fry and subyearlings migrating to the ocean will still be exposed to residualized hatchery steelhead in the lower portions of the basins. These steelhead may predate on these juveniles resulting in increased mortality.

Predation by residualized hatchery fish may also reduce the effectiveness of reintroduction efforts upstream of the dams. Currently, NMFS is asking that proposed fish passage facilities pass all juvenile life stages arriving at the dams. Collected fry for example would be released downstream of the dams where they may rear or migrate to the mainstem Willamette River. Residualized summer steelhead juveniles would have the opportunity to prey on these fish as well. #31

Pg. 114/115

Text on page 114 states that interaction period between hatchery and natural juveniles is short-lived…and on page 115 states that time of interaction is up to 1 -2 weeks. This seems to be inconsistent with data in the McKenzie HGMP. The data on page 78 of the McKenzie HGMP indicates that hatchery juveniles spend between 27-54 days migrating to Willamette Falls compared to 6-34 days for naturally produced juveniles. #32

A check of the PTAGIS database indicates that on average McKenzie Hatchery yearling fish released in February and March required 21 days to Migrate to Willamette Falls (Sullivan Plant) with some taking over 100 days; and 20% taking over 34 days. Would this meet the Standard of rapid migration after release?

Migration rate to Willamette Falls does not seem to be included in the other spring Chinook HGMPs.

Performance objectives for hatchery fish travel time out of the Willamette River system are also not provided in the HGMPs.

Thanks for the opportunity to comment on the DEIS. No written response is requested.

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NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Malone	1	Noted. The EIS evaluates the benefits and risks of the hatchery summer steelhead program. Under the ESA, a program can be authorized as long as it does not jeopardize the conservation and recovery of the listed species. The risks associated with this program, and measures proposed to reduce these risks are analyzed in the EIS in section 4.4. Additionally, NMFS will issue a biological opinion discussing the effects of the program on ESA-listed Upper Willamette River Chinook and steelhead in greater detail. Comments submitted here will be taken into account on assessing those effects.
Malone	2	Noted, and added to the HGMP.
Malone	3	Noted. NMFS does not make changes to the HGMPs submitted under section 4(d) of the ESA. Our regulations at 50 CFR 223.203 require us to make a determination of whether the HGMPs, as submitted, meet the standards for approval. However, NMFS works extensively with hatchery operators prior to their submission of final HGMPs, often seeking or recommending changes to the hatchery operations. Finally, the action proposed as alternative #2 is the approval of the HGMPs. NMFS is not prejudging the outcome of its approval process, but for the purposes of analyzing impacts to the environment, alternative 2 assumes that the HGMPs would be approved.
Malone	4	Noted. NMFS must fulfill our responsibilities under NEPA and ESA in evaluating the hatchery programs. This EIS is in response to NEPA. There will also be evaluations under section 7 and section 4(d) of the ESA prior to a final determination being issued.
Malone	5	Noted. The summary table in the Executive Summary provides a high-level comparison of each alternative. In response to comment, included new table on pHOS, pNOB, and PNI for salmon programs. The commentor desires a hatchery-specific summary of each alternative for a variety of juvenile and adult metrics. Our analysis quantifies these metrics to the extent possible using the best available information. For NEPA evaluations, the No-action alternative provides the baseline to which all of the other alternatives are compared. This is summarized in the Executive Summary table.
Malone	6	Agree. NMFS has edited the FEIS to reflect the comment.
Malone	7	Noted. Included new information in Table S-1 for salmon and steelhead.
Malone	8	Noted. Added language in Table S-1 for the summer steelhead program.
Malone	9	Noted. The overall effect takes into account space and time, whereas the table referenced in the comment is describing only the spatial aspect.
Malone	10	Noted. We used two metrics for evaluating ecological interactions between hatchery and natural fish: 1) degree of spatial overlap, and 2) density of hatchery fish in the affected area. In response to this comment, we have included the data used to calculate the risk determination in the Appendix of the FEIS.
Malone	11	Please see discussion regarding the effects of harvest on hatchery fish affecting naturally produced fish immediately after Table 26.
Malone	12	Noted. *C. shasta* is a well known naturally occurring disease in the Willamette River, particularly for *O. mykiss* . Measures are in place for the hatchery programs to minimize transfer to natural fish.
Malone	13	Our regulations require NMFS to make a determination whether the HGMP, as submitted, meets the requirements to approval for an exemption from section 9 of the ESA. See response to comment #3 above.
Malone	14	Noted. In the EIS, the "ecological effects" of Section 4.4 evaluates hatchery fish interactions (e.g. predation, competition) with natural-origin salmon and steelhead in affected habitats. The HGMPs describe the physiological condition of hatchery smolts when released to ensure the hatchery fish emigrate at the highest rate possible to minimize ecological interactions.
Malone	15	Noted. The risk of hatchery fish residualism depends upon the program. For summer steelhead, smolts that do not emigrate are removed and stocked into standing water bodies to minimize the effects of residuals. This program has the greatest risk of ecological effects on natural fish. Section 4.4 "Ecological Effects" of the EIS evaluates these management actions.
Malone	16	See response to comment #14. The risks of residualism and predation depend upon the hatchery program. Best management practices have been included in the HGMPs to minimize these risks for each program. The EIS includes an evaluation of these effects.
Malone	17	Noted
Malone	18	NMFS used PCDRisk modeling to evaluate ecological interactions in the section 7 Biological Opinion for evaluating the hatchery programs. That Opinion will be available for public review concurrently with publication of the final EIS.
Malone	19	Noted.
Malone	20	Noted. The EIS evaluates the proposed action (implementation of the hatchery programs via the HGMPs, including performance objectives) and a range of other alternatives.
Malone	21	Noted.

Malone	22	The proposed action regarding the summer steelhead program was determined through feedback and discussions with the co-managers. These recommendations can be brought to the co-managers and discussed more thoroughly to determine feasibility and whether the program will still meet its intended goal.
Malone	23	We refer the reader to the paragraph above Table 26 , subsection Effects of Hatchery Programs on Natural-origin Fish under Section 4.4. In that paragraph, it is stated that pHOS will be reduced once natural-origin fish increase for spring Chinook salmon and that the intent of managers is to have summer steelhead pHOS as low as possible. We also note that Table 26 has the current and desired future pHOS values for each population separately.
Malone	24	We do not dispute the modeling results from the HSRG. However, it is important that while discussing the potential effects of high pHOS (or low PNI), that other factors are considered, such as low returns of natural-origin adults. This is one of several threats to recovery, along with the risks associated with the hatchery programs.
Malone	25	Noted. In section 4.4 of the EIS, the effects of low spawner abundance and PNI are evaluated. The FEIS includes new information on PNI. Each metric is important to achieve as each represents a distinct consideration toward the effects of the proposed action on species.
Malone	26	Noted. Included new information in section 4.4 on pHOS, pNOB, and PNI.
Malone	27	We refer the reader to Table 26, where specific pHOS targets are shown. The future desired targets are from the HGMPs, including the North Santiam. In terms of discussion on the reasons for reducing pHOS, we refer the reader to language in subsection Effects of Hatchery Programs on Natural-origin Fish under Section 4.4: "Hatchery fish that spawn in the wild can interbreed with natural-origin fish and affect the genetic integrity of the natural population (Table 25). Depending upon how the hatchery broodstock has been managed, hatchery fish that interbreed with natural fish can reduce the productivity and long-term fitness of the wild population to varying degrees from inbreeding and outbreeding depression. Prior to release from the hatchery, hatchery fish experience different selection pressures than fish in the wild. This hatchery-influenced selection (often referred to as domestication) occurs in hatchery fish which may alter the genetic make-up of the natural-origin population. Consequently, when hatchery fish interbreed in the wild, genetic changes may occur to the wild population from the hatchery program depending upon the demographic condition of the natural-origin population, and level of straying and interbreeding." In addition, we refer the reader to the FEIS for additional information concerning effects of hatchery fish on natural-origin fish: " A more detailed discussion of the general effects of hatchery programs on salmon, steelhead, and their habitat can be found in the Final Environmental Impact Statement to Inform Columbia River Basin Hatchery Operations and the Funding of Mitchell Act Hatchery Programs (NMFS 2014)." And finally, "In summary, management is structured to minimize hatchery-related risks where natural production currently is occurring in greater abundance in the Clackamas River, McKenzie River, South Santiam River above Foster Dam, and Fall Creek above the dam. The goal in these population areas is to minimize pHOS and implement actions to reduce hatchery fish spawning to less than 10% (ODFW and NMFS 2011)." Also, Section 4.4.2 states, "By including natural-origin fish in the broodstock, any genetic legacy of local adaption to the natural environment will be incorporated into the population to a higher degree. If, at the same time the long-term goal of reducing pHOS is achieved, the productivity and long-term fitness of the population (and ESU) would increase."
Malone	28	Noted. pNOB is controlled by the status of natural-origin fish. We hope recovery will occur and higher integration rates will be possible.
Malone	29	Please note that the Mitchell Act FEIS is incorporated into the Willamette EIS, and there is much more information pertaining to the risks of different types of hatchery programs. On page 129, the DEIS does suggest that pNOB could be as high as 100%, but the previous sentences describe how the programs will be run on a "sliding scale," meaning that when the natural-origin run is low (regardless of which basin we are discussing), fewer natural-origin fish will be used for broodstock, and when the run is high, more will be incorporated (e.g., up to 100%). The subsequent sentences in the paragraph suggest that the McKenzie River basin is the likely hatchery program to achieve a higher pNOB because natural-origin runs are higher than the other basins where spring Chinook salmon are released.
Malone	30	Noted. We used miles of critical habitat to evaluate hatchery ecological interactions because it represents habitat of ESA-listed salmon and steelhead in the Willamette River. We calculated the proportion of overlap from critical habitat. It is not an assumption, but a calculation.
Malone	31	Noted, and while residualism is a concern for steelhead, it is less so for spring Chinook, unless excessive maturing parr are found on the spawning grounds (predation is unlikely because of size of hatchery smolts), which have not been observed in the UWR. This information can be found in the HGMPs.
Malone	32	Noted. While NMFS' conclusions are based on average migration times, we acknowledge that some fish emigrate slower than average.

MCKENZIE RIVER GUIDES ASSOCIATION

P.O. Box 464 Walterville, Oregon 97489

May 28, 2018

Barry Thom, Regional Administrator

NMFS, Oregon Coast Hatchery DEIS

2900 NW Stewart Parkway

Roseburg, Oregon 97471

willamettehatcheryEIS.wcr@noaa.gov

Dear Mr. Thom:

The McKenzie River Guides Association (MRGA) appreciates the opportunity to comment on the Upper Willamette Hatchery DEIS, March 2018. MRGA supports Alternative 2 (Proposed Action/Preferred Alternative). We understand adoption of this alternative would mean NMFS would determine that submitted HGMPs for Upper Willamette hatcheries (UWH) meet the requirements of Limit 5 under the 4(d) Rule of the ESA and that the HGMPs for the UWH would be approved under the ESA and continue to be implemented by the co-managers. We also understand that adoption of Alternative 2 means that spring Chinook salmon programs will use natural-origin salmon as brood stock. Finally, we understand the Proposed Action applies to hatchery salmon, steelhead and trout and associated facilities above Willamette Falls including those at the McKenzie Hatchery, Leaburg Hatchery, and Leaburg Dam. #1

Sincerely,

Stephen P. Mealey

President, MRGA

NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Mealey	1	Noted. Thanks for taking the time to review the EIS.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue, Suite 155
Seattle, WA 98101-3140

OFFICE OF
ENVIRONMENTAL REVIEW
AND ASSESSMENT

May 16, 2018

Lance Kruzic
NMFS West Coast Region
2900 NW Stewart Parkway
Roseburg, Oregon 97471

Dear Mr. Kruzic:

The U.S. Environmental Protection Agency has reviewed the Draft Environmental Impact Statement to Analyze Impacts of NOAA's National Marine Fisheries Service Proposed Approval of Hatchery and Genetic Management Plans for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette River Basin Pursuant to Section 4(d) of the Endangered Species Act (CEQ No. 20180045, EPA Region 10 No. 18-0013-NOA) pursuant to Section 309 of the Clean Air Act and the National Environmental Policy Act.

We agree with and appreciate the information included in the DEIS. Our environmental concerns with the proposed approval of the four hatchery and genetic management plans relate to having assurances the hatcheries are not contributing to water quality problems in the Upper Willamette River Basin, important mandates are effectively integrated into hatchery management decision-making, and known facility issues (e.g., the Willamette Hatchery broodstock pond) are considered. To address these concerns, our enclosed comments include recommendations for additional information to include in the Final EIS. Based on our review, we are rating the DEIS as Environmental Concerns – Insufficient Information (EC-2). A copy of our rating system is enclosed. #1

We appreciate the opportunity to comment on the DEIS. If you have any questions regarding these comments, the staff contact for this project is Erik Peterson. He may be reached at (206) 553-6382 or by email at peterson.erik@epa.gov, or you may contact me at (206) 553-1841 or nogi.jill@epa.gov.

Sincerely,

Jill A. Nogi, Manager
Environmental Review and Sediment Management Unit

Enclosures:

1. U.S. Environmental Protection Agency Detailed Comments on the Draft Environmental Impact Statement for the Upper Willamette River Basin Hatcheries
2. U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements

U.S. Environmental Protection Agency Detailed Comments on the Draft Environmental Impact Statement for the Upper Willamette River Basin Hatcheries

Water Quality

The EPA agrees with the DEIS that the discharge of effluent from the hatchery facility can affect the water quality of the adjacent stream or river. For example, hatchery effluent may contain elevated concentrations of nutrients, such as phosphorus, which can accelerate eutrophication processes in freshwaters. Eutrophication can lead to multiple impacts, such as low dissolved oxygen, high pH, high ammonia, excess turbidity, and reduced aesthetics, among other water quality issues.

Given that the current condition of most of the streams and rivers in the UWR exceed one or more of the Clean Water Act Section 303 water quality standards, it is important to understand whether and how these UWR hatchery facilities may cause or contribute to existing water quality problems and whether any contribution would change under the action alternatives. The DEIS concludes that the preferred alternative would have negligible water quality effects and no effect on the impaired waters listed under Section 303(d) of the CWA, the same as the No-action alternative. We agree with the DEIS's large scale water quality conclusions while also noting that there is likely going to be "...some localized impacts from hatchery effluent at the point of discharge".[1] #2

While we agree with the DEIS's water quality conclusion, we are interested in the Final EIS including additional information to support the water quality analysis. Specifically, we recommend the Final EIS include justification for the "Cause of impairment" column in Table 4, "Water source and use by hatchery facility and applicable 303(d) listings".[2]

The causes of impairment in Table 4 are used throughout the DEIS to support the conclusion that "the hatchery facilities are not identified as a cause for any of the current 303(d) listings within the UWR (*Upper Willamette River*)".[3] We note the DEIS's reference for the causes of current 303(d) listings in the UWR is the State of Oregon 2010 Integrated Report.[4] It is important to also note the Integrated Reports and 303(d) lists do not definitively identify causes of impairment, as the causes/pollutant sources are generally identified and characterized during the Total Maximum Daily Load (TMDL), or "planning" phase, of the Clean Water Act's framework to restore and protect water.[5] We suggest considering the following potential references for causes of water quality impairment include the Upper Willamette Subbasin TMDL[6] and the Willamette Basin Rivers and Streams Assessment.[7] #3

Also, the DEIS states the hatcheries have National Pollutant Discharge Elimination System (NPDES) permits "administered by the Environmental Protection Agency" and "administered by the Oregon Department of Environmental Quality".[8] Given that EPA has delegated the authority to issue NPDES #4

[1] DEIS, p. 91
[2] DEIS, p. 31
[3] DEIS, p. 30
[4] Accessed online 5/1/18 at: http://www.deq.state.or.us/wq/assessment/rpt2010/results.asp
[5] Accessed online 5/1/18 at: https://www.epa.gov/tmdl/impaired-waters-restoration-pipeline-planning
[6] Accessed online 5/1/18 at: http://www.oregon.gov/deq/FilterDocs/chpt10upperwill.pdf
[7] Accessed online 5/1/18 at: http://www.oregon.gov/deq/FilterDocs/DEQ09-LAB-016.pdf
[8] DEIS, p. 29

permits to the Oregon Department of Environmental Quality,[9] we recommend this statement "hatcheries have NPDES permits administered by the EPA be removed in the Final EIS."

Hatchery Management and Other Mandates

We appreciate that the DEIS acknowledges hatchery management must take other mandates into account, such as the 2008 Biological Opinion for the Willamette Project and the federal recovery plan for salmon and steelhead in the Upper Willamette River. The DEIS concludes that future actions associated with the Biological Opinion "...will significantly benefit these salmon and steelhead populations and their habitat once implemented."[10] The HGMPs also acknowledge the relationship between hatchery management and other mandates. All four of the HGMPs anticipate reduced hatchery production as natural production is improved by implementation of the Biological Opinion and the federal recovery plan.[11]

Because hatchery management must take other mandates into account, and because the DEIS and HGMPs acknowledge the importance of actions stemming from the Biological Opinion and recovery plan, we recommend the Final EIS include additional information on the status of implementation of the Biological Opinion and recovery plan. We further recommend the Final EIS indicate which part of the planning or implementation phase key Biological Opinion and recovery plan actions are in, such as actions related to fish passage and downstream temperature improvements at dams and screening irrigation diversions. We also suggest the Final EIS discuss the likelihood of implementation and estimated completion time of these key Biological Opinion and recovery plan actions, address whether they are reasonably foreseeable future actions and if so, analyze their impacts in the cumulative impacts chapter. #5

Attaining Hatchery Program Goals by Alternative Actions and Reforms

We appreciate that the DEIS describes how the HGMPs include actions and reforms considered by the hatchery co-managers, which could be implemented to meet program goals and objectives. Based on our review of the co-managers' actions and reforms in the HGMPs, we recommend the Final EIS include additional information on the effects of the current broodstock pond at the Willamette Hatchery. #6

We are concerned about the broodstock pond at the Willamette Hatchery because the Middle Fork Willamette Spring Chinook Salmon HGMP clearly concludes the pond is an issue of concern. According to the HGMP,[12] the "...current broodstock pond at Willamette Hatchery needs to be replaced to update infrastructure and correct water quality issues that contribute to very high PSM (*pre-spawning mortality*)."[13] Also, the HGMP concludes the broodstock pond is "...inadequate for current adult holding needs...the adults are overcrowded, not easily captured, and overly stressed which contributes to high PSM of collected broodstock."[14]

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[9] Except on tribal lands and in federal waters off the coast

[10] DEIS, p. 162

[11] HGMPs, Section 1.16, Accessed online 4/30/18 at: http://www.westcoast.fisheries.noaa.gov/hatcheries/hgmp/willamette_deis.html

[12] Accessed online 5/2/18 at: http://www.westcoast.fisheries.noaa.gov/publications/hatchery/willamette_hatcheries/middleforkwill_hgmp_publicreview.pdf

[13] Willamette Spring Chinook Salmon HGMP, p. 24

[14] Willamette Spring Chinook Salmon HGMP, p. 47

As you know, high pre-spawning mortality is a concern because addressing it requires additional medications, such as antibiotics. Antibiotics can affect the natural microbial communities that play a key role in the maintenance of soil and water quality.[15] High pre-spawning mortality is also a concern because the broodstock itself is listed as threatened or endangered under the Endangered Species Act, and because under the preferred action more natural-origin spring Chinook salmon would be used in the broodstock.

