**DRAFT ENVIRONMENTAL ASSESSMENT**

# Environmental Assessment to Analyze Impacts of NOAA's National Marine Fisheries Service Determination that Six Hatchery Programs for Snohomish River Basin Salmon as Described in Joint State-Tribal Hatchery and Genetic Management Plans Satisfy the Endangered Species Act Section 4(d) Rule

Prepared by the
National Marine Fisheries Service, West Coast Region

In Cooperation with the
Bureau of Indian Affairs, Northwest Region

Cover Sheet
Draft Environmental Assessment

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| Title of Environmental Review: | Environmental Assessment to Analyze Impacts of NOAA's National Marine Fisheries Service Determination that Six Hatchery Programs for Snohomish River Basin Salmon as Described in Joint State-Tribal Hatchery and Genetic Management Plans Satisfy the Endangered Species Act Section 4(d) Rule |
| Distinct Population Segments: | Puget Sound Chinook Salmon and Puget Sound Steelhead |
| Lead Agency and Official: | Barry Thom<br>Regional Administrator<br>National Marine Fisheries Service<br>West Coast Region<br>7600 Sand Point Way N.E., Building 1<br>Seattle, WA 98115 |
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| Legal Mandate: | Endangered Species Act of 1973, as amended and implemented – 50 CFR Part 223 |
| Location of Proposed Activities: | Snohomish River basin, Washington |
| Activity Considered: | ESA determination regarding the effects of Hatchery and Genetic Management Plans (HGMPs) for two Chinook salmon, three coho salmon, and one fall chum salmon hatchery programs through part of the range of the ESA-listed Puget Sound Chinook Salmon Evolutionarily Significant Unit and Puget Sound Steelhead Distinct Population Segment pursuant to the ESA 4(d) Rule. |

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# 1 PURPOSE OF AND NEED FOR THE PROPOSED ACTION

## 1.1 Background

NOAA's National Marine Fisheries Service (NMFS) is the lead agency for administering the Endangered Species Act (ESA) as it relates to ESA-listed salmon and steelhead. On July 10, 2000, NMFS issued a final rule pursuant to ESA section 4(d) (4(d) Rule), adopting regulations necessary and advisable to conserve threatened species (50 CFR 223.203). The 4(d) Rule applies the take prohibitions in section 9(a)(1) of the ESA to salmon and steelhead listed as threatened, and also sets forth specific circumstances when the prohibitions will not apply, known as 4(d) limits. With regard to hatchery programs described in Hatchery and Genetic Management Plans (HGMPs), NMFS declared under limit 6 of the 4(d) Rule that section 9 take prohibitions would not apply to activities carried out under those HGMPs when NMFS determines that the HGMPs meet the requirements of limit 6. As described in Section 3.3, Salmon and Steelhead, Puget Sound Chinook salmon and Puget Sound steelhead are listed as threatened under the ESA.

On December 20, 2012, the Tulalip Tribes submitted an HGMP for the Bernie Kai-Kai Gobin summer Chinook salmon hatchery program (Tulalip 2012). On June 20, 2013, the Tulalip Tribes subsequently submitted two additional HGMPs for coho salmon and fall chum salmon hatchery programs that would release juvenile fish into Tulalip Bay (Tulalip 2013a; 2013b). On February 19, 2013, Washington Department of Fish and Wildlife (WDFW) submitted an HGMP for a Chinook salmon hatchery program at Wallace River Hatchery (WDFW 2012a). On October 14, 2013 (updated September 16, 2016), and June 27, 2013, respectively, WDFW submitted HGMPs for the Wallace River Hatchery coho salmon program (which includes Eagle Creek Hatchery as a satellite program), and the Everett Bay Net-Pen coho program. All six HGMPs were submitted as joint tribal/state Resource Management Plans pursuant to limit 6 of the 4(d) Rule (Table 1).

Table 1. HGMPs for Snohomish River basin salmon hatchery programs.

| HGMP | Hatchery Operator |
|---|---|
| Bernie Kai-Kai Gobin Salmon Hatchery (also known as Tulalip Hatchery) Subyearling Summer Chinook Salmon | Tulalip Tribes |
| Tulalip Bay Hatchery Coho Salmon | Tulalip Tribes |
| Tulalip Bay Hatchery Chum Salmon | Tulalip Tribes |
| Wallace River Hatchery Summer Chinook Salmon | WDFW |
| Wallace River Hatchery Coho Salmon (with Eagle Creek Hatchery cooperative program) | WDFW |
| Everett Bay Net-Pen Coho Salmon | WDFW |

Under limit 6 of rule 4(d), the take prohibitions of the ESA do not apply to actions undertaken in compliance with a resource management plan developed jointly by the States of Washington, and the Tribes (joint plan) within the continuing jurisdiction of United States v. Washington, the on-going Federal court proceedings to enforce and implement reserved treaty fishing rights, provided the limit conditions are satisfied.

## 1.2 Description of the Proposed Action

As described in Section 1.1, Background, the Tulalip Tribes and WDFW have submitted six joint tribal/state HGMPs for NMFS' review under limit 6 of the 4(d) Rule. NMFS will evaluate the six HGMPs collectively in one Environmental Assessment (EA) because they overlap in geography, were submitted to NMFS at approximately the same time, and were all submitted for review under limit 6 of the 4(d) Rule.

Two of the proposed hatchery programs release ESA-listed Chinook salmon, and four hatchery programs release non-ESA-listed coho and fall chum salmon into, or in the immediate vicinity of, the Snohomish River basin. The Chinook and coho salmon hatchery programs raise fish native to the Snohomish River basin. The fall chum salmon program at Tulalip Bay propagates fish of transferred stock origin (Hood Canal and Deep South Sound).

Under the Proposed Action, NMFS would make a determination that the submitted HGMPs meet the requirements of limit 6 of the 4(d) Rule. Activities included in the plans are as follows:

- Broodstock collection at WDFW's Wallace River Hatchery (Wallace River and May Creek weirs) and Sunset Falls Fishway; and the Tulalip Tribes' Tulalip Creek Hatchery lower pond and Battle Creek (also known as Mission Creek) station through operation of weirs and fish traps (Table 2);
- Transport of adult Chinook salmon from the Sunset Falls Fishway to Wallace River Hatchery (Table 2);
- Holding, identification, and spawning of adult fish at Wallace River Hatchery, the lower Tulalip Creek pond, and the Battle Creek station (Table 2);
- Egg incubation and fish rearing at Wallace River Hatchery, Bernie Kai-Kai Gobin Tulalip Tribal Salmon