To address our concerns, we recommend the Final EIS include additional information on the effects of the current Willamette Hatchery broodstock pond. We also recommend NMFS consider incorporating actions into the preferred alternative to improve this broodstock pond up to current Integrated Hatchery Operations Team standards and guidelines. According to the HGMP, such an improvement would "…dramatically increase the survival of this ESA-listed broodstock needed for conservation/recovery efforts in the Middle Fork Willamette River, reduce annual transportation costs of adults to the hatchery from Dexter trap, and reduce annual operation costs at the hatchery (i.e. antibiotic treatments)."[16]

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[15] See Grenni *et al.*, Ecological effects of antibiotics on natural ecosystems: A review. Microchemical Journal. 2017. Accessed online 5/8/18 at:
http://www.minambiente.it/sites/default/files/archivio/allegati/reach/MicrochemicalAntibioticReview2018.pdf
[16] Willamette Spring Chinook Salmon HGMP, p. 48

U.S. Environmental Protection Agency Rating System for Draft Environmental Impact Statements Definitions and Follow-Up Action*

Environmental Impact of the Action

LO – Lack of Objections

The U.S. Environmental Protection Agency (EPA) review has not identified any potential environmental impacts requiring substantive changes to the proposal. The review may have disclosed opportunities for application of mitigation measures that could be accomplished with no more than minor changes to the proposal.

EC – Environmental Concerns

EPA review has identified environmental impacts that should be avoided in order to fully protect the environment. Corrective measures may require changes to the preferred alternative or application of mitigation measures that can reduce these impacts.

EO – Environmental Objections

EPA review has identified significant environmental impacts that should be avoided in order to provide adequate protection for the environment. Corrective measures may require substantial changes to the preferred alternative or consideration of some other project alternative (including the no-action alternative or a new alternative). EPA intends to work with the lead agency to reduce these impacts.

EU – Environmentally Unsatisfactory

EPA review has identified adverse environmental impacts that are of sufficient magnitude that they are unsatisfactory from the standpoint of public health or welfare or environmental quality. EPA intends to work with the lead agency to reduce these impacts. If the potential unsatisfactory impacts are not corrected at the final EIS stage, this proposal will be recommended for referral to the Council on Environmental Quality (CEQ).

Adequacy of the Impact Statement

Category 1 – Adequate

EPA believes the draft EIS adequately sets forth the environmental impact(s) of the preferred alternative and those of the alternatives reasonably available to the project or action. No further analysis of data collection is necessary, but the reviewer may suggest the addition of clarifying language or information.

Category 2 – Insufficient Information

The draft EIS does not contain sufficient information for EPA to fully assess environmental impacts that should be avoided in order to fully protect the environment, or the EPA reviewer has identified new reasonably available alternatives that are within the spectrum of alternatives analyzed in the draft EIS, which could reduce the environmental impacts of the action. The identified additional information, data, analyses or discussion should be included in the final EIS.

Category 3 – Inadequate

EPA does not believe that the draft EIS adequately assesses potentially significant environmental impacts of the action, or the EPA reviewer has identified new, reasonably available alternatives that are outside of the spectrum of alternatives analyzed in the draft EIS, which should be analyzed in order to reduce the potentially significant environmental impacts. EPA believes that the identified additional information, data, analyses, or discussions are of such a magnitude that they should have full public review at a draft stage. EPA does not believe that the draft EIS is adequate for the purposes of the National Environmental Policy Act and or Section 309 review, and thus should be formally revised and made available for public comment in a supplemental or revised draft EIS. On the basis of the potential significant impacts involved, this proposal could be a candidate for referral to the CEQ.

* From EPA Manual 1640 Policy and Procedures for the Review of Federal Actions Impacting the Environment. February, 1987.

NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Nogi	1	Noted.
Nogi	2	Noted.
Nogi	3	Noted. Revised as stated.
Nogi	4	Noted. Revised as stated.
Nogi	5	Noted. We have included information on the implementation of some RPA actions in the Biological Opinion for this consultation. For more information, we suggest contacting the USACE for updated schedules.
Nogi	6	Noted. Further information on the broodstock pond at Willamette Hatchery is included in the Biological Opinion for this consultation.

Association of Northwest Steelheaders

6641 SE Lake Rd. • Milwaukie OR 97222
503-653-4176
office@anws.org • www.nwsteelheaders.org

Established 1960

May 29, 2018

Via Electronic Mail

National Marine Fisheries Service
Sustainable Fisheries Division,
2900 NW Stewart Parkway,
Roseburg, OR 97471
WillamettehatcheryEIS.wcr@noaa.gov

Re: Comments to Upper Willamette River Hatchery DEIS

Dear Sir or Madame:

Thank you for the opportunity to provide comments to the National Oceanographic and Atmospheric Administration's (NOAA) draft environmental impact statement (DEIS) concerning Hatchery and Genetic Management Plans (HGMPs) for spring Chinook salmon, steelhead, and rainbow trout in the Upper Willamette Basin. The Association of Northwest Steelheaders (Steelheaders) appreciates the time, effort and resources invested in the preparation of the DEIS and encourages NOAA to complete the Final EIS/Record of Decision and Endangered Species Act (ESA) Rule 4(d) process as soon as practicable so that natural-origin spring Chinook may be incorporated into hatchery broodstocks as called for in the 2008 Biological Opinion. #1

Steelheaders was founded in 1960 and is one of the oldest sport fishing advocacy and conservation organizations in the Pacific Northwest. Steelheaders is a 501(c)(3) non-profit organization incorporated in Oregon with 11 chapters and approximately 1600 members, a great many of whom live and fish for salmon, steelhead, and trout in the Willamette Basin. The mission of the Steelheaders is to enhance and protect fisheries and fish habitats for today and tomorrow, with our vision being abundant and sustainable fisheries in healthy watersheds. Steelheaders thus support both the conservation and recovery of native salmonids in their natural habitat, and abundant and sustainable recreational fisheries and the hatchery programs that support those fisheries. #2

In support of its mission, last year Steelheaders launched a campaign ("Quest for 100K") to significantly increase the abundance of Willamette River Basin spring Chinook salmon. The campaign seeks to promote and support conservation and enhancement measures that will benefit both hatchery and natural-origin ("wild") salmon and steelhead and the fisheries they support. The conservation and

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Established 1960

management of Willamette Basin salmon, steelhead, and trout populations and associated fisheries are thus of utmost importance to Steelheaders and its members.

DEIS Comments

In the Willamette Basin, wild spring Chinook salmon and winter steelhead populations are mere shadows of their former abundances. Although there are many factors for their declines, the current key limiting factors to recovery are impassible dams, which block access to hundreds of miles of spawning and rearing habitat, and degraded habitat quality and quantity, particularly in lowland areas of the Willamette Valley and lower Columbia River.

As the DEIS notes, in light of these limiting factors, in some cases, hatchery fish can play an important role in the recovery and rebuilding of wild populations. Moreover, hatchery salmon, steelhead and trout programs in the Willamette Basin are vital mitigation measures necessary to maintain and support sustainable recreational and commercial harvest fisheries in the face of reduced abundance and productivity of wild populations.

While we appreciate that hatchery fish pose some risks to natural populations, we believe that science-based best management practices can significantly reduce those risks, and we support hatchery reform efforts to ensure that hatcheries are operated in a manner compatible with wild salmon and steelhead conservation and recovery efforts.

Accordingly, Steelheaders support the purpose and need of the proposed action – "to operate the hatchery programs for the conservation and recovery of ESA-listed salmon and steelhead, while providing hatchery-origin fish for recreational and commercial fisheries in the Willamette River, lower Columbia River, and ocean." DEIS at iv. #3

The DEIS notes that the primary change to hatchery operations under the proposed alternative will be the use of natural-origin spring Chinook salmon for broodstock purposes, as was identified as a Reasonable and Prudent Alternative in NMFS' 2008 Biological Opinion. DEIS at v.

The Steelheaders support the proposed alternative and are optimistic that the incorporation of natural-origin Chinook into hatchery broodstocks will not only decrease the genetic risks of hatchery operations and potentially increase the fitness and productivity of the integrated populations, but also potentially benefit recreational and commercial fishing through increased return rates of hatchery-origin fish. #4

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The Steelheaders have witnessed, and indeed participated in, successful natural-origin broodstock programs elsewhere (e.g., wild broodstock hatchery winter steelhead programs on the Wilson and Nestucca Rivers), and are hopeful that such success can be repeated in the Willamette Basin.

With respect to the DEIS's discussion of the risks posed by hatchery summer steelhead to wild winter populations, and specifically to the fraction of hybrid hatchery x wild smolts observed, we note that the authors in the cited study emphasized "that the[ ] estimates of hybrid fraction likely represent cumulative effects from multiple generations of natural production by hatchery summer steelhead in the basin and may therefore exceed pHOS of any single generation." Johnson 2013 at 27. Indeed, out-of-DPS-origin hatchery summer steelhead have been planted in the upper Willamette Basin for nearly half a century, yet the native natural-origin winter steelhead population remains genetically distinct, and the "magnitude of risk appears to be low." Johnson 2013 at 29. #5

Noteworthy also is ODFW's recent population viability analysis which determined that the extinction risk of upper Willamette native winter steelhead was low in the absence of sea lion predation at Willamette Falls. This suggests that in considering all of the limiting factors and threats (including hydropower, sea lion predation, and habitat degradation), hatchery impacts are low on the list of concerns for the viability of upper Willamette native winter steelhead DPS. DEIS at 127. #6

Finally, we wish to stress that hatchery winter steelhead programs in the upper Willamette were terminated long ago, and the impact of eliminating hatchery summer steelhead in the Willamette Basin (such as under Alternatives 3 & 4) would be a drastic reduction in steelhead fishing opportunity, and a complete elimination of harvest opportunity. #7

Thank you for considering our comments to the DEIS.

Respectfully,

Bob Rees

Bob Rees, Executive Director

NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Rees	1	NMFS appreciates the encouragement to complete the EIS and ROD, and will be doing so after the comment period is complete.
Rees	2	Noted.
Rees	3	Noted.
Rees	4	Noted.
Rees	5	Noted.
Rees	6	NMFS agrees that the risk to UWR steelhead posed by hatchery programs is one of several important limiting factors with respect to achieving viability of the species.
Rees	7	Noted.

May 28, 2018

National Marine Fisheries Service
Oregon Coast Hatchery DEIS
2900 N.W. Stewart Parkway
Roseburg, Oregon 97471

Re: Proposed Spring Chinook Hatchery and Genetic Management Plans

Dear Sir/Madam:

Thank you for the opportunity to comment on the draft Environmental Impact Statement ("DEIS") prepared by the National Marine Fisheries Service ("NMFS") related to four proposed Hatchery and Genetic Management Plans ("HGMPs") for spring Chinook in the upper Willamette River basin ("UWR") in Oregon.

My name is Arlen Thomason. I am a member of McKenzie Flyfishers. I attach to these comments documents referred to in our group's comments.

Exhibit A is McKenzie River pHOS. It shows the actual pHOS for years 2002 through 2014. The dotted line shows the mandated pHOS level of 10%.

Exhibit B is Proportion of Redds below Leaburg Dam. It shows the level of Chinook salmon spawning redds below Leaburg Dam, as a proportion of the total redds in the McKenzie River, for years 2002 through 2014. The diagonal line is the software-generated trend line over that period.

Exhibit C is Leaburg Dam monthly returns 2010-13 (table). It tabulates the counts of returning Chinook salmon, both marked (hatchery) and unmarked (wild), during the return months of April – October; for years 2010-2013.

Exhibit D is Leaburg Dam monthly returns 2010-13 (graph). It graphs the counts of returning Chinook salmon, both marked (hatchery) and unmarked (wild), during the return months of April–October; for years 2010-2013.

Exhibit E is Leaburg Dam Ladder Trap Operation. It tabulates the counts of hatchery Chinook salmon removed at the Leaburg ladder trap during the return months of April—October for years 2011—2013.

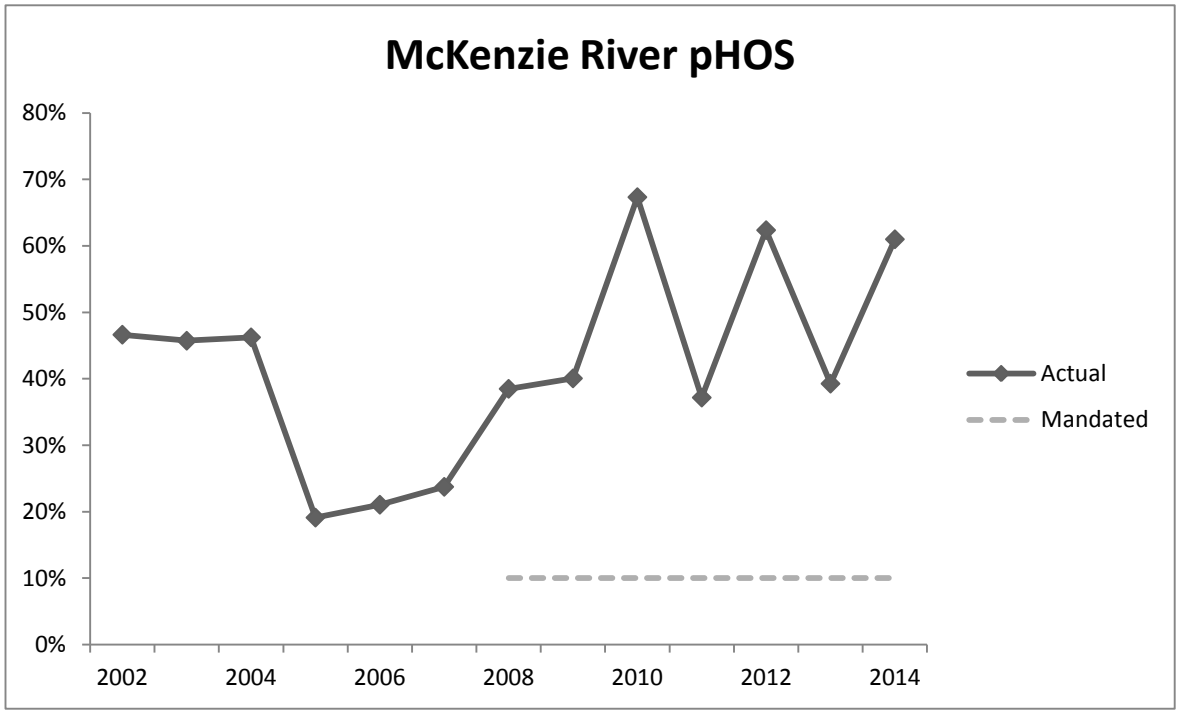
Exhibit F is Number of McKenzie River Wild Chinook Spawners. It tabulates the number of spawning salmon in the mainstem McKenzie River over the last five years.

Exhibit G is an excerpt from a draft HGMP for the McKenzie Hatchery submitted by the U.S. Army Corps of Engineers.

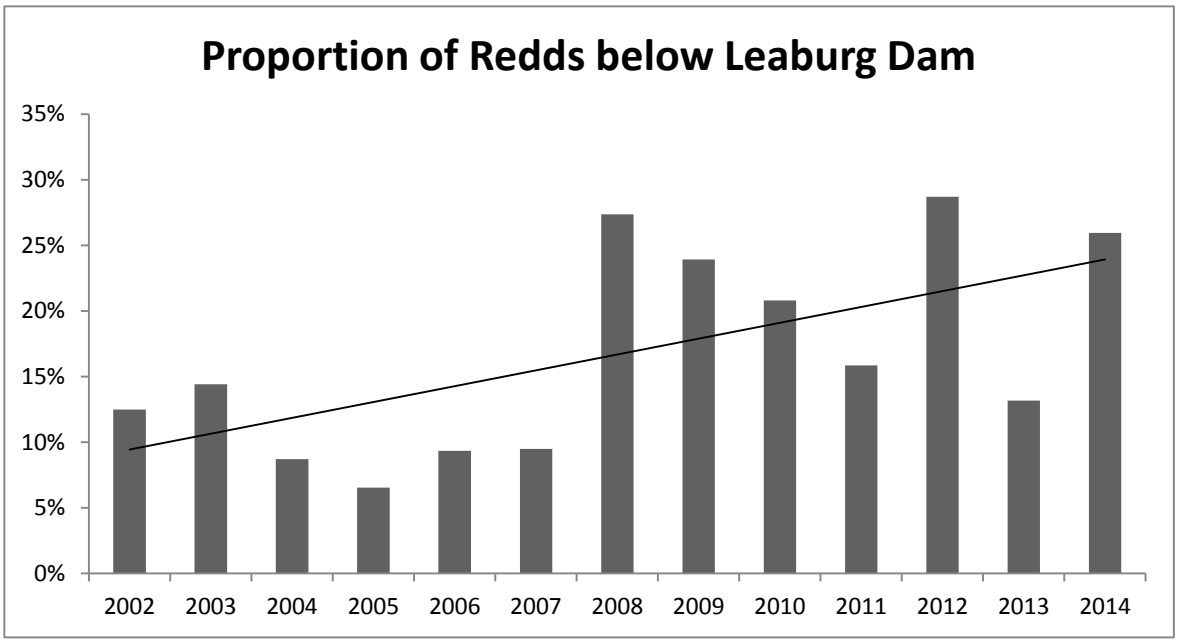
Exhibit H is a document including notes from federal and state agencies assessing alternatives to reduce pHOS in the McKenzie River basin.

Thank you for the opportunity to comment.

/s/ Arlen Thomason
Arlen Thomason



Data source: ODFW files *MCK_0002571.xlsx* and *2014 DRAFT Prelim Summary.xlsx*



Data source: ODFW files *MCK_0002571.xlsx* and *2014 DRAFT Prelim Summary.xlsx*

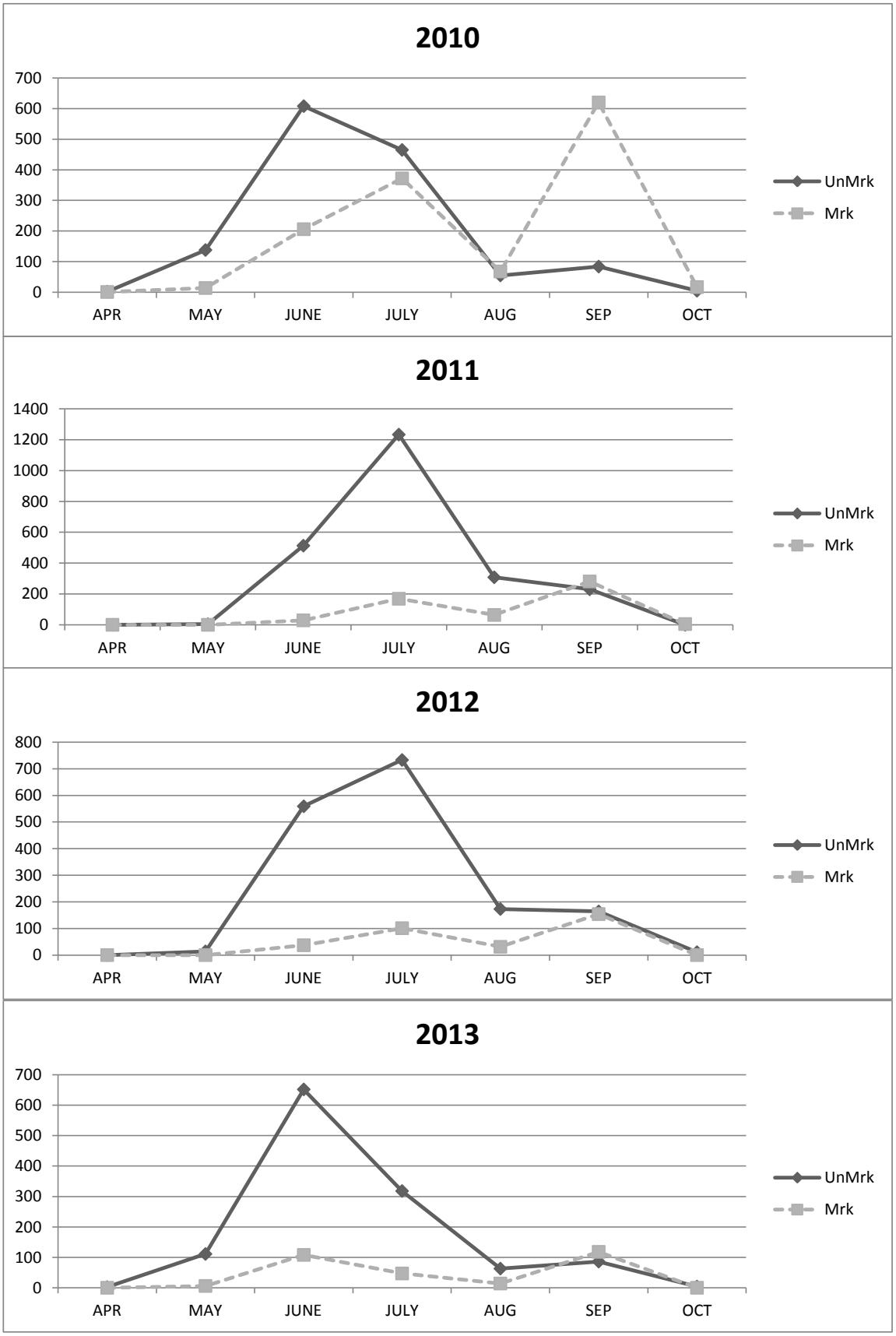
2010		
	Unmark	Marked
APR	2	1
MAY	138	14
JUNE	608	206
JULY	465	372
AUG	55	68
SEP	84	620
OCT	5	17
Total	1357	1298

2011		
	Unmark	Mrk+Rem
APR	0	0
MAY	4	0
JUNE	513	29
JULY	1233	169
AUG	308	64
SEP	230	281
OCT	0	5
Total	2288	548

2012		
	Unmark	Mrk+Rem
APR	0	0
MAY	14	0
JUNE	559	37
JULY	733	101
AUG	173	31
SEP	164	154
OCT	11	0
Total	1654	323

2013		
	Unmark	Mrk+Rem
APR	2	0
MAY	111	6
JUNE	652	108
JULY	318	47
AUG	63	14
SEP	86	118
OCT	4	0
Total	1236	293

Monthly returns for marked and unmarked McKenzie Hatchery Chinook salmon at Leaburg Dam.
Data source: ODFW file "Copy of Leaburg 2010-2013.xlsx"



Monthly returns for marked and unmarked McKenzie Hatchery Chinook salmon at Leaburg Dam.
Data source: ODFW file "Copy of Leaburg 2010-2013.xlsx"

Number of McKenzie River Wild Chinook Salmon Spawners - Last 5 Years

Year	Spawners
2010	1412
2011	2460
2012	1514
2013	1033
2014	1045

Data source: ODFW files *MCK_0002571.xlsx* and *2014 DRAFT Prelim Summary.xlsx*

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS, PORTLAND DISTRICT
PO BOX 2946
PORTLAND OR 97208-2946

OCT 2 8 2014

Planning, Programs and Project
Management Division

Rob Jones
Anadromous Production and Inland Fisheries Branch Chief
National Marine Fisheries Service
1201 NE Lloyd Boulevard, Suite 1100
Portland, OR 97232

Dear Mr. Jones:

Enclosed please find the U.S. Army Corps of Engineers, Portland District's ("Corps") McKenzie Hatchery Spring Chinook Salmon Program Hatchery Genetic Management Plan ("HGMP") for your review and approval under the National Marine Fisheries Service's ("NMFS") 4(d) Rule for artificial propagation programs (65 Fed. Reg. 42,422; July 10, 2000).

The HGMP is based on the current NMFS HGMP template. The information included in the HGMP is accurate and meets applicable scientific and technical standards. We are therefore submitting the HGMP in accordance with Reasonable and Prudent Alternative Measure 6.1 of the 2008 Willamette Valley Project Biological Opinion, and request that NMFS process the HGMP under Section 4d of the Endangered Species Act.

By way of background, the Corps, together with the Bonneville Power Administration ("BPA") (together "Action Agencies"), in coordination with the Oregon Department of Fish and Wildlife ("ODFW"), first submitted the HGMP to NMFS on February 13, 2013. After ongoing coordination with NMFS and ODFW, the Corps submitted a second revised version on November 14, 2013. A third revised version of the HGMP (dated February 12, 2014) was submitted electronically by the Corps on February 13, 2014, and amended on March 6, 2014 (two paragraphs in Section 5.1 were revised in response to NMFS' comments, to clarify the proposed action regarding hatchery improvements). NMFS then circulated a draft sufficiency letter for review on March 18, 2014. After further consideration of a March 26, 2014, letter from the McKenzie Flyfishers and Steamboaters, NMFS transmitted additional global comments on May 8, 2014, and a redline strikeout of the HGMP was provided by Mr. Lance Kruzic of NMFS on May 29, 2014. NMFS commented in its May 29, 2014, transmittal that if the Action Agencies were to accept the edits in the redline strikeout, the HGMP would be deemed sufficient to proceed with Section 7 consultation.

The Corps accepted the vast majority of edits provided on May 29, 2014, by NMFS and has attempted to suggest only minimal further edits. Where an edit was not accepted, it is noted in a comment. That said, the Action Agencies still have some significant concerns about the HGMP, which we anticipate will be resolved during the consultation

process. It is our understanding that NMFS will now issue a final sufficiency letter for the McKenzie HGMP, complete a NEPA process on the proposed action, and ultimately issue a 4(d) authorization for the hatchery program, after having analyzed and incorporated public comment, including making any necessary adjustments to the documentation. To that end, we wish to offer the following thoughts to aid in the development of our joint consultation.

1. *Production and Release Numbers of Spring Chinook Salmon.*

The proposed action in the submitted HGMP provides for the production and release of 604,750 fish for brood years 2014-2016, followed by a release the subsequent years of up to 808,000 smolts depending upon whether the proportion of hatchery-origin spawners ("pHOS") performance standard is met. These production and release numbers include fish for all hatchery purposes, not only federal conservation needs. The rationale for the proposed release of 604,750 includes that the release level would: (1) ensure a reasonable return of spring Chinook under varying smolt to adult returns ("SARs") to meet broodstock requirements; (2) provide sufficient numbers of adults for outplanting/reintroduction above Cougar Dam (the federal program) and Trail Bridge Dam (the state program); (3) reduce pHOS in the McKenzie subbasin and/or what NMFS has described as "its core natural production areas"; and, (4) provide fish for state licensed and regulated fishery harvest within Endangered Species Act ("ESA") limits.

The HGMP lacks information to support rationale number 4 listed above. The HGMP has a harvest goal for the McKenzie River (1000 adult spring Chinook) based on an Oregon Adminstrative Rule, but there is no harvest goal for either the sport or commercial fishery below Willamette Falls and in the lower Columbia River. The conservation goal for the hatchery program is also specified: 400 male and 200 female adult spring Chinook upstream of Cougar Dam; and 60 male and female adults upstream of Trail Bridge Dam. However, without a total adult goal it is difficult to know what the appropriate annual smolt production level should be. *Most importantly* the HGMP should include an assessment of how the harvest goal, particularly in the McKenzie River, would be met while minimizing impacts to ESA listed species.

Based on scientific analyses and our review of that science, the Action Agencies believe that there is a range of production and release numbers for hatchery juvenile spring Chinook salmon that could meet the ESA conservation needs for the McKenzie River subbasin, consistent with survival and recovery of the Evolutionarily Significant Unit ("ESU"). *See* 65 Fed. Reg. 42477 (Jul. 10, 2000), codified at 50 C.F.R. § 223.203(b)(5)(i)(C)(i.e., 4(d) standard). Because this hatchery program's purpose is for both conservation and harvest it is important to identify the number of fish that must be produced for conservation purposes vs. those that are produced for secondary purposes like harvest. *Id.* ("After the species conservation needs are met and when consistent with survival and recovery of the ESU, broodstock collection programs may be authorized by NMFS such for secondary purposes, as to sustain tribal, recreational, and commercial fisheries."). We look forward to assisting NMFS and ODFW as NMFS identifies appropriate production and release numbers for each purpose. We would expect production and release numbers both above and below the numbers contained in the proposed action (see

above) to be meaningfully considered. Also, while we recognize that each consultation is its own unique product, based on the facts for each local hatchery program and basin, we encourage NMFS to identify and analyze different levels of production and release numbers during the NEPA process as appropriate, particularly based on lessons-learned in recent litigation.

2. *Split-Basin Management Approach and the pHOS Target*

The Action Agencies proposed a pHOS target rate in Standard 3.7 of the HGMP at < 10% for the McKenzie River subbasin, which is consistent with the 2008 Willamette BiOp. NMFS' May 29, 2014, comments requested that the Action Agencies allow for a "split-basin management approach," in which a pHOS of < 10% would be applied to the "wild fish focus area" between the privately-owned Leaburg Dam and the Corps-owned Cougar Dam, and a higher pHOS would be applied to a "hatchery-focus zone" below Leaburg Dam. The Action Agencies have included the possibility of a "split-basin management approach" in the HGMP per NMFS' request, but the HGMP does not identify where the split between a "wild fish focus area" and a "hatchery-focus zone" would be.

The Action Agencies also agreed to fund ODFW to manually conduct late-season (July to September) trapping and removal of hatchery-origin fish at Leaburg Dam to further decrease pHOS levels in the overall subbasin. While the split-basin approach may indeed work well in some basins, including other basins within the Willamette, and is included in our proposed action, we have concerns about whether this approach is the most appropriate for the McKenzie Basin given the lack of a substantially effective way to separate the two areas. We also question whether it is consistent with the 2008 Willamette BiOp, which expressly discusses measures in terms of a single population approach.

The Action Agencies similarly look forward to assisting NMFS and ODFW as it identifies alternatives related to measure of, and number for, a pHOS target, particularly as it relates to the overall basin targets and management. We also anticipate that NMFS will appropriately consider the following in any NEPA analysis and 4(d) authorization: (1) different pHOS targets; (2) different possibilities for how and when to evaluate those pHOS targets, [1] including how and when adaptive management would occur to respond to those evaluations should pHOS be unacceptably high in any given year; and, (3) different spatial distribution, including both employing a pHOS target for the entire basin and using a "split-basin" management approach that would separate "wild fish" and "hatchery focus" areas. For example, it is our understanding that recently available data show that the numbers of hatchery-origin spawners spawning below Leaburg Dam is increasing. As we have discussed, this may indicate that the habitat below Leaburg Dam is indeed valuable for natural-origin fish, particularly in a basin where access to spawning habitat is a key limiting factor, and where hatchery fish are apparently spawning with success.

3. *Inclusion of State Trail Bridge Program*

The Action Agencies recognize that operation of the McKenzie Hatchery Spring Chinook program may include purposes beyond the conservation needs of the species, when NMFS determines that those secondary purposes are consistent with survival and recovery of the ESU. We therefore understand that ODFW may also fund the production of hatchery smolts (above and beyond the numbers required for the federal program) in order to ensure that sufficient adults return to the hatchery to continue the Trail Bridge outplant program , which ODFW considers to be as an integral component of the State's reintroduction program. With that understanding, we have agreed to include the State's Trail Bridge Program as part of the proposed action, specifically by increasing production and release numbers and conducting adult outplanting. That said, we question the efficacy of the Trail Bridge program given the quality of the habitat above Trail Bridge Dam as well as other work being conducted there, and also note that Federal funds and actions will be implicated because pHOS levels and results will be potentially affected. As stated above, we recognize that NMFS will identify appropriate numbers for production and release, consistent with survival and recovery of the ESU, through its NEPA process and subsequent 4(d) authorization, including identifying any hatchery production numbers associated with conservation and secondary purposes.

If you have any questions please contact David Leonhardt of my staff at david.s.leonhardt@usace.army.mil, or (503) 808-4786.

Sincerely,

Joyce E. Casey

Joyce E. Casey
Chief, Environmental Resources Branch

Enclosure

[1] After incorporating NMFS' comments, the proposed action states that pHOS for any given year will be calculated on a three-year rolling average, and where the appropriateness of the pHOS target will be assessed twice: once in calendar year 2018, when brood year 2012 at the 850,000 annual production level have all returned, and again in calendar year 2021 when brood years 2014-2016 at the 604,750 annual production level have all returned.

DRAFT- Not finalized. Not for distribution.

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	McKenzie River Spring Chinook Salmon
Species or Hatchery Stock:	Spring Chinook Salmon (stock 23)
Agency/Operator:	Oregon Department of Fish and Wildlife
Watershed and Region:	Willamette River, Columbia River
Date Submitted:	November 2013
Date Last Updated:	February 2014

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Appendix A. FY14 Baseline Hatchery Monitoring and Evaluation Plan
Appendix B. Adaptive Management Plan for McKenzie Hatchery Spring Chinook
Appendix C. Draft of Reintroduction Planning: Management of Spring Chinook Salmon above Cougar Dam South Fork McKenzie River 2013-2017

List of Acronyms

°C	Degrees Celsius
°F	Degrees Fahrenheit
BiOp	Biological Opinion
BKD	Bacterial Kidney Disease
BO	Biological Opinion
BOR	Bureau of Reclamation
BPA	Bonneville Power Administration
cfs	Cubic Feet per Second
CHS	Spring Chinook Salmon
COP	Configuration Operation Plan

Cost responsibilities for McKenzie Hatchery production are split between the US Army Corps of Engineers (USACE) (with partial reimbursement by Bonneville Power Administration (BPA) according to its operation and maintenance power share percentage at Cougar Dam) and Oregon Department of Fish and Wildlife (ODFW) based on each party's production level. The USACE funds production and release of up to 80,800 pounds of smolts. Oregon Department of Fish and Wildlife funds 1,380 pounds of smolts based on current release numbers and size at release for the McKenzie River. Production levels and the state/federal funding split are reviewed on an annual basis under the USACE and ODFW Cooperative Agreement (2012).

Comment [JRR1]: Added to better describe BPA's funding and to be consistent with other HGMPs.

Staffing Level: This facility has five permanent positions and one seasonal (ten-month) position.

Budget: The annual operation and maintenance budget, including both USACE and ODFW programs, for the spring Chinook at McKenzie Hatchery for budget year 2013-14 was $897,000 (including indirect costs). Funding for fish pathology, fish identification (marking), and Research, Monitoring, and Evaluation (RM&E) is separate from the operation and maintenance budget.

1.5) Location of hatchery and associated facilities.

The McKenzie Hatchery is located on the McKenzie River near river mile 37, which is about 17 miles east of Springfield, Oregon. The facility is located at an elevation of 700 feet (ft) above sea level, at latitude 44° 07' 00" N and longitude 122° 38' 10" W. The regional mark processing center code is 5F33317 H17 21.

Leaburg Dam, which is privately-owned by the Eugene Water and Electric Board, is located on the McKenzie River near river mile 38.9.

Comment [JRR2]: Added to clarify ownership of the EWEB dam.

Adult collection occurs at the McKenzie Hatchery. However, hatchery-produced broods are also collected at Leaburg Dam during the late run time, while the number of wild fish is very low at Leaburg Dam. In the past (1996-1997 and 2006-2008), some wild adults were also collected for broodstock from the left bank fish ladder at Leaburg Dam. All spawning and rearing activities occur at the McKenzie Hatchery.

1.6) Type of program.

The McKenzie CHS hatchery program is managed as an integrated ~~harvest~~ program to meet ~~harvest~~ goals for both harvest and ESA conservation needs, consistent with survival and recovery of the ESU,[1] and assist with implementation of the Upper Willamette Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011) (Recovery Plan) and comply with the Willamette Biological Opinion (NMFS 2008). The hatchery program was founded on McKenzie River stock salmon and uses integration to avoid genetic drift, reduce domestication risks, and maintain stock

Comment [JRR3]: Edited to use language from the 4d reg with citation and makes it consistent with other HGMPs.

Comment [JRR4]: Added to introduce abbreviation.

[1] *See* 65 Fed. Reg. 42477 (Jul. 10, 2000), codified at 50 C.F.R. § 223.203(b)(5)(i)(C).

spawning streams in the McKenzie River Basin.

Indicator 8.1.1: Pathogen-free hHatchery fish may be placed in streams for nutrient enrichment. ***Benefit***

Comment [JRR14]: Consistent with other HGMPs.

Indicator 8.1.2: Hatchery carcasses placed for nutrient enrichment will comply with ODFW and Oregon Department of Environmental Quality (ODEQ) guidelines for disease control and water quality. ***Benefit***

Table 1.9-1. Recommended performance targets for rearing and release of hatchery fish.

Variables	Performance Target (benchmark)
Size at release	Target size at release is 10-11 fish per pound (fpp)
Release timing	See Table 1.11.2-1
Acclimation time	N/A (fish over-winter on site)
Migration timing	Similar to naturally-produced fish
Level of disease/pathogen occurrence in hatchery smolt for release	Below ODFW Fish Health Management Policy and IHOT standards
Number of fish released	Up to approximately 808,000 smolts for all hatchery purposes (see Section 1.11.2 below). The proposed release is up to 604,750 smolts annually for brood years 2014 through 2016.
Number of hatchery produced fish required for broodstock and conservation needs	To satisfy this variable up to 604,750 smolts are released in the McKenzie River to meet broodstock and other conservation (outplanting) needs. ~~upstream of Cougar DamTrailbridge Dam, and Mohawk River.~~
In-hatchery life stage survival	Maximum and unbiased survival
Rearing density	Implement best management practices
Growth rate	Achieve target size at release
Residualism rates	< 10%
Precocial rates	< 10%

Comment [JRR15]: There is some inconsistency throughout the document as to whether this should read 2017 or 2016. We think it should read 2017. See also pages 18, 19, 21, 25, 56, 62, 71 (and maybe elsewhere).

Comment [JRR16]: No. Not accepted.

Table 1.9-2. Recommended performance targets for returning adult hatchery fish.

Variables	Performance Target (benchmark)
Number of hatchery produced fish removed for broodstock	Up to 600 (1:1 male female ratio is goal. The broodstock size for the production goal of 604,750 smolts is up to 450 fish.
Number of hatchery fish harvested	Goal of 1,000 minimum within McKenzie basin, plus ocean/Columbia River/Lower Willamette fisheries.
Number of fish passed upstream into target areas above Cougar Dam	Determined on annual basis by Corps, BPA, USFWS, ODFW, and NMFS considering recommendations from the WATER's Team
Age structure	Similar to naturally-produced fish
Sex ratio	Similar to naturally-produced fish
Fecundity	Similar to naturally-produced fish

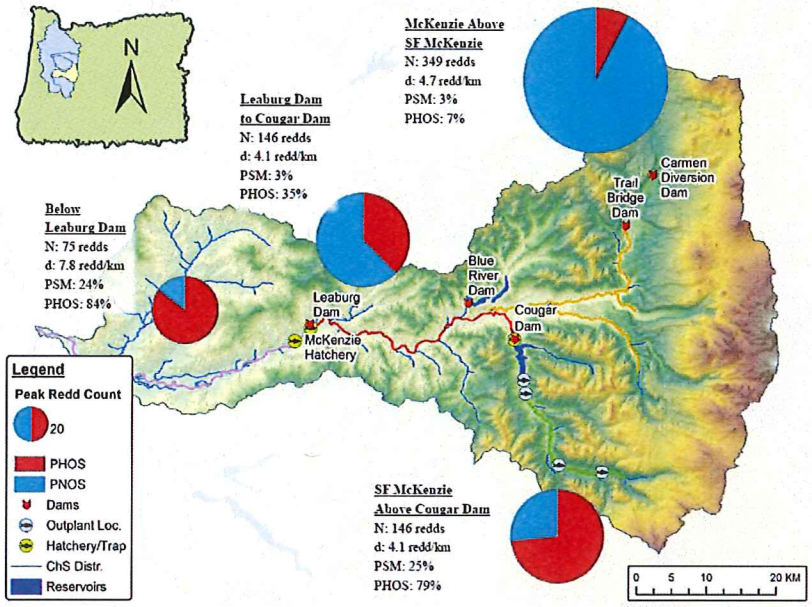

Figure 2.2.2-1 Summary of spring Chinook spawning surveys for 2013. The size of the pie charts reflect the relative number of redds (N). PSM is prespawning mortality rate. PHOS is proportion of hatchery-origin Chinook compared to natural-origin Chinook. Hatchery Chinook are purposefully outplanted in the SF McKenzie River above Cougar Dam for reintroduction purposes in historic habitat. Figure taken from Sharpe (2014).

Comment [JRR32]: Please work with ODFW to provide pHOS for the entire basin in 2013.

2.2.3) Describe the hatchery activities, including associated monitoring and evaluation and research programs that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take.

(a) Describe hatchery activities that may lead to the take of listed salmonid populations in the target area including how, where and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock collection at McKenzie Hatchery occurs from mid-May through mid-October. All CHS captured at the McKenzie Hatchery are ESA-listed as part of the Upper Willamette ESU. Thus, direct or indirect take of listed CHS is part of normal trap operation through migration delay, capture, handling, and upstream release. Trapping and handling devices may further lead to injury to listed fish through confinement, delayed migration and spawning, or delayed mortality as a result of injury. In addition, direct take is needed for up to 600 adults for broodstock needs including incorporation of natural-origin adults into the broodstock at a rate averaging 5-10% annually. Natural-

3.1) Describe alignment of the hatchery program with any Evolutionary Significant Unit (ESU)-wide hatchery plan or other regionally accepted policies. Explain any proposed deviations from the plan or policies.

Upper Willamette River Conservation and Recovery Plan for Chinook salmon and steelhead (OAR 635-500-6600)

In August 2011, the Recovery Plan for the Upper Willamette River Chinook ESU and steelhead Distinct Population Segment (DPS) was adopted (ODFW and NMFS 2011). The Upper Willamette River Chinook ESU includes the McKenzie spring Chinook population. The Recovery Plan provides the primary guidance for addressing limiting factors and threats for ESA Section 4 recovery of Willamette River CHS and establishes delisting criteria. Chapters 4 and 6 of the plan documented the current status of the population across the ~~DPS~~ ESU and report desired status goal for the population based on interrelations of the populations, limiting factors and threats (LFT), and recovery potential by subbasin. The plan also contains standards for a "viable salmonid population" (VSP) of McKenzie River spring Chinook salmon in terms of abundance, productivity, distribution and diversity. The plan also establishes measurable criteria for delisting spring Chinook salmon, with a focus on reducing threats that contribute to the species decline. General limiting factor threats in the McKenzie River subbasin and their relative mortality impacts on spring Chinook salmon include freshwater habitat loss and degradation (26%), flood control/hydropower dams (49%), other species (5%), harvest (5%), and hatchery (13%).

The McKenzie CHS population is currently at moderate to low risk of extinction, but not recovered. The desired status is to increase the abundance of spring Chinook to approximately 9,000 fish and the population at a very low risk of extinction (1%). Chapter 7 of the Recovery Plan identified several management actions to achieve desired status. For details see:
http://www.dfw.state.or.us/fish/CRP/upper_willamette_river_plan.asp

Recovery Plan goals related to the hatchery program are cross-referenced in Table 3.1-1 of this HGMP.

Comment [JRR33]: Added to be consistent with other HGMPs.

Willamette Hatchery River Basin Flood Control Project Biological Opinion (NMFS 2008)

In ~~May~~ July 2008, the NMFS released their BiOp regarding impacts to ESA-listed species that are related to the Willamette Project, including operation of USACE's 13 Willamette Project dams and funding of the Hatchery Mitigation Program (NMFS 2008). In this opinion, NMFS concluded that the proposed action (PA) ~~would~~ was likely to jeopardize the continued existence of the listed UWR spring Chinook salmon ESU and winter steelhead DPS, and to adversely modify or destroy designated critical habitat for those species.. NMFS provided Reasonable and Prudent Alternatives (RPA), a package of measures designed to support survival and increase the potential for recovery of the CHS ESU and steelhead DPS.

Comment [JRR34]: Additions in this section to be more precise and to be consistent with other HGMPs.

Hatchery using R2's report prepare a Design Document Report (DDR), Plans and Specifications (P&S), and construct the improvements. Environmental compliance and permitting will be completed concurrently with the DDR and P&S. The improvements to the water supply at McKenzie Hatchery will provide biological benefits in 2020 from improved Cogswell Creek imprinting.

Brood Collection at Leaburg Dam Ladder: ODFW will consider collection of natural-origin adult Chinook salmon from the left bank fish ladder at Leaburg Dam if monitoring results demonstrate need for higher integration levels of the natural-origin component of the broodstock. Collection from the ladder has proven to be effective in the past for supplementing the natural-origin component of the broodstock, but is labor intensive and has associated risks. These risks include handling stress from trapping too many fish in the ladder section. In addition, this technique temporarily disrupts the upstream migration of fish using the ladder and results in some fish backing out of the ladder as the water is drained. Natural-origin adults that volunteer to the hatchery will be used for brood, however, if monitoring results detect measurable reductions in heterozygosity or increased genetic drift, than broodstock may be collected from the Leaburg Ladder for incorporation into the broodstock. Specific needs will be determined on a case-by-case basis and coordinated and concurred by NMFS' Propagation and Inland Fisheries Branch staff prior to implementation.

Removal of hatchery-origin fish at Leaburg Dam Ladder: Hatchery salmon and steelhead may be trapped and removed from left bank fish ladder at Leaburg Dam to reduce hatchery fish straying upstream of Leaburg Dam. Trapping may occur only after the peak of the natural-origin CHS migration in May through early July. The intent of this effort would be to remove the later arriving hatchery CHS that have been observed migrating past Leaburg Dam in August and September to further reduce pHOS. In recent years, from zero to 100 hatchery CHS have typically been trapped and removed at Leaburg Dam. The trapping will not occur if run sizes of natural-origin CHS are greater than 3,000 fish. The specific plans for operation of the trap at Leaburg Dam will be submitted by USACE, BPA, and ODFW to NMFS. Written concurrence by NMFS' Propagation and Inland Fisheries Branch staff of the specific plans is required before implementation.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

McKenzie Hatchery has a liberation tank truck (purchased in 2005) with a 1,500-gallon capacity. While broodstock is generally collected and spawned on-site, this unit can haul up to 130 adult CHS. For outplanting, approximately 75 fish per load are hauled following the outplanting protocol described in Section 15. Fish are anesthetized with Tricaine Methanesulphonate (MS-222), injected with antibiotics, and manually loaded into a polyvinylchloride (PVC) pipe attached to the transport truck.

5.3) Broodstock holding and spawning facilities.

1.9) List of program "Performance Standards".

See Section 1.10

1.10) List of program "Performance Indicators" designated by "Benefits" and "Risks".

Category 1: Legal Mandates

Comment [JRR7]: Added headers to be consistent with other HGMPs

Standard 1.1: Meet production levels for mitigation, fisheries, ESA conservation objectives consistent with survival and recovery of the ESU, and reintroduction purposes consistent with the Cooperative Agreement (2012)

Indicator 1.1.1: Produce and release up to 808,000 spring Chinook salmon smolts (the maximum production identified in the Cooperative Agreement (2012)) ~~full federal mitigation responsibility in the McKenzie subbasin (80,800 lbs at 10 fish per pound)~~ annually for release into the McKenzie River. The proposed production level for brood years 2014-2016 is 604,750 smolts annually. ***Benefit***

Comment [JRR8]: NO. Did not accept this proposed edit from NMFS.

Standard 1.2: Program goals are aligned with authorized federal, state, regional, and local fisheries conservation and restoration initiatives.

Indicator 1.2.1: Program is aligned with the Oregon Native Fish Conservation Policy (NFCP), the McKenzie River Sub-Basin Plan, the Upper Willamette River Conservation and Recovery Plan for Chinook Salmon and Steelhead (ODFW and NMFS 2011) where appropriate, and complies with the Willamette Biological Opinion (NMFS 2008). The Hatchery and Genetic Management Plan (HGMP) will be reviewed and submitted to NMFS for approval. ***Benefit***

Category 2: Harvest

Standard 2.1: Maintain sufficient hatchery broodstock to mitigate for construction of the Cougar and Blue River dams to meet harvest goals while minimizing impacts to natural-origin Chinook salmon. Take of listed fish associated with harvest is covered through the FMEP for upper Willamette spring Chinook (ODFW 2001).

Indicator 2.1.1: Number of hatchery CHS available for harvest in ocean, Columbia River, Willamette River, and McKenzie River sport and commercial fisheries. ***Benefit***

Category 3: Conservation

Holm, Leanne NWP

From: Lance Kruzic [lance.kruzic@noaa.gov]
Sent: Wednesday, January 04, 2012 1:29 PM
To: Brown,Cecilia K (BPA) - KEWM-4
Cc: Costello,Ronald J (BPA) - KEWR-4; Spear,Daniel J (BPA) - PGB-5; Gleason,John M (BPA) - LC-7; Mazaika,Rosemary (BPA) - KEWL-4; Brown,Kimberly A (CONTR) - PGL-5; Gresh,Ted S (CONTR) - KEC-4; Melissa.Jundt@noaa.gov; Kurt Kremers; Steven Marx; manny.a.farinas@state.or.us; Jeffrey.S.Ziller@state.or.us; Leonhardt, David S NWP; Piaskowski, Richard M NWP; MCLAUGHLIN Lisa; marylouise keefe; rob jones
Subject: Re: December 13th interagency (correct version
Attachments: DRAFT 12 13 2011_leaburg_meeting minutes Kruzic comments 1.4.12.docx

First, Kim and Cecilia, thanks a bunch for putting together the notes from this meeting!

Attached are my edits to the McKenzie minutes (due today). Since this was a significant meeting, I got a bit pickier than usual. Also wanted to move some stuff around a bit to reflect the agenda structure.

Please redistribute when finalized. Let me know if anything comes up re my comments.

thanks! Lance

On Wed, Dec 21, 2011 at 1:35 PM, Brown,Cecilia K (BPA) - KEWM-4 <ckbrown@bpa.gov> wrote:

Hello all,

I sent out the incorrect file in my previous email. Attached is a clean copy of the draft minutes from our December 13, 2011 interagency meeting.

Kim Brown and I compiled minutes from our notes and internal BPA review. Please review for accuracy and provide me with comments no later than Wednesday January 5, 2012. I do not want to misrepresent any agency position or misquote anyone, so please call any errors to my attention if you see them. I am particularly interested in feedback on the Action Items, as we didn't articulate them clearly at the end of the meeting.

Thank you,
Cecilia

Cecilia K. Brown
Bonneville Power Fish & Wildlife
P.O. Box 3621
Portland, OR 97232
Phone (503) 230-3462 <tel:%28503%29%20230-3462>

--
Lance Kruzic

USACE AR 030725

Fisheries Biologist
NOAA Fisheries, NMFS
Roseburg, Oregon
541-957-3381
lance.kruzic@noaa.gov

DRAFT **DRAFT** **DRAFT**

DRAFT Meeting minutes, Leaburg Inter-Agency Coordination Meeting
Date: Dec 13, 2011
Where: BPA

Attendees:
Lance Kruzic, Rob Jones and Melissa Jundt; NMFS (Melissa joined by phone)
David Leonhardt and Rich Piaskowski, USACE
Steve Marx, Manuel Farinas, Kurt Kremers and Jeff Ziller, ODFW
Mary Louise Keefe, R2 Resources
Dan Spear-PGB, Rosy Mazaika-KEW, Ted Gresh-KEC, John Gleason-LC, Cecilia Brown-KEWM, Ron Costello-KEWR and Kim Brown –PGL, BPA
Lisa McLaughlin, EWEB

Disclaimer: BPA staff compiled these minutes. They represent, to the best of our recollection, the discussions of this meeting. If any agency positions or opinions appear to be misrepresented, please verify with the appropriate agency personnel.

1. Introductory comments by agencies, goals of meeting

   Each agency provided introductions and gave brief description of previous comments on this project (see below for more details).

2. Brief recap of range of alternatives and agency comments

   a. McKenzie Hatchery ladder & water supply reforms
   b. Leaburg Hatchery ladder reforms
   c. Leaburg Dam hatchery fish sorting
   d. McKenzie Hatchery production changes
   e. Cougar Dam reintroduction to increase wild spring Chinook production
   f. O & M costs

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Topic:
Leaburg Inter-Agency Coordination Meeting
Continue discussion on alternatives to meet the RPA 6.1.4 of the Willamette BiOp that mandates improvements reduction of hatchery spring Chinook straying above Leaburg dam to less than 10% of total spawning population in the wild.

BPA contracted with R2 Consultants to generate two reports that proposed alternative actions to resolve the McKenzie River straying issue. One is a sorter/separator system at Leaburg Dam; the other is improved attraction flow for homing fish to ladders at the McKenzie and Leaburg Hatcheries. ODFW (Oregon Dept of Fish and Wildlife) submitted a report on moving the release site of some McKenzie hatchery spring Chinook to the Coast Fork of the Willamette River to

USACE AR 030727

reduce the number of hatchery Chinook on-station releases (which would subsequently reduce the number of adult hatchery fish returning to the McKenzie River).

Decisions: Attendees agreed to weigh the pros and cons of the different alternatives and agree on action items if warranted.

Lance gave an overview of the alternatives and RPA issues: RPA stipulates less than 10% proportion of hatchery origin spawners (PHOS) in the natural spawning population. Construction of hatchery improvements or Leaburg Dam fish sorter needs to be complete by Dec 2013/2014 deadline to meet RPA requirements. Implementation of hatchery improvements or Leaburg Dam fish sorter must be completed by prior to the 2014 spring Chinook migration (late w~~W~~inter/early spring) to meet RPA requirements. Any hatchery production changes need to be in place before 2014, but realize benefits in terms of adult returns will be in later years.

McKenzie Hatchery O&M is partially funded by COE/BPA and ODFW and is managed by ODFW. COE/BPA fund production of hatchery fish as a mitigation requirement, and ODFW produces additional fish for recreation. Evaluation of hatchery reforms would address the following issues: water supply at McKenzie hatchery, adult attraction at the ladder of McKenzie hatchery, ~~-~~and hatchery production levels in the McKenzie River. ODFW has proposed the transfer of McKenzie smolts to the Coast Fork of the Willamette River. Leaburg Dam has fish ladders on both r~~R~~ight and l~~L~~eft banks to allow passage of wild fish above the dam. A proposed sorter facility would most likely be placed at both ladders. The Action Agencies are developing plans for~~considering~~ downstream passage of ~~for~~ juveniles at Cougar Dam to increase the wild Chinook population. Cougar Dam already has temperature control and an adult ladder.

NMFS has recommended against the construction of a sorter and would prefer the Action Agencies (COE and BPA) and ODFW first explore how well ~~construct~~ improvements at the McKenzie Hatchery and hatchery production reduction would first deal with the issue. This suite of actions should be evaluated first to see if accomplish 10% goal before also looking at the benefits of a sorter at Leaburg Dam. ~~NMFS also plans to review the ODFW hatchery reprogramming proposal further and may recommend modifications. All agencies~~ NMFS anticipates a~~n~~ substantial increase in numbers of returning wild Chinook due to the Cougar Dam downstream juvenile passage improvements when they occur, and should be factored into this analysis also.

ODFW favors reprogramming of hatchery fish and hatchery improvements. Sorter is another option but may not be necessary if Cougar improvements are completed and allow for a corresponding reduction in mitigation fish produced at the hatchery.

EWEB is in support of reducing hatchery straying and hatchery improvements. There are logistics regarding the sorter project; EWEB is FERC regulated. Modification of EWEB's existing ladders to include sorters could trigger a review of the dam's FERC license. EWEB's review of the implications of inserting a sorting mechanism onto the existing ladders may result in delaying the implementation of the project beyond the date specified in the RPA. The timeline for a potential review by FERC is not known at this time. EWEB requires that the long-term operations, with no liability to EWEB be very clear for any improvements to move forward.

COE believes the goal of meeting the less than 10% of PHOS will be best achieved by the sorter alternative. The RPA is clear that less than 10% straying is required, and hatchery improvements and reprogramming may not achieve this goal. The COE mentioned that fish production at McKenzie Hatchery currently operated by ODFW exceeds the mitigation requirement. Current production is approximately 125K lbs of juvenile fish; mitigation requirement is 80K lbs. If the preferred alternative includes reprogramming, COE and BPA will not pay for monitoring costs associated with assessing the impact of reprogramming excess hatchery production to the Coast Fork.

BPA agrees with the COE in its preference of the sorter alternative. If a sorter is the preferred alternative, EWEB will need to agree to allow it to be constructed on their facility (Leaburg Dam). BPA informed EWEB that construction of the sorter would be contingent on EWEB's approval. BPA also wants to make sure the agreement for O&M of either the sorter or the upgraded hatchery facilities is in place before moving forward. BPA wishes to address RPA 6.1.4 separately from the RPA that addresses Cougar Dam downstream passage improvements, since they are separate actions in the BiOp. NOAA needs to make a feasibility determination on the sorter and send letter to BPA and COE to ensure that BPA and COE are in compliance with the RPA (see Action Items below).

ALTERNATIVES

3. Identify and discuss preferred alternatives (pros & cons)

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a. McKenzie Hatchery ladder & water supply reforms

~~**Leaburg Canal Improvements/Increased delivery of canal water to McKenzie Hatchery**~~

Discussion occurred on the possibility of using more water from Leaburg canal for the hatchery. Leaburg Canal runs parallel to the McKenzie River on the ~~left~~right bank. The canal was built in the 1920s and leaks. Canal conditions put the hatchery at risk. Repairs now occur in a way that accommodates hatchery water needs. Canal is at capacity now without repairs. The canal intake has a fish screen that is also at capacity. Additional water flow would likely require the fish screen to be replaced. EWEB noted that they have voluntarily operated the canal to accommodate hatchery improvements in the past but there is increased interest to operate the canal to accommodate electrical load delivery.

ODFW's water right is from the McKenzie River, but they obtain water from Leaburg Canal. ODFW expressed concern with ongoing dependence on the canal for hatchery water and thinks a pump station is an important part of hatchery improvements. R2's reconnaissance report for hatchery improvements included the concept of pumping auxiliary water from the river into the ladder.

NOAA is concerned with riparian habitat loss, ~~and~~ residential noise impact if a pump station is placed the riverbank, and costs with this new pumping facility (compared to costs associated with somehow using Leaburg canal water during May-July). NOAA also commented that increased flow in the hatchery ladders should meet NMFS fish passage criteria, or flows may not be sufficient to attract enough hatchery fish to reduce the PHOS below 10%. Meeting criteria will require significantly more water than the status quo of 50-70 cfs and, if criteria attained for ladder attraction, could be a significant improvement.

Adult spring Chinook return is primarily May through July, so this is the period when ODFW would need additional water in the hatchery ladder. EWEB currently times canal water outages/canal repairs when the hatchery can use water from Cogswell Creek. The c~~C~~anal has a 2500 cfs capacity, and the minimum in-river flow requirement of~~is~~ 1000 cfs. The question was raised as to whether ODFW can pull more water from canal, or can water be diverted at the dam. Water diverted from the dam forebay could be conveyed via a pipeline to the hatchery; a pipeline of this type would require the screening the pipe intake (costly). A river pump station at the McKenzie Hatchery would be costly as well. Need to scope out the costs associated with these different alternatives before deciding path forward.

FERC issues: modification of facilities at Leaburg Dam or Leaburg Canal (fish screen, pipes etc.) may require modification of FERC license. Modification of the FERC license could be considered a federal action under Endangered Species Act (ESA), requiring reinitiation of~~a~~ Section 7 consultation with NOAA, but this needs to be determined based upon the actions decided upon first.

Some options for hatchery improvements: (1) Pump station; (2) Increased water from canal (somehow); (3) Changes to hatchery ladders; (4) Change use of Cogswell Creek water to improve imprinting to hatchery water by hatchery salmon; (5) Reducing production to 80K lbs from 125K lbs; (6) modify Cougar Dam operations to augment May-July flows;, (7) EWEB compensated for lost generation associated with hatchery getting more water; (8) Augment canal flows with Cogswell Creek water to improve attraction flows (to the extent possible based on limited creek flows).

~~**Leaburg Hatchery Ladder Improvements**~~

b. Leaburg Hatchery ladder reforms

Ladder improvements at Leaburg Hatchery may collect a few adult Spring Chinook but not likely very many. The general consensus among the group was that improvements to Leaburg Hatchery had a high projected cost with minimal~~mum~~ benefit, and that ladder improvements at Leaburg Hatchery should not be pursued.

~~**Leaburg Canal Improvements/Increased delivery of canal water to McKenzie Hatchery**~~

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~~Leaburg Canal runs parallel to the McKenzie River on the left bank. The canal was built in the 1920s and leaks. Canal conditions put the hatchery at risk. Repairs now occur in a way that accommodates hatchery water needs. Canal is at capacity now without repairs. The canal intake has a fish screen that is also at capacity. Additional water flow would likely require the fish screen to be replaced. EWEB noted that they have voluntarily operated the canal to accommodate hatchery improvements in the past but there is increased interest to operate the canal to accommodate electrical load delivery.~~

~~ODFW's water right is from the McKenzie River, but they obtain water from Leaburg Canal. ODFW expressed concern with ongoing dependence on the canal for hatchery water and thinks a pump station is an important part of hatchery improvements. R2's reconnaissance report for hatchery improvements included the concept of pumping auxiliary water from the river into the ladder.~~

~~NOAA is concerned with riparian habitat loss and residential noise impact if a pump station is placed the riverbank. NOAA also commented that increased flow in the hatchery ladders should meet NMFS fish passage criteria, or flows may not be sufficient to attract enough hatchery fish to reduce the PHOS below 10%.~~

~~Adult spring Chinook return is primarily May through July, so this is the period when ODFW would need additional water in the hatchery ladder. EWEB currently times canal water outages/canal repairs when the hatchery can use water from Cogswell Creek. The Canal has a 2500 cfs capacity, and the minimum in-river requirement is1000 cfs. The question was raised as to whether ODFW can pull more water from canal, or can water be diverted at the dam. Water diverted from the dam forebay could be conveyed via a pipeline to the hatchery; a pipeline of this type would require the screening the pipe intake (costly). A river pump station at the McKenzie Hatchery would be costly as well.~~

~~FERC issues: modification of facilities at Leaburg Dam or Leaburg Canal (fish screen, pipes etc.) may require modification of FERC license. Modification of the FERC license could be considered a federal action under Endangered Species Act (ESA), requiring a Section 7 consultation with NOAA.~~

~~Some options for hatchery improvements: (1) Pump station; (2) Increased water from canal (somehow); (3) Changes to hatchery ladders; (4) Change use of Cogswell Creek water to improve imprinting to hatchery water by hatchery salmon; (5) Reducing production to 80K lbs from 125K lbs; (6) modify Cougar Dam operations to augment May-July flows;; (7) EWEB compensated for lost generation; (8) Augment canal flows with Cogswell Creek water to improve attraction flows.~~

~~**Sorter at Leaburg Dam**~~

c. Leaburg Dam hatchery fish sorting

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Leaburg Dam has two ladders (left and right banks). Options are to construct a single sorter, either on left or right bank, or two sorters (one on each ladder). Data shows fish passage in one year will be primarily left bank, while another year majority pass right bank.

Sorter locations: EWEB just completed a new park on the left bank of river, so the left bank sorter would be downstream below the road. The right bank sorter has a tighter fit; maybe on ladder facility. R2 offered two different sorters; coded wire tag (CWT) mechanical sorter or optical sorter.

CWT: mechanism detects fish entering upper ladder of sorter and triggers gate; depending detection of a tag, fish is either shunted to collection tank (for tagged fish) or returned directly to the river/dam forebay (un-tagged fish).

Optical: mechanism is located at top-end of a Denil ladder, requires fish to pass over weir in single file, sorts by presence of adipose fin; fish without adipose fin are shunted down chutes into pond. NMFS requires that water depth of ladder meet their fish passage criteria. Optical sorter is very new technology, not assured that it would work.

The CWT sorter is 99% effective at other facilities in the NW; possibility of wild fish with lure/hook in the mouth being detected and sorted as hatchery fish. Facility could build CWT with more space for later installation of an optical sorter. Pattern on fish travel at Leaburg Dam is unpredictable as to which ladder (right- or left-bank they will use; so two sorters in lieu of a single sorter will be required to accomplish the sorting objective for hatchery strays.

NOAA expressed concerns with the sorting facility. Need to~~:~~ flesh out risks to wild fish by having sorter in place. McKenzie River spring Chinook run consists of thousands of wild fish. Any additional handling, stress for spring Chinook that hold for extended periods before spawning is of greatest concern, particularly since prespawning mortality is a huge problem in the Willamette. Other sorting facilities with different wild fish numbers may not have the same effects as a sorter at Leaburg Dam. By contrast, the sorter at Warm Springs has not dealt with the same level of fish as in the McKenzie situation.~~has a very small numbers of wild fish.~~

EWEB Concerns: The complexity of a system designed and funded by BPA, maintained by ODFW, and on EWEB property. All conversations with FERC regarding possible modifications to their license need to be initiated by EWEB.

PROS
All hatchery fish already get coded wire tags (CWT)
Cost of CWTs ~~O&M~~ around $50K per year for this production
High e~~E~~fficiency of removal of hatchery fish
Removal of summer steelhead also possible~~Leaburg Hatchery steelhead strays [Cecilia's note: my list said "STS removal"; this was my guess as to its meaning]~~
Meets RPA
Seasonal sorting possible to reduce stress on wild fish

CONS

Addresses symptom of hatchery issue, not the root cause
Wild fish impacts
May conflict with EWEB's FERC agreements

Reprogramming McKenzie Fish to Coast~~al~~ Fork Willamette River:

d. McKenzie Hatchery production changes

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Current production at McKenzie hatchery is 125,000 pounds of spring Chinook.~~K-140K lbs of fish [Cecilia's note: different amounts were stated during the meeting]~~ This -translates to approximately 1.2 million juvenile salmon released. Reprogramming proposal is to continue to raise to hatchery fish to smolts at McKenzie Hatchery, move 200-300K (25%) to Coast Fork of the Willamette River to release. Juvenile fish would acclimate to the Coast Fork and return there as adults ~~to spawn~~. Still a concern with these fish straying back to the McKenzie as adults, since the fish were raised at McKenzie hatchery and using McKenzie fish as broodstock. The consensus in the literature is that about 10% of juveniles released would stray back to the McKenzie. Other fish may stray elsewhere.

McKenzie production is for recreational fishing and brood stock need. Currently ODFW's McKenzie harvest target is 1000 adults; they also need ~1600 adult fish annually for hatchery brood stock. Anglers typically don't achieve harvest level (usually 700-900 on average) even though river is heavily fished.

Variations on ODFW Proposal: (1) Increase reprogramming level up to about 1/3 of current levels, ~~and~~ using~~e~~ Willamette stock, for release in Coast Fork Willamette River. Problem to address with this option is that Hatchery Science Research Group (HSRG) has recommended lower densities in Willamette Hatchery rearing ponds. (2) Construct additional acclimation ponds at the Willamette Hatchery, and/or shift production throughout the Willamette basin to make room at Willamette hatchery, and place McKenzie juvenile or smolts in these acclimation ponds prior to transferring and releasing them into the Coast Fork. This action would likely reduce straying of Coast Fork-reared fish back to the McKenzie River. Problem to address with this action: space and water supply for these ponds at Willamette Hatchery. (3) Fall release of smolts might reduce straying (Schroeder memo). (4) Higher numbers of smolts moved to CF Willamette (400K-500K).

PROS
New fishery opportunity in the Coast Fork ~~fishery opportunity~~
Higher percentage of returning Chinook will be wild fish in the McKenzie River
Could start moving fish in 2012
Spring release vs. Fall release

CONS
Level of reduction proposed by ODFW may not be sufficient to achieve >10% PHOS
McKenzie brood stock source for Coast Fork fish releases
Capacity of Willamette Hatchery: what is appropriate level of reprogramming or reduction?

Required f~~F~~acilities for acclimation in the Coast Fork~~y CF – Ponds~~
Wouldn't guarantee meeting the >10% PHOS, but NOAA would analyze.

~~**Cougar Dam Improvements to increase wild spring Chinook production**~~

e. Cougar Dam reintroduction to increase wild spring Chinook production

If downstream juvenile passage improvements are made at Cougar Dam, the number of wild spawners will increase, thereby achieving a lower straying rate of hatchery Chinook. The current mitigation agreement is ~~requirement~~ 80,800 pounds at McKenzie hatchery from the loss of 4,060 adult Chinook above Cougar and Blue River dams.~~is 4,040(?) returning adult spawners above Cougar Dam (NOAA to check on this number).~~ Of this total, Jeff Ziller stated 4,000 from Cougar and 60 from Blue River.

Over the last decade, on average 2,300 wild fish on average cross Leaburg Dam ~~spawn~~ o~~i~~n the McKenzie River ~~below Cougar Dam~~. Tabulate efficiency of Cougar downstream passage number on number of returning wild spawners. Will have to make assumptions and analyze. If Cougar team decides to operate dam to increase juvenile passage, NOAA will look at wild fish production under different downstream scenarios. Cougar Dam changes can be analyzed as part of the cumulative effects analysis of the NEPA document for this project. Although Cougar improvements could help BPA/COE meet the less than 10% straying rate RPA, the RPA needs to be met regardless of what Cougar improvements achieve. Even without any structural or operational changes at Cougar dam, there are adults returning to Cougar that are the progeny of adults that have been outplanted above Cougar. The Action Agencies stated t~~T~~he mitigation production at McKenzie~~Leaburg~~ hatchery should be reduced by the pounds equivalent to the number of natural origin adults that are currently returning to the adult trap at Cougar dam. NMFS responded this is not a year to year determination but a long term average.

BPA to work with NEPA timeline & design, need decision by March, need 10 months for an EA.

f. O & M costs

General discussion of funding the long-term O&M costs of any long-term facility operations. All agencies want to reduce O&M costs to the lowest extent possible and know long-term obligations prior to buying off on an agreement.

4. Tentatively agree on suite of alternatives to be analyzed further to meet RPA #6.1.4

   Tentative actions to be further analyzed as specified below in Action Items.

5. Next steps: agency sign-off, agency task commitments

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Action Items

NOAA: (1) Analyze effects/stressors to wild fish from a sorter at Leaburg Dam. (2) Once the WATER Fish Passage Team or Cougar PDT provides estimated increase in wild production from Cougar downstream passage fixes (see below), a~~A~~nalyze effects of projected wild Chinook production above Cougar Dam with downstream juvenile passage improvements in place. (3) Once a definitive suite of actions for reform have been identified, NMFS will scope out any necessary FERC and sec 7 consultation changes needed with EWEB, FERC.~~If FERC license changes are needed, NOAA will work with EWEB and FERC on possible ESA section 7 consultation.~~ (4) Verify the required number of returning wild spawning Chinook above Cougar Dam.

BPA: (1) Meet with EWEB and COE to discuss EWEB's concerns re. logistical and regulatory feasibility of sorters at Leaburg Dam ladders. (2) Investigate the cost of a river pump station on the McKenzie river bank. (3) Further investigate/determine flow needs at McKenzie hatchery to meet NOAA criteria for adult attraction at the ladder. (4) If NOAA and EWEB agree to allow a sorter, BPA will craft an agreement with EWEB to allow access for construction and O&M.

COE: Meet with EWEB and BPA to discuss EWEB's concerns re. logistical and regulatory feasibility of sorters at Leaburg Dam ladders.

ODFW: (1) Provide details on the risks to McKenzie Hatchery water supplies. (2) Provide information to the group on the Schroeder paper outlining the effects to the McKenzie fishery from a fall smolt release from McKenzie Hatchery into the Coast Fork Willamette River.

EWEB: Confer with their legal counsel on the need to revise FERC license if sorters are built at their ladders. Explore all possibilities to use more canal water during specific months of May and June for additional attraction water for the McKenzie hatchery ladder (including reimbursement costs to EWEB).

WATER Fish Passage team or Cougar downstream PDT: Provide range of estimated numbers of adult Chinook produced above Cougar Dam, given the current designs for downstream passage alternatives currently on the table. These estimates will be included in the analyses of reductions in hatchery Chinook needed to meet 10% RPA goal.~~Discuss effects of projected wild Chinook production above Cougar Dam with downstream juvenile passage improvements in place.~~

Deadline: January 25~~30~~th have a suite of actions identified and preliminary analysis to show the anticipated benefits of the reform actions in meeting the RPA. ~~,~~ NMFS and ODFW will send out to Technical Group for review prior to the next meeting. ~~has a report due to everyone by Jan 15 that needs to be done before others and meet their deadlines~~

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Next Meeting: on or around Jan 30th, 2012
~~Lance NOAA by Jan 15th will have the wild fish impact analysis or some type of feasibility determination report to the team, so the team can finish their action items~~

Date and Time: TBA
Location: TBA

NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Thomason	1	Noted. Please see responses to comments submitted by the Western Environmental Law Center.

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Via email and first class mail

May 29, 2018

National Marine Fisheries Service
Oregon Coast [*sic*] Hatchery DEIS
2900 N.W. Stewart Parkway
Roseburg, Oregon 97471

Dear Sir/Madam:

Thank you for the opportunity to comment on the draft Environmental Impact Statement ("DEIS") prepared by the National Marine Fisheries Service ("NMFS") related to four proposed Hatchery and Genetic Management Plans ("HGMPs") for spring Chinook in the upper Willamette River basin ("UWR") in Oregon. Thank you as well for agreeing to accept comments on the final EIS before issuing any record of decision. *See* DEIS at 11.

These comments are submitted by McKenzie Flyfishers, Conservation Angler, and Willamette Riverkeeper.

Legal Standards.

1. The DEIS at 6 notes that NMFS must "ensure the hatchery programs are being managed for the conservation and recovery of listed spring Chinook salmon and winter steelhead" in the UWR. The ESA recovery standard means, among other things, that NMFS cannot allow spring Chinook in the UWR to continue their "slow slide into oblivion." *Nat. Wildlife Fed. v. Nat'l Marine Fish. Serv.*, 524 F.3d 917, 930 (9th Cir 2014). As NMFS itself has recognized, "the longer a species remains at low population levels, the greater the probability of extinction from chance events, inbreeding depression, or additional environmental disturbance." NOAA Fisheries, *Consultation Handbook* at 4-12. It is impermissible for NMFS to set a recovery goal "that can be satisfied with only infinitesimally small growth, despite populations that are already dangerously low in abundance," because doing so "risks tipping species to a point where recovery is no longer feasible." *Nat. Wildlife Fed. v. Nat'l Marine Fish. Serv.*, 184 F. Supp. 3d 861, 872 (D. Or. 2016).

2. As NMFS is aware, after it released the DEIS, on April 9, 2018, the Corps of Engineers requested reinitiation of consultation under Section 7(a)(2) of the ESA for the entire suite of federal actions in the Willamette Basin River Flood Control

Project. The project includes funding for and use of facilities at which the four spring Chinook programs are implemented. It is improper under NEPA and under Section 7(d) ESA for NMFS to make any irreversible or irretrievable commitments of resources, including approving HGMPs for hatchery programs in the UWR, before completing reinitiation of consultation under Section 7(a)(2). 16 U.S.C. § 1536(d). #1

3. The DEIS at 9 states that NMFS "has a limited role (i.e., approve or deny [the HGMPs]) under Limit 5 of the 4(d) rule." If what NMFS means is that it can only approve or deny the HGMPs as submitted, that is incorrect. When NMFS adopted the 4(d) rule in 2000, it also published "A Citizens Guide to the 4(d) Rule." 65 Fed. Reg. 42,422, 42,423 (July 10, 2000). The Citizens Guide provides: #2

> HGMPs are developed and approved in the following manner: A fish management agency, such as a state department of fish and wildlife, develops an HGMP that meets the 4(d) rule criteria. They send it to NMFS who then requests public review and comment. The public input is used to revise the HGMP, if necessary. Once the HGMP is deemed sufficient, NMFS writes a letter of approval to the agency that developed the HGMP. The HGMP is then implemented . . . .

Citizens Guide at 10. NMFS's "Updated July 2000 4(d) Rule Implementation Binder" (Aug. 2003) states the same process: After an entity submits an HGMP to NMFS, it "then requests that the public and technical experts review and comment on it. This input is used to revise the HGMP, if necessary, and is considered by NOAA in its evaluation." *Id*. at 5-1; *see also id*. at 5-5 ("review comments are shared with the submitting agency and are used to revise the HGMP if necessary."). This DEIS is the first opportunity for the public and at least some technical experts to review and comment on the submitted HGMPs. Accordingly, under the 4(d) Rule and NEPA, the HGMPs can be revised, if necessary. *Id*. Further, NMFS must consider the public's and technical experts' input to evaluate whether the HGMPs should be revised. *Id*.

4. Separately, as NMFS is aware, under Section 7 of the ESA, it must self-consult to determine if approving any HGMP may jeopardize the continued existence of spring Chinook or winter steelhead in the UWR. *See* 2003 4(d) Rule Implementation at 12; DEIS at 9.[1] If NMFS concludes that one or more HGMPs will jeopardize either species, it must provide reasonable and prudent alternatives to avoid jeopardy. Further, if NMFS ultimately concludes that jeopardy will not occur, it still must prepare an incidental take statement that includes mandatory reasonable and prudent measures to minimize take. (That is what NMFS did, for example, in the process of approving an HGMP for hatcheries on the Elwah River in Washington.) It is incorrect that NMFS can only, prior to receiving public and technical expert comments, and completing self-consultation, deny or approve the submitted HGMPs. #3

[1] The biological opinion and incidental take statement should be made available for public review and comment along with the final EIS, prior to any record of decision.

5. Hatchery spring Chinook are not qualified to be part of the ESU. In 2005, NMFS proposed to include hatchery-origin fish in the ESUs of listed salmonids. 70 Fed. Reg. 37,160 (June 28, 2005). That choice was not evaluated under NEPA. The most recent proposal to include hatchery origin fish in the ESU was in 2016. 81 Fed. Reg. 204 (Oct. 21, 2016). That choice was not evaluated under NEPA either. NMFS has stated that hatchery stocks should be a part of the ESU because there is evidence of similarities between hatchery origin and native-spawning fish in the ESU. *Id*. But this is not supported by the best available science. Recent published research demonstrates that when employing appropriate genomic analyses, there are substantial differences between hatchery and natural-origin fish at the gene level, and these alternative adaptations to hatcheries or the river are both rapid and fully heritable. *See*, *e.g.*, Christie, et al., 2014. The results of this research are consistent with previous studies. The DEIS fails to consider and disclose the bases for NMFS's determination that the hatchery fish should be a part of the ESU, and include an alternative that consider and discloses environmental effects when they are not. #4

6. The DEIS at 19 states the proposed alternative includes implementing, among other things, a "steelhead" HGMP. The DEIS at 2 n.2 states the "co-managers" are "updating the summer steelhead HGMP to reflect current management." On NMFS's website announcing the availability of the DEIS (and extending the comment period to May 29, 2018), there are links to four HGMPs -- all for spring Chinook. *See* http://www.westcoast.fisheries.noaa.gov/hatcheries/hgmp/willamette_deis.html (visited May 22, 2018). It is not possible to comment on something that has not been made available for review. Because any updated summer steelhead HGMP will influence the effects analysis in the EIS, after finding any submitted summer steelhead HGMP to be sufficient for consideration, NMFS must release it for the public and technical review experts to review and comment on, and it must reflect their comments in an updated DEIS, to comply with NEPA and the ESA. #5

7. The DEIS at 1-2 states that "the hatchery summer steelhead and rainbow trout program [*sic*] are included in this evaluation using existing HGMPs for these programs." The DEIS lacks any substantive evaluation of the effects on spring Chinook or winter steelhead, except to note that the rainbow trout has no "conservation/reintroduction benefits," DEIS at 21, and that at least in the McKenzie River, introducing rainbow trout is among the "limiting factor[s]/threat" to spring Chinook. DEIS at 116. The 2008 BiOp at 4.5-19 states that "[p]redation of juvenile salmon and steelhead by warmwater fish species as well as hatchery rainbow trout has not been directly studied at Foster and Green Peter reservoirs although, as described above, USACE (1995) hypothesized that it might be a factor in low juvenile fish collection at Green Peter." The 2008 BiOp at 5.1-53 notes that generally, fishing for rainbow trout itself may harm juvenile spring Chinook and winter steelhead, because "fisheries targeting [rainbow] trout typically intercept, catch, handle, and sometimes kill juvenile salmon and steelhead." In its Supplemental BA prior to the 2008 BiOp, at 3-104, the Corps of Engineers proposed to "[c]ontinue current operations, production schedules, and releases" of hatchery rainbow trout, until further studies were done as to impacts on winter steelhead and spring #6

Chinook salmon. The DEIS fails to disclose the status of any of those studies, and fails to disclose the continuing impact from hatchery rainbow trout on natural-origin spring Chinook and winter steelhead.

Baseline or Current Environmental Conditions.

8. NEPA regulations require an EIS to describe "the environment of the area(s) to be affected or created by the alternatives under consideration." 40 C.F.R. § 1502.15. "The concept of a baseline against which to compare predictions of the effects of the proposed action and reasonable alternatives is critical to the NEPA process." Council on Environmental Quality, Considering Cumulative Effects under NEPA (May 11, 1999). It is only when an agency action is "mandatory" that "the no action alternative is properly defined as the carrying out of that action." *Pacific Coast Federation of Fishermen's Associations v. U.S. Dep't of the Interior*, 655 Fed. Appx. 595 (9th Cir. 2016) (citing *Dep't of Transp. v. Pub. Citizen*, 541 U.S. 752, 769 (2004)). By contrast, "a 'no action' alternative is 'meaningless' if it assumes the existence of the very plan being proposed." *Id*. (citing *Friends of Yosemite Valley v. Kempthorne*, 520 F.3d 1024, 1038 (9th Cir. 2008)). #7

9. The DEIS at v. states a "no action" alternative of "continuation of the existing hatchery programs for spring Chinook, summer steelhead, and rainbow trout" in the UWR. The DEIS at v. also states that these "programs are currently being managed under the mandates" of the 2008 BiOp. We agree the Corps of Engineers has a duty to mitigate for the loss of fish caused by the Willamette Valley Project. We also agree that currently, to avoid jeopardy to the spring Chinook ESU and to facilitate its recovery, some hatchery spring Chinook must be released in the UWR for conservation purposes. By contrast, however, the 2008 BiOp does not mandate or require release of hatchery summer steelhead or rainbow trout in the UWR. *See* Exhibit A. Moreover, given that the Corps of Engineers has requested reinitiation of consultation related to the 2008 BiOp, NMFS cannot assume the result of consultation will be any requirement or mandate related to any specific species of hatchery fish. The DEIS includes a "no action" alternative that is partially wrong and, regardless, may be contradicted. #8

10. The DEIS at 2 states that "existing hatchery facilities are considered part of current conditions existing in the environment at this point in time because the hatchery facilities have been operating for many decades." But after the hatcheries were built, the species of fish produced and released have in some places changed, and the number of fish produced and released have in some places changed. The effects analysis in the DEIS cannot fairly be based on the <u>current</u> species or number of released hatchery fish as the "no-action" alternative. #9

11. The proposed HGMPs and DEIS fail to consider, disclose, or account for the significant decline in overall populations of spring Chinook in the UWR. The available date for the recent history of spring Chinook salmon in the basin shows that sub-basin spawning areas show either a decline in numbers or a population #10

number for wild spawning fish that is so low that it is unlikely that the run will persist (Sharpe, C., 2017a).

12. The proposed HGMPs and DEIS fail to consider, disclose, or account for the stark differences between the status of natural-origin spring Chinook populations in each sub-basin of the UWR. In the most recent 5-year review of the ESU, NMFS found that there is a continuing decline in the status of its viability (NMFS, 2016; section 2.3.1). Of greater concern is the conclusion that the status of the McKenzie River population has declined in the last 10 years, given that this population was previously seen as a stronghold in the ESU. The following table summarizes the latest monitoring results of salmon spawning in each sub-basin in 2016. #11

Table 1. UWR Spring Salmon Status by Sub-basin: 2016 Monitoring Results[1]

Location	Redds Count	PSM (%)	pHOS	# Natural Spawners	# Hatchery Origin Spawners
North Santiam (Below Minto Dam)	410	3%	59.6%	≈300	≈400
North Santiam (Above Detroit Dam)[2]	481	5%	100%	0	≈1,299
South Santiam (Below Foster Dam)	1,200	4%	92.2%	≈300	≈2,700
South Santiam (Above Foster Dam)[2]	162	11%	35.2%	≈275	>100
McKenzie River (Below Leaburg Dam)	180	17%	91.3%	≈50	≈500
McKenzie River (Above Leaburg Dam)	1,117	0	31.8%	>1,500	≈800
McKenzie River (Above Cougar Dam)[2]	293	0	91.3%	?	?
Middle Fork Willamette	7	96%	78%	<10	<10

(Below Dexter Dam)					
Middle Fork Willamette (Above Fall Creek Dam)	98	15%	0%	>200	<10

Fn 1: Source: Sharpe, C. 2017a. 2016 Willamette Biological Opinion Hatchery Research, Monitoring, and Evaluation: Preliminary Observations on Chinook Salmon Abundance, Distribution and Diversity. Paper Presented at Willamette Fishery Science Review (Feb. 9, 2017). Corvallis, Oregon.

> Note: the indication of "preliminary" refers to the unfinished analysis of otoliths from presumed wild spawners. In the past, some unclipped carcasses have turned out to be hatchery origin fish that were not properly marked (*i.e.*, unclipped). If this occurs in these data, it will increase estimated pHOS and reduce the number of wild spawning fish.)

Fn 2: Indicates population that is above a barrier to fish passage.

These data make it clear the number of natural-origin spring Chinook whose progeny have unfettered access to the ocean is small. Generally, any population with an effective (genetic) population size (Ne) less than 500 is highly threatened (Allendorf, F., et al., 2013 and HSRG, 2014). It is clear that only the McKenzie River supports a population of natural-origin spring Chinook above this threshold. Beyond the gross number of fish potentially available for spawning, the very high pHOS levels and, in the case of the Middle Fork population, very high pre-spawning mortality, raise the question of whether there remains a natural-origin run of spring Chinook independent from the hatchery stock in other sub-basins. It should also be understood that the number of naturally-spawning fish are estimated from fish passage information or extrapolated from counting redds. These methodologies result in a maximum estimate of effective population size. These estimates likely overestimate the true number of individuals contributing genes to the next generation by a fairly large margin.

13. The DEIS at 105 acknowledges that continuing existing hatchery operations in the UWR "would continue to pose short- and long-term risks associated with demographic and genetic effects, competition and predation effects, hatchery facility effects, incidental fishing effects, and transfer of pathogens from hatchery fish and/or the hatchery facility to the adjacent river or stream where natural-origin salmon and steelhead occur." *See also* DEIS at 94-97 (listing negative effects of hatcheries). The DEIS fails to consider and evaluate those risks with current, declining spring Chinook and winter steelhead populations. Each and every one of these risks needs to be separately stated, evaluated, and considered as to both populations. #12

14. For the winter steelhead DPS, the DEIS at 42-43 refers to data (or fish counts) for "the last 10 years." Does that mean 2007-2017? What ten-year time period is referred to. #13

15. NMFS has found that winter steelhead in the South and North Santiam River basins are the "core" and "genetic legacy" populations in the DPS. BiOp 3-20. To estimate natural-origin winter steelhead returns in the DPS, the DEIS at 43 states that data on adult returns at Willamette Falls from 1971 through the 1990s are irrelevant, because they do not distinguish between hatchery and natural-origin fish. For returns of natural-origin winter steelhead to the North Santiam River, the DEIS at 43 states the "best measure of steelhead abundance is the count of returning winter-run adults to Upper and Lower Bennett Dam." The DEIS at 44 states that "the most recent average count [at Bennett Dam] for unmarked (presumed native) winter steelhead (2010-1014 [*sic*] is 1,195 [plus or minus] 194." Those data, if accurate, are outdated, at best. The most recent counts at Upper and Lower Bennett Dams (dated Dec. 16, 2017) are 132 unmarked steelhead at Upper Bennett Dam and 53 at Lower Bennett Dam. *See* https://www.dfw.state.or.us/fish/fish_counts/north_santiam/bennett_dams.asp (visited May 23, 2018). Immediately prior years' data show the same significantly depressed returns to the basin. The DEIS fails to consider or disclose the significant discrepancy in the data it relies on for assumptions about any stability or viability of winter steelhead in the North Santiam, and that the data show a significant decline in returning adults in a core and genetic legacy population in the ESU. *See also* Sharpe, C., et al. 2017b. #14

16. The DEIS at 45 concludes, after reviewing all of the various methodologies intended to estimate the number of returning winter steelhead to their spawning areas, these data show that "[t]hese numbers would suggest that abundances have been fairly stable, albeit at a depressed level." We agree the numbers indicate severely depressed populations and should be of major concern because they contradict the recovery duty. However, characterizing these data as showing some sort of stability is flatly contradicted at DEIS at 46, which clearly demonstrates that each of the rivers supporting winter steelhead show a trend of continuing decline. #15

17. The BiOp notes that the "non-native summer steelhead hatchery program creates threats to listed winter steelhead." BiOp 3-25. The BiOp notes that in the South Santiam River, "hatchery summer steelhead spawn naturally in the same areas as winter steelhead (Schroeder et al. 2006). Since there is some overlap in the spawn timing of summer- and winter-run fish from February through March, the potential exists for summer steelhead to interbreed with winter steelhead in the South Santiam River." BiOp 5-5–23. The DEIS at 98 includes data showing significant overlap in run timing, presence of summer steelhead on winter steelhead spawning grounds, or both: it states a current estimate of percentage of hatchery-origin fish spawning in the wild ("pHOS") is 66% for the North Santiam sub-basin and 65% for the South Santiam sub-basin. *Id*. #16

18. Of note, the DEIS at 120 notes that Johnson et al. (2010) found that about 10 percent of unmarked juvenile steelhead sampled at Willamette Falls in 2009-2011 were "summer x winter steelhead hybrids," and that summer steelhead hybrids represented 11.1 percent and 14.8 percent of samples in the North and South Santiam Rivers, respectively. These rates of introgression are damaging to winter steelhead populations, and do not support the generalization in the DEIS at 121 that the summer steelhead program poses a merely "medium" risk to winter steelhead. This conclusion is contradicted by recent research that provides strong evidence that allowing this run timing hybridization to occur is damaging to the fitness (in this case the ability of a local population to persist) of either or both populations. (Prince, D.J., et. al., 2017). #17

19. The DEIS at 125 acknowledges that "competition" between hatchery summer steelhead and natural-origin winter steelhead is a "key limiting factor" for recovery of winter steelhead in the North Santiam and South Santiam basins. The DEIS acknowledges that negative effects include released summer steelhead exceeding carrying capacities and thus "displacing" winter steelhead, which the DEIS states "is presumed to be the case in UWR sub-basins"; summer steelhead spawning earlier than winter steelhead and thus emerging earlier, creating a competitive advantage in occupying feeding territories; that summer steelhead are "large-sized when released within the UWR and thus have the high potential to prey upon a variety of other fish species"; and that summer steelhead residualize, meaning they do not emigrate. *Id*. & 126. As to the last, the DEIS at 126 notes that Harnish et al. 2014 and McMichael et al. 2014 found that in 2013 and 2014, a "substantial portion" of hatchery summer steelhead did not emigrate from the South Santiam River, and that those present in the river >30 days after release "were present in all locations visited through the final snorkel surveys in both 2013 and 2014." Based on these acknowledgments, there is no solid basis for the DEIS to conclude that the ecological risk of the summer steelhead program on natural-origin winter steelhead is merely "medium-high." But even if it were, the DEIS then fails to consider and disclose any basis by which NMFS may eventually choose to *continue* a hatchery program that has such a risk, in the face of the severely depressed populations of natural-origin winter steelhead in the UWR. #18

20. The DEIS fails to consider or disclose that, to maximize fishing opportunities, some summer steelhead adults that return to hatcheries have been "recycled," *i.e.*, "hauled downstream and 'recycled' through the fishery until approximately mid-October." In 2013, for example, 2,444 summer steelhead that returned to the Foster Fish Facility were "recycled" back into the South Santiam River. The DEIS fails to consider or disclose the effects on winter steelhead of the return of recycled summer steelhead back in to the river systems. #19

21. The DEIS at 133 purports to evaluate effects on winter steelhead of ending hatchery steelhead releases into winter steelhead habitat. The DEIS states: "[T]here is potential that eliminating the summer steelhead hatchery program may increase the viability of the UWR winter steelhead DPS by reducing the genetic effects of #20

interbreeding and the ecological interaction effects with hatchery summer steelhead." The DEIS fails to consider and contrast Jones (2018), which examines that natural-origin coho populations rebounded in the Salmon River in Oregon after hatchery coho releases averaging roughly 200,000 fish were discontinued. Among other things, Jones (2018) at 51 notes that after hatchery coho releases ceased, total escapement did not decline, as natural-origin coho spawners apparently replaced hatchery coho, which to the authors reinforced concerns that hatchery releases "replace rather than supplement wild production (Quinones et al. 2014)."

22. The DEIS at 133 states that if summer steelhead releases into the UWR end, "the current sport fishery that brings increased financial benefit to the area would disappear." The DEIS fails to consider or disclose the conceded probable genetic and ecological benefits as to recovering winter steelhead from ending summer steelhead releases, and only a financial impact to the current sport fishery. #21

Monitoring

23. The four proposed HGMPs treat each sub-basin's spring Chinook population as a discrete part of the ESU, but there is no monitoring program that evaluates the incidence of straying between the sub-populations. A program utilizing coded wire tags in hatchery releases was started and apparently abandoned in 2006. This task could be accomplished by using an adequate number of coded wire tags for tracking straying of hatchery-origin releases, or preferably, by adequately genetically characterizing the hatchery-origin stocks and native-origin stocks in each sub-basin. #22

24. The proposed HGMPs and DEIS fail to note that the current monitoring program for spring Chinook and winter steelhead in the UWR often does not provide sufficient information to support timely and needed management decisions. Even now, ten years after the 2008 BiOp was issued, there have been insufficient monitoring and studies to sufficiently genetically characterize natural-origin and and hatchery-spawned populations, even though the existing data strongly suggest that introgression has occurred. For instance, the DEIS fails to consider or disclose the current extent of straying between sub-basins, even though earlier studies showed this was occurring among hatchery-origin fish, and presumably still is. The DEIS fails to address any straying among natural-origin fish. The true extent of gene-flow within sub-basins between natural-origin and hatchery fish is also unavailable due to the reliance on redd counts and fish carcasses to estimate only pHOS. #23

25. The DEIS fails to address the issue that given the limited number of natural-origin spring Chinook in all of the rivers in the UWR, there are not more precise estimates of the effective population size (Ne). Studies of the reproduction of natural-origin salmonids have repeatedly shown that the majority of matings do not produce offspring that contribute to the next generation and that, of those that do produce returning offspring, a large percentage of these returns are from a minority of the matings. For example, in one instance where an appropriate parentage #24

analysis of fish spawning above Detroit Dam (Black, et al., 2017) was performed, it was shown that gross spawning numbers overestimate the effective population size (Ne) by at least a factor of 4. The consequences of this difference raise serious concerns that the DEIS fails to consider or disclose the true risks of extirpation of spring Chinook populations.

26. The Corps of Engineers did not fund monitoring in 2017 that was required under the 2008 BiOp and, as a result, monitoring was not performed. The DEIS fails to consider or disclose that data gap, and to discuss how it influences the effects analysis and alternatives. #25

Best Available Scientific Data.

27. The best available science on aspects of managing hatcheries was formulated by the Hatchery Scientific Review Group ("HSRG"). As stated in HSRG (2014) at 12, "HSRG principles are often cited in the literature and referenced in scientific reviews of hatchery programs." In 2009, the Washington Department of Fish and Wildlife ("WDFW") adopted the HSRG principles in its Hatchery and Fishery Reform Policy (WDFW Commission Policy C-3619). The policy states that WDFW will "use the principles, standards, and recommendations of the [HSRG] to guide the management of hatcheries operated by the Department….and promote the achievement of hatchery goals through adaptive management based on a structured monitoring, evaluation, and research program." In the absence of any other similarly well-researched and considered scientific hatchery management standards, we strongly urge NMFS to follow the state of Washington's example and adopt the HSRG recommendations for reviewing and critiquing all HGMP submissions. #26

28. The proposed HGMPs and the DEIS fail to use or present the best available science to inform prospective decisions. The four proposed HGMPs state that they are "integrated" programs. The only information provided to support this statement is the fact that historically the hatchery broodstock is mostly derived from naturally-spawned fish of the same sub-basin origin at some time in the past. In some cases, at various intervals a small number of naturally-spawned fish were included but in no case has this been systematically carried out. The distinction between integrated and segregated hatchery programs, as defined by the HSRG in 2004 and restated and clarified most recently in 2014 (HSRG, 2014), is that an integrated hatchery management program must be based upon consideration of the relative proportions of hatchery-origin fish ("pHOS") and natural-origin fish ("pNOB") and the resulting proportionate natural influence ("PNI"). None of the hatchery programs in question is anywhere close to achieving an appropriate PNI number and, more importantly, given the number of remaining naturally-spawning fish, none is able to achieve these minimum benchmarks without seriously "mining" the existing natural-origin population: a problem clearly described in the latest HSRG document. HSRG (2014) at sec. 3.1.2. Given this situation, the hatchery broodstock programs should be considered segregated programs and, as such, must be separated genetically from the natural-spawning population to the extent #27

possible. This conclusion is in direct conflict with the proposed standards in the proposed HGMPs, which set the acceptable levels for genetic interactions between naturally-spawned and hatchery-spawned fish (pHOS) much higher than any rationally defined, described, and accepted standard.

29. Referring to "segregated" and "integrated" hatchery programs, the HSRG stated: "In practice, all hatchery programs must fall into one of the two categories; "intermediate" programs cannot exist without imposing significant risks to natural populations because of fundamental differences in the biological principles underlying the two types of programs." HSRG (2004) at B-4. Further, in its most recent report, the HSRG stated "Baskett and Waples (2013) found that intermediate strategies result in the greatest adverse fitness and demographic consequences. This finding is also consistent with the HSRG's working hypothesis about productivity and fitness." HSRG (2014) at 41. As noted, if NMFS does not adopt the HSRG definitions for integrated and segregated hatcheries, it is obligated to provide justifications for departing from them and to institute a similarly scientifically rigorous set of definitions and principles to guide hatchery programs. #28

30. The proposed HGMPs have varying levels of incorporation of native-origin fish into the hatchery programs. These levels are not based on the best available science but, instead, are more of an estimate of how many natural-origin Chinook would possibly be available for removal from spawning grounds. This is particularly concerning as the counts of natural-origin Chinook are low and there are no good estimates of the effective population size (Ne) on any of these rivers, though they will certainly go down from the counts presently available (more on this topic below). Moreover, a study comparing the performance of integrated with traditional domesticated hatcheries (Chilcote, et al. 2011) failed to show any advantage for the integrated programs. Accordingly, it seems important to consider whether the costs (reduced numbers of natural-origin spawners) of integration programs outweigh the benefits. #29

31. The proposed HGMPs and the DEIS fail to provide any justification for the allowed or target pHOS in any of the sub-basins. The DEIS at 98 states "future targets" of up to 21% pHOS in the North Santiam River downstream of Detroit Dam, 80% pHOS in the South Santiam River downstream of Foster Dam, and 10% pHOS in the McKenzie River downstream of Cougar Dam and Trail Bridge Dam. The DEIS fails completely to rationalize these numbers. There is no published scientific study or article that suggests that even 10% is a safe and acceptable pHOS and will avoid genetic degradation of natural-origin spring Chinook or winter steelhead. Further, the DEIS is contradictory in this respect. On the one hand, for example, the DEIS at 98 states that for summer steelhead, "it is the intent of managers to reduce natural spawning of hatchery fish to the lowest degree possible, but some introgression from summer-run hatchery fish with natural-origin winter run steelhead has been detected (Johnson et al. 2013)." Then, on the same page, NMFS sets a "target" of 21% pHOS downstream of Detroit Dam and 80% pHOS downstream of Foster Dam. #30

32. NMFS commissioned the HSRG to recommend how to manage hatcheries. HSRG did so. *See* HSRG White Paper No. 1: Predicted Fitness Effects of Interbreeding between Hatchery and Natural Populations of Pacific Salmon & Steelhead. Columbia River Hatchery Reform Project Final Systemwide Report (Feb. 2009). The HSRG report does not use pHOS alone to address genetic introgression of wild populations by hatchery fish. Instead, it uses Proportionate Natural Influence ("PNI"). The proposed HGMPs and DEIS fail to consider or disclose PNI; why they adopt a different standard for introgression; and why that standard is as high as it is. #31

33. The data presented for each of the hatcheries are not current or even near-current. Specifically, relevant data such as observed pHOS, redd counts and pNOB are generally presented only through 2013. The DEIS improperly fails to consider and disclose readily-available data from 2014-2016. Including these data is likely to show, among other things, the continuing decline in the status of the native-origin spring Chinook in the UWR and certainly no evidence of recovery. #32

34. The DEIS at 162 is correct that that the federal dams in the UWR have a significant harmful effect on natural-origin spring Chinook and winter steelhead. That was a basis for the jeopardy finding in the 2008 BiOp and the reasonable and prudent alternatives, which require work to effectuate fish passage at the dams. However, the proposed HGMPs assume that passage will be achieved and productivity of natural-origin fish will significantly increase, so that the current high levels of genetic introgression will be greatly diluted, thereby obviating the need to reduce releases of hatchery fish below the dams. But there remains uncertainty as to when, if ever, effective downstream fish passage will be achieved. Given the costs and technical challenges to making significant changes to high dams in the Willamette Basin, the HGMPs and the DEIS rely too heavily on the success of these efforts. The number of hatchery fish released below them must therefore be dramatically decreased to lower pHOS and lessen competition and predation, at least until the hoped for increase of the natural-origin escapement is realized. #33

34b. The DEIS at 167 concludes that impacts from the operation of hatcheries and release of hatchery fish will continue into the future, and could increase if natural-origin salmon and steelhead continue to decrease from other factors. However, it then goes on to state that none of the alternatives—including the extremes of eliminating hatcheries altogether (Alternative 4) or running them at maximum capacity (Alternative 5)—"would affect the overall trend" (which is downward) in salmon and steelhead populations. The basis for this conclusion is that "existing hatchery programs overall result in relatively low impacts to the affected species populations." The best available science flatly contradicts this assertion, and the DEIS lacks any discussion or analysis to compare this assertion with that evidence.

Alternatives.

35. The DEIS fails to consider a reasonable range of alternatives as to rainbow trout. One reasonable alternative would be to place hatchery rainbow trout into #34

lakes and reservoirs in Oregon where outplanted ESA-listed spring Chinook and winter steelhead do not exist. Similarly, a second reasonable alternative would include altering the timing of when hatchery rainbow trout are placed into reservoirs, to avoid interaction with the offspring of outplanted spring Chinook and winter steelhead. The DEIS fails to consider or disclose either reasonable alternative.

36. The DEIS at 16 & 22 states that alternative 3 includes producing 121,000 hatchery winter steelhead for release into the North Santiam River, and 161,500 hatchery winter steelhead for release into the South Santiam River. Until the late 1990s, hatchery winter steelhead were released into the UWR. 2008 BiOp at 5.1-26. Producing hatchery winter steelhead is a bad idea. It would among other things exacerbate the genetic introgression problem that already exists from the commingling of winter and summer steelhead. It is inconsistent with the best available science related to effects of hatchery rearing, as the loss of fitness in the wild occurs in the first generation and is heritable to future generations (*see, e.g.*, Christie et al., 2016b). Further, the low number of returning naturally-spawned winter steelhead are insufficient to allow removal from the spawning grounds without threatening the extirpation of the population. #35

37. The DEIS at 107 states that "[i]n the South Santiam, returns of natural-origin salmon have increased at Foster Dam in sufficient numbers to eliminate the need for hatchery supplementation." If true, then on what basis does NMFS propose to approve the release of 1,031,000 hatchery Chinook smolts into the river? *Cf.* South Santiam HGMP at 21. #36

Connected, Cumulative, and Similar Actions.

38. The DEIS fails to consider and disclose the effects of "connected," "cumulative," and "similar" actions. Connected actions are those that "are closely related and therefore should be discussed in the same impact statement." 40 C.F.R. § 1508.25(a)(1). They include actions that are "interdependent parts of a larger action and depend on the larger action for their justification." 40 C.F.R. § 1508.25(a)(1)(iii). Cumulative actions are those that "when viewed with other proposed actions have cumulatively significant impacts. 40 C.F.R. § 1508.25(a)(2). Similar actions are those that "have similarities that provide a basis for evaluating their environmental consequences together, such as common timing or geography." 40 C.F.R. § 1508.25(a)(3). #37

39. The DEIS fails to consider and disclose the effects of connected actions in the UWR. As an example, the DEIS at 162 acknowledges that the construction and operation of federal dams in the UWR are among the most significant causes of the listing of spring Chinook. In turn, the proposed spring Chinook HGMP for the McKenzie Hatchery at 12 justifies the number of hatchery smolt releases based on an assumed need to produce enough returning adult spring Chinook to transport above Cougar Dam to spawn. Currently, however, the Corps of Engineers is developing options to provide for more effective downstream fish passage through #38

Cougar Dam, and it has announced it will evaluate those options pursuant to NEPA. Exhibit D at 18; *see also* DEIS at 162. If implemented, these measures may increase survival rates for outmigrating smolts, and returns of unclipped Chinook to the base of the dam, which would reduce if not eliminate any ostensible conservation need for hatchery spring Chinook releases in the McKenzie. Similarly, in January, 2018, the Corps of Engineers initiated scoping under NEPA to evaluate enhancing downstream fish passage at Detroit Dam on the North Santiam River. The DEIS improperly excludes disclosure or consideration of this and other connected actions.

40. The DEIS fails to consider or disclose the similar actions of other ongoing or reasonably foreseeable hatchery operations in the UWR. The DEIS narrowly focuses on only the spring Chinook programs at four hatcheries in the UWR, without considering or disclosing that some of these hatcheries also produce hatchery fish other than spring Chinook (*e.g.*, South Santiam Hatchery, which ODFW intends to use to produce and release summer steelhead). Further, the DEIS narrowly focuses on only four hatcheries in the UWR, even though there are other federally-funded hatcheries (*e.g.*, Roaring Springs on the Santiam River) that also produce fish for release into the UWR. Further, the DEIS fails to note the Corps of Engineers is considering relinquishing ownership of Leaburg Hatchery on the McKenzie River, and giving title to ODFW; ODFW has informed the Oregon legislature it hopes to increase by 20% current releases of "trophy trout" into the UWR, and increase by 6% current releases of spring Chinook into the UWR. Exhibit B. All of these hatchery actions are similar and yet the DEIS fails to consider or disclose all of their effects. #39

41. ODFW asserts that in 2016, sea lions at the base of Willamette Falls consumed approximately 24% of the ESA-listed winter steelhead run. *See* Exhibit C at 9. The DEIS at 13 states that "NMFS is currently reviewing an application to lethally remove sea lions at Willamette Falls because of excessive predation of winter steelhead. . . ." The DEIS fails to consider or disclose the cumulative effects of sea lions, hatcheries, and other harmful factors (fisheries) on winter steelhead and spring Chinook. #40

Fisheries.

42. The HGMPs and DEIS fail to meet the regulatory requirement to meaningfully "describe[] interrelationships and interdependencies with fisheries management." 50 C.F.R. § 223.203(b)(5)(F). The DEIS at viii broadly states that changes in hatchery fish releases will affect "harvest" opportunities. But the DEIS fails to consider or disclose the <u>effects</u> of continued state-licensed fishing on natural-origin winter steelhead and spring Chinook. The only "discussion" in the DEIS is at 99: "Natural-origin salmon and steelhead can be affected by [hatchery] fisheries to varying degrees. In most cases, natural-origin fish are required to be released upon capture and externally marked hatchery-origin fish can be kept. The incidental effects of these catch-and-release fisheries on natural-origin fish typically range from 0 to 15 percent mortality (NMFS 2001a; NMFS 2001b)." First, the list of references in the DEIS does not include any documents that correspond with NMFS 2001a or NMFS $41

2001b. Second, the DEIS fails to identify where in the UWR (and for what species) there is any exception (*cf.* "most cases") to the catch-and-release rule for spring Chinook and winter steelhead. Third, the DEIS fails to consider or disclose the significant individual and cumulative effects of fisheries that may lead to up to 15 percent mortality on spring Chinook and winter steelhead populations that are nearing extirpation.

43. The DEIS at 22 states that in 2001, NMFS approved Fisheries Management and Evaluation Plans ("FMEPs") that specify allowable fishery impacts on spring Chinook and winter steelhead in the UWR, but the DEIS fails to provide any data from any such documents, or any NEPA analysis that accompanied them, that would enable NMFS to tier to them to supply the analysis of fisheries effects missing from it. #42

44. The HGMPs and DEIS fail to prove that "[t]he combination of artificial propagation programs and harvest management . . . provide as many benefits and as few biological risks as possible for the listed species." 50 C.F.R. § 223.203(b)(5)(F). The DEIS lacks a reasoned and supported evaluation of the expected costs and benefits of the alternatives that makes it difficult, if not impossible, to evaluate them. For instance, the DEIS fails to specify the expected impacts of continuing current Chinook hatchery programs on the demonstrated need to recover of threatened wild stock, and what if any offsetting benefits justifies continuing such programs. #43

45. There is no basis for the suggestion in the DEIS at page iv. that hatchery steelhead trout and rainbow trout contribute to a commercial fishery in the ocean. The FEIS should correct or eliminate that suggestion. #44

Climate Change.

46. The DEIS fails to consider or disclose the best available information related to climate change. The DEIS at 153 concedes climate change is among the "[r]easonably foreseeable future actions and conditions" that influence effects of hatchery spring Chinook into the UWR. The DEIS at 157-158 includes a seriatim list of probable and significant (if not catastrophic) effects to fish in the UWR due to climate change. The DEIS then concedes (but fails to consider or analyze) the correct proposition that "if natural-origin salmon and steelhead continue to decrease from other factors [such as climate change], then hatchery impacts could increase (e.g., higher pHOS from having fewer natural-origin fish spawning in the wild)." Given that increasing environmental stress is likely to characterize the UWR fisheries going forward, rather than taking the position that as we lose these fish we will just simply replace them, given the obligation to recover these already threatened populations NMFS should be looking to programs that increase the resilience of these populations. #45

47. The DEIS at 165 states that "[u]nder all alternatives [including alternative 4, having no hatchery spring Chinook in the UWR] impacts to salmon and steelhead from climate change are expected to be similar, because climate change would #46

impact fish habitat under each alternative in the same manner." That assertion is not based on the best available scientific information. As the DEIS acknowledges, climate change is likely to cause a number of significant changes to habitat in the UWR, but NMFS cannot assume that the effects of releasing hatchery fish into natural-origin fish habitat remains the same. For example, warming of waters or diminished streamflow (or both) may influence rates of competition or predation among hatchery and natural-origin fish. The DEIS fails to consider or disclose what are likely to be intensifying impacts to natural-origin spring Chinook from the continued releases of hatchery Chinook in the face of climate change.

McKenzie Spring Chinook HGMP:

47b. The DEIS at 20 states that under Alternative 3 (Reduce Hatchery Production to Reintroduction Needs), the "co-managers would produce only enough hatchery fish for reintroduction of adult salmon and steelhead above the Corps dams." The DEIS at 16 states that, for reintroduction efforts in the McKenzie River basin, this means 604,750 hatchery smolts. Yet the McKenzie HGMP at 3, 17, 19, and 21 states that recent, current, and future releases is the same number: 604,750 smolts. The DEIS is wrong that 604,750 hatchery smolts are needed in the McKenzie River to continue reintroduction of spring Chinook above dams. Instead, the HGMP at 18 and 51 make it clear that 604,750 hatchery smolts are proposed for release into the McKenzie River basin in order to also satisfy ODFW's goal of having a "minimum" of 1000 returned adult hatchery spring Chinook available for harvest. #47

48. The McKenzie HGMP at 18 states that the broodstock size to produce 604,750 smolts is 523 adults, and that the broodstock size to produce 787,000 smolts is 520 adults. It doesn't make sense that fewer adults are needed for more smolts. #48

49. The McKenzie HGMP at 14 provides for the outplanting of 60 males/60 females of hatchery origin above Trail Bridge Dam, if available. The DEIS fails to consider and disclose the effects on natural-origin spring Chinook of deliberately outplanting hatchery adults in the mainstem McKenzie upstream of Leaburg Dam, which NMFS in 2000 found should be managed as a "wild fish sanctuary." #49

50. The DEIS fails to note that the McKenzie HGMP proposes releases into the Mohawk River too, and fails to consider or disclose those effects. The Mohawk has a sandy riverbed and is listed under the Clean Water Act as "water quality limited" for high temperatures. Outplanting Chinook in the Mohawk will likely only increase prespawn mortality, and/or increase pHOS if the outplanted fish leave the inhospitable Mohawk and return to the mainstem McKenzie River to spawn. #50

51. The McKenzie HGMP at 14 & 18 states that hatchery spring Chinook smolt production is needed in part to meet a minimum escapement goal of 400 females and 200 males above Cougar Dam. The HGMP and the DEIS fail to explain why 400 females are needed when only 200 males are needed when, for example and by #51

contrast, prospective outplanting above Trail Bridge Dam and into the Mohawk River have an equal number of males and females. *See* HGMP at 27.

52. The McKenzie HGMP at 2 & 13-14 states that the hatchery will be managed to ensure less than 10% pHOS in entire basin except upstream of Cougar Dam and Trail Bridge Dam by four methods: (1) reduce releases, (2) trap at Leaburg Dam, (3) improve homing to hatchery (including using water from Cogswell Creek) and (4) improve natural-origin returns to Cougar.

53. The McKenzie HGMP at 14 states that to reduce pHOS, hatchery fish will be trapped at the left bank ladder at Leaburg Dam beginning in July through September, after "the bulk" of wild fish have passed, measured as more hatchery than wild returns. The DEIS fails to consider and disclose that the timing of trapping is not based on the best available science or data, and that the trap will further harm natural origin fish. In the past, ODFW operated a trap at Leaburg Dam only in the "late run time, while the number of wild fish is very low at Leaburg Dam," meaning the last few days of August and into September. *See* HGMP at 9. ODFW did so then to collect broodstock for the hatchery, not to reduce pHOS. *Id*. The HGMP at 54 proposes to operate the trap "during July through September," with a target of removing 100 hatchery adults. However, the DEIS fails to consider or disclose that July is one of the two months in the year when the greatest number of wild spring Chinook pass Leaburg Dam, greatly exceeding the number of hatchery fish. For example, in July, 2011, 1,223 unclipped and 169 clipped Chinook were counted at Leaburg Dam; in July, 2012, 733 unclipped and 101 clipped Chinook were counted; in July, 2013, 318 unclipped and 47 clipped Chinook were counted. Thomason Comments, Ex. C. #52

54. Operating a trap at Leaburg Dam can cause significant harm to wild spring Chinook, by delaying upstream migration, or causing them to avoid the ladders at the dam altogether. *See* Frissell Comments. Pre-spawning mortality in the McKenzie River below Leaburg Dam was recently estimated to be as high as 24%. Thomason Comments, Ex. G at 12 (2013 estimates). NMFS previously found that "<u>any</u> additional handling, stress for spring Chinook that hold for extended periods before spawning is of greatest concern, particularly since prespawning mortality is a huge problem in the Willamette." Thomason Comments, Ex. H at 6 (emphasis added). In the 2008 BiOp at 5.3-22, NMFS stated: "Over the last few years, efforts were conducted to remove hatchery Chinook from the ladder at Leaburg Dam in order to reduce hatchery fish spawning in the wild. However, the ladders on Leaburg Dam are not adequate for sorting out hatchery fish without having significant impacts to commingled wild fish. Due to these wild fish concerns, the efforts to remove hatchery fish were discontinued." Avoidance or delay due to trapping at the dam is in fact likely to exacerbate already high pHOS below the dam, which is significant because the proportion of Chinook spawning below the dam has been increasing over the last decade, roughly doubling to about 20-25% of the current total. Thomason Comments, Ex. B. The DEIS fails to consider or disclose these data, and #53

present a rational basis for approving any trapping of natural-origin Chinook at Leaburg Dam.

55. Eugene Water and Electric Board ("EWEB") owns Leaburg Dam. Any trap at the dam must be approved by EWEB and the Federal Energy Regulatory Commission ("FERC").

56. The natural-origin population of spring Chinook in the McKenzie River sub-basin should be managed cautiously given the serious threats of extinction in other UWR sub-basins. Data provided in the HGMPs suggest that native-origin spring Chinook in the Middle Fork of the Willamette River and the North Santiam River, which are currently classified as "at high risk of extinction," are at such low numbers that it is questionable whether viable stocks remain. For instance, both populations have been exposed to high levels of genetic introgression from hatchery spring Chinook for decades, which is likely to have reduced their reproductive fitness (Kostow, 2009). Moreover, with the small number of spawning fish, the possibility of maintaining appropriate levels of heterozygosity is remote on purely statistical grounds (*e.g.*, loss of genetic variation due to genetic drift). The South Santiam population of spring Chinook is currently classified as "threatened" with a risk of extinction. But here again the natural-origin population has also been subject to high rates of genetic introgression from hatchery spring Chinook for decades. A larger concern is the small number of native spawners returning to the river. In 2013, the last year data are reported in the HGMP, 177 spring Chinook adults returned to the South Santiam River. The effective population size (Ne) which formed the next generation's gene pool is unknown, but it was certainly smaller than the total number of spring Chinook returning to the river; perhaps much smaller. These are extremely concerning numbers (*See*, *e.g.*, the discussion of critical effective population size in Allendorf, et al, 2013, Ch. 7). Given this situation, it is clear that if the Upper Willamette Basin spring Chinook ESU has a future it is almost certainly going to require attaining a robust Chinook population in the McKenzie River. #54

57. The risk assessment for McKenzie River spring Chinook is out of date and should be reconsidered. As the proposed HGMP notes, NMFS classified the McKenzie River spring Chinook population at "at low risk of extinction" seven years ago, based upon the four VSP parameters (NMFS, 2011). However, factors used in this analysis are heavily weighted towards maintaining a viable physical environment and an appropriate number of fish returning to the river. This natural-origin population is critical to preserving and recovering the ESU. Until there are better data regarding the inclusive fitness of this population, its persistence should not be taken for granted. Also, regardless of the risk assessment, data provided in the proposed HGMP show that native spawning spring Chinook are declining as a proportion of spring Chinook spawning above Leaburg Dam, particularly looking at the density of redds observed. *See* HGMP Table 2.2.2-1. Further, the proposed HGMP observes that "[o]ver the last decade, the counts of natural-origin Chinook at Leaburg Dam have exhibited a downward trend." HGMP at 34. #55

58. The monitoring program described in the proposed HGMP at Appendix B must be supplemented. As observed, the population of native-origin spring Chinook has been subject to high pHOS levels for decades. Beyond this genetic introgression we must presume that hatchery spring Chinook spawning below Leaburg Dam are producing unclipped progeny that, when they return as adults, are counted as natural origin fish. It is now understood that the reduction in fitness of hatchery-origin fish spawning in the wild have a heritable reduction in fitness and so are likely to reduce the fitness of the native-origin gene pool beyond just the immediate effects captured by the pHOS numbers (Christie et al., 2016b). The proposed HGMP merely mentions taking tissue samples and subsequent genetic analysis, Appendix B, Task 4, but any approved HGMP must expand this work to cover all stocks as they are naturally spawning. #56

59. It is critical to adequately characterize both the native-origin and hatchery-origin stocks in the sub-basin. This would allow for estimates of gene-flow on the river and provide a more informative estimate of effective population size (Ne). pHOS remains a useful estimate of the interactions of between hatchery origin and wild spring Chinook, given that at present it is the best available estimate we have regarding this phenomenon. However, this analysis (counting proportions of apparent wild and hatchery carcasses near some redds) is unavailable for winter Steelhead and is likely under estimating the levels of genetic interaction. Moreover, considerably more accurate genetic tests are now available and should be employed. Previously, directly defining a gene pool of a species, or sub-population of a species, was expensive, time consuming and the technology not readily available. Today, these factors are not major impediments (*cf*. Christie et al., 2016b and Phillipson et al., 2011 for examples). The data generated could also be used to monitor inclusive fitness of native spawners using pedigree analysis. If the work were extended to populations of other sub-basins, this should also provide reasonably precise estimates of straying among the sub-basins. #57

60. The proposed HGMP indicates that the hatchery brood stock will be monitored for maintenance of appropriate levels of heterozygosity, avoiding genetic drift and to reduce or control domestication effects as necessary (Secs. 5.1 and 6.1). In the case of heterozygosity, we are unaware of any clear standard appropriate for salmonids whose populations carry large numbers of alleles at many loci. Lacking any standard for what is biologically meaningful or concerning the use of tests of statistical significance are largely meaningless regardless of whether some differences reach or do not reach some *a priori* α level. It might be that if such an experimental design were developed, the sampling requirement to power an appropriate test might not be practical. #58

61. Genetic drift, modeled assuming random mating, is a function of stochastic fluctuations which increase as a function of reduction of effective breeding populations (Allendorf, 2013, Sec. 6.1). Given this, managing the scale of the brood stock is the most important factor for avoiding genetic drift. However, while this phenomenon has been important in the recovery of mammalian populations, we are #59

unaware of data from salmonid populations identifying this issue. It is also relevant that recent research on salmon has shown that inbreeding depression (a special case of loss in genetic variation) explains very little of the loss of fitness of hatchery origin fish spawning in the wild (Christie et al., 2016a).

62. Domestication effects must be monitored. As currently used, this term seems to refer to reductions in survival and heritable fitness of progeny in the wild. When such concepts are employed it would help if used with reference to specific quantifiable traits. Regardless, at this point the best available science indicates that domestication as a heritable trait occurs within a single generation and involves the expression of a large number of genes (Christie et al., 2014 and 2016b). Currently, specific genetic markers are lacking that indicate either the presence of or absence of domestication. Regardless, it appears domestication is a byproduct of the hatchery experience currently employed. So until we isolate the relevant factors and re-engineer hatchery programs to correct for this, in the interest of preserving native-origin fish, the more separation we can provide from hatchery fish, the better. #60

63. The HGMP at 11 and 50 refers to a "Cooperative Agreement." The prior cooperative agreement between the Corps of Engineers and the Oregon Department of Fish and Wildlife expired in 2017. The Corps' role in the McKenzie Hatchery is now set forth by annual contract, which the DEIS should refer to and incorporate. #61

64. The HGMP at 50 fails to note the ongoing case *McKenzie Flyfishers v. McIntosh*, No. 6:13-cv-02125-TC (D. Or.) that includes the requirement to achieve ten percent or less pHOS by 2020 based on a three-year rolling average from 2018 to 2020. The DEIS fails to consider or disclose data from 2018 as to any progress to reduce pHOS in the McKenzie River basin and, thereby, to judge any efficacy of any of the measures either implemented or envisioned to reduce pHOS. #62

Thank you again for the opportunity to comment.

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NMFS responses to the public comments submitted on the DEIS.

Author	Comment #	NMFS Response
Western Environmental Law Center	1	Noted. NMFS considers the information obtained from the public in both its responses to comments here and in its biological opinion, where we provide a more detailed analysis of the impacts of the proposed action, approval of the hatchery programs, on threatened and endangered species. NMFS understands that much of the public's interest in this action, an ESA approval, is focused on our analysis of effects on ESA-listed species. The Biological Opinion is where we determine whether an action jeopardizes ESA-listed species, while in the NEPA process we examine a wider range of potential impacts to the human environment. We appreciate the detailed input we have received in this letter as we gather all relevant information and ideas for that Opinion, and we look forward to sharing that Opinion with the public when it is complete. NMFS expects to make its Opinion available concurrently with the release of the Final EIS, and prior to signing our Record of Decision.
Western Environmental Law Center	2	Agree, NMFS typically works with the public and the applicant to identify possible changes to HGMPs under review. However, NMFS does not unilaterally make changes to HGMPs, and once an HGMP is deemed sufficient and in its final form, NMFS' role is limited to determining whether it meets the criteria under the relevant Limit of the 4(d) rules.
Western Environmental Law Center	3	This comment conflates the consultation process under §7 of the ESA with the process for determining the applicability of limits under the 4(d) rules at 50 CFR 223.203(b). The statement with which the commenter takes issue was a description of the latter legal process and not intended to describe all applicable legal requirements such as consultation under §7, NEPA, tribal trust responsibilities and numerous other applicable statutes, regulations, policies, etc.
Western Environmental Law Center	4	Noted. Decisions to list Upper Willamette Chinook salmon and steelhead were made in 2006 and updated in 2014. The commenter may refer to those decisions and supporting documentation for more information about the inclusion of hatchery fish in the listings.
Western Environmental Law Center	5	Disagree. The summer steelhead HGMP is not the subject of a 4(d) limit determination; rather, it is a federal agency action (funding by the Corps) which is being evaluated under section 7 of the ESA. Therefore, the public review and comment procedures in the 4(d) rules do not apply to the summer steelhead program. We note that the Upper Willamette River summer steelhead HGMP is available on the websites of both the Corps of Engineers and the Oregon Department of Fish & Wildlife. If the commenter wishes to comment on the contents, they may contact those agencies or use the present commenting process under NEPA to express any concerns which would assist NMFS in its review.
Western Environmental Law Center	6	In the EIS, NMFS evaluated the summer steelhead, rainbow trout, and Chinook salmon hatchery programs consistent with our responsibilities under NEPA to disclose the effects of these programs on the human environmental under a range of alternatives. Under the ESA, NMFS conducted additional analysis of the effects of these programs specifically on ESA-listed salmon and steelhead in the Upper Willamette River.
Western Environmental Law Center	7	Noted. The commenter is advised that the agency action is NMFS making a determination as to whether or not the programs submitted under a 4(d) rule limit meet the applicable standards, and the funding by the Corps of those programs and the additional steelhead and trout programs. The No Action alternative assumes that the agencies do not take those actions, and then determines to the best of our ability what the affected environment and impacts would be absent those actions.
Western Environmental Law Center	8	Noted. NMFS disagrees with the characterization of the no action alternative. See response to comment #7. The 2008 biological opinion for the operation of the Willamette River Basin Flood Control Project (NMFS 2008) contains several specific actions including the submission of HGMPs to NMFS under the Reasonable and Prudent Alternative. Those HGMPs have been submitted for consideration in this action.
Western Environmental Law Center	9	NMFS has defined the no-action alternative in accordance with CEQ regulations and guidance. However, NMFS recognizes the need for the analysis of alternatives to identify meaningful differences among the choices and potential impacts to the environment. Therefore, while we have explained why our choice of the no-action alternative results in the continuation of hatchery programs by the state of Oregon, we created Alternative 4 whereby all hatchery operations would cease, in order to inform ourselves and the public of the potential impacts of ceasing hatchery operations, compared to the remaining alternatives.
Western Environmental Law Center	10	Disagree. Please see sections 3.4.1 and 3.4.2 concerning the status of spring Chinook and winter steelhead within the Upper Willamette River.
Western Environmental Law Center	11	Disagree. Please see sections 3.4.1 and 3.4.2 concerning the status of spring Chinook and winter steelhead within the Upper Willamette River. The information provided by table 1 in the comment is noted.
Western Environmental Law Center	12	Disagree. Please see Section 4.4 for an evaluation of the effects of hatchery program operations on ESA-listed fish.
Western Environmental Law Center	13	Agree, the ten years referred to are 2007-2017. Revised in EIS.
Western Environmental Law Center	14	Noted. The EIS reports the latest information available through 2018 run years.
Western Environmental Law Center	15	Noted.
Western Environmental Law Center	16	Noted.
Western Environmental Law Center	17	Noted.
Western Environmental Law Center	18	Noted. The EIS discloses effects of summer steelhead on winter steelhead where they overlap in space and time. The extent to which this overlap occurs is limited in scope as hatchery fish do not occur throughout all habitat for winter steelhead, which informs our risk determination in the EIS.
Western Environmental Law Center	19	Noted. However, there are management guidelines in the HGMPs that prohibit recycling after September 1st each year. There are no limits to recycling before this date, although ODFW may choose to not recycle.
Western Environmental Law Center	20	Noted. We have considered Jones (2018). However, coho salmon in the Salmon River have different limiting factors/threats than winter steelhead in the Upper Willamette River.
Western Environmental Law Center	21	Noted. Under NEPA, the EIS discloses impacts on the human environment including socio-economic effects.
Western Environmental Law Center	22	Noted. Previous research, using coded wire tags, has shown low levels of straying among populations in the Upper Willamette River.

Western Environmental Law Center	23	Disagree. See section 4.4 of the EIS which specifically addresses straying, among other subjects. In addition, review the following studies cited in the EIS related to evaluating the effects of hatchery fish on UWR spring Chinook and winter steelhead: Johnson and Friesen 2013, Johnson et al. 2013, Banks et al. 2014, Black et al 2017, Evans et al 2016, O'Malley et al 2014, O'Malley et al 2017a, O'Malley et al 2017b, O'Malley and Bohn 2018, Sard et al 2017, Schroeder et al. 2007, Schroeder et al 2006, and Van Doornik et al 2015.
Western Environmental Law Center	24	Noted. Effective population sizes are typically calculated over a generation and not annually. See data reported in studies cited in response to comment #23.
Western Environmental Law Center	25	Noted. There is no information available in years when no monitoring occurs.
Western Environmental Law Center	26	Noted. NMFS is required by law to rely on the best available science, which does include but is not limited to the publications of the HSRG.
Western Environmental Law Center	27	NMFS disagrees. An integrated program is one that uses natural-origin broodstock with the goal of producing a population that is genetically indistinguishable over time. The comment confuses the definition of an integrated program with the goal of integrated programs, which is to reduce the hatchery influence by meeting an acceptably high PNI. Moreover, the comment confuses the proposed action with recent operations. The proposed action includes taking natural-origin fish for broodstock purposes. This previously was not authorized under the ESA. If the HGMPs are approved, integration rates, pNOB, and PNI will likely improve toward meeting the PNI goal.
Western Environmental Law Center	28	See previous response. The Chinook programs are integrated. Additionally, as previously discussed, the HSRG's
Western Environmental Law Center	29	Noted. Integration of natural-origin fish into hatchery broodstocks is a strategy that includes risks associated with removal of natural-origin fish from the naturally-spawning population, but with the potential benefit of increasing PNI and contributing to boosting the population. A range of alternatives were evaluated in the EIS in section 4.4, Genetic Effects.
Western Environmental Law Center	30	The HGMPs adopted the pHOS goals as stated in the ESA Recovery Plan (ODFW and NMFS 2011). Table 28, section 4.4 in the EIS discloses these effects.
Western Environmental Law Center	31	Noted. Additional information included in final EIS.
Western Environmental Law Center	32	Noted. Additional information included in final EIS.
Western Environmental Law Center	33	NMFS disagrees with the comment that it is inappropriately relying on fish passage or that the hatcheries will affect the overall trend of affected species. Genetic pedigree analyses (cited in EIS) demonstrates the hatchery salmon programs have (or currently are) providing benefits that lessen the extinction risk of the ESU, which is a function of many factors besides pHOS. Terminating these programs may increase risks in terms of abundance, productivity, and spatial structure of the ESU. The current production levels of the hatchery programs are based upon conservation objectives, not harvest. All of thse considerations, as well as the risks, are included in the DEIS.
Western Environmental Law Center	34	Disagree. A range of alternatives are considered in the EIS, including the ones described in the comment. Refer to the proposed action for a description of current trout stockings, as there appears to be some misconceptions.
Western Environmental Law Center	35	Noted.
Western Environmental Law Center	36	The HGMP proposes to not supplement with hatchery salmon above Foster Dam as long as natural-origin returns are above the critical threshold. However, hatchery production will still occur for broodstock needs, fishery mitigation, and potential future supplementation needs above Foster and Green Peter dams, if appropriate. The EIS evaluates these management objectives.
Western Environmental Law Center	37	Noted. The EIS evaluates all of the hatchery programs for all species in the Upper Willamette River Basin. Section 5 (Cumulative Impacts) discloses all past, present, and future actions and conditions.
Western Environmental Law Center	38	NMFS disagrees with the comment. Actions which affect salmon simultaneously with a hatchery program are not necessarily "connected actions." NMFS has disclosed the impacts of dams and fish passage throughout the DEIS, based on all presently available information.
Western Environmental Law Center	39	Disagree. The EIS discloses detailed information on all of the hatchery programs in the proposed action, and considers the effects of other hatchery programs (summer steelhead and rainbow trout) in the region. While NMFS must (and has) make resonable projections regarding other potential actions in the cumulative impacts section, the DEIS is not a vehicle for unlimited speculation about future increases in hatchery operations.
Western Environmental Law Center	40	Disagree. Section 5 (Cumulative Impacts) of the EIS considers all factors/threats currently facing the ESU and DPS in the Upper Willamette River.
Western Environmental Law Center	41	Noted. Included missing references. In the EIS, sections 2.5, 5.4.4, and 5.5.3 consider and disclose the effects of fishing on UWR salmon and steelhead.
Western Environmental Law Center	42	See response to comment #41.
Western Environmental Law Center	43	Regarding the standards of Limit 5, whether the standard is met is not determined in the DEIS; that is determined in NMFS' evaluation of the HGMPs. The DEIS evaluates and discloses the impacts to the affected environment, both positive and negative, as required by NEPA.
Western Environmental Law Center	44	Agree. Corrected.
Western Environmental Law Center	45	The effects of climate change are analyzed throughout the EIS. Section 5.4.6 specifically evaluates climate change in cumulative impacts. Regarding the commenter's statement that NMFS should look to programs that increase the resilience of threatened populations, NMFS is obligated to evaluate programs submitted in accordance with our regulations, regardless of their potential positive or negative effects, and under NEPA to disclose the impacts of those programs. To emphasize the needs of listed populations, NMFS consults with hatchery operators and enacts recovery plans to guide federal, state and private actions. WE add that the salmon hatchery programs in the proposed action can provide benefits in the short-term while other limiting factors/threats are being addressed, such as restoring access to cooler, headwater habitats above the federal dams. NMFS generally does not regard hatcheries as a substitute for naturally-reproducing, self-sustaining runs of salmon.
Western Environmental Law Center	46	Noted. Section 5 (Cumulative Impacts) discloses the effects of climate change in the UWR.
Western Environmental Law Center	47	Noted.
Western Environmental Law Center	48	Noted. NMFS will pass this comment along to ODFW and Corps for review of the numbers.
Western Environmental Law Center	49	Noted. Included in Proposed Action of the McKenzie HGMP.
Western Environmental Law Center	50	Noted. Included in Proposed Action of the McKenzie HGMP.

Western Environmental Law Center	51	The rationale for 400 females and 200 males is described in the appendices of the McKenzie HGMP. Note, these are minimum escapement goals, not limits.
Western Environmental Law Center	52	Noted. NMFS is currently evaluating the criteria proposed to trap hatchery fish from Leaburg Dam. This will be considered further in our biological opinion and our final decision on the HGMPs.
Western Environmental Law Center	53	Noted.
Western Environmental Law Center	54	Noted.
Western Environmental Law Center	55	Noted. See ODFW (2018) cited in EIS.
Western Environmental Law Center	56	Noted.
Western Environmental Law Center	57	Noted.
Western Environmental Law Center	58	Noted.
Western Environmental Law Center	59	Noted.
Western Environmental Law Center	60	At present, PNI is being used as a measure of hatchery-induced selection pressures on natural populations. Currently, PNI values are low. As discussed in the EIS, the PNI values may improve if the program incorporated natural-origin broodstock.
Western Environmental Law Center	61	Noted.
Western Environmental Law Center	62	Noted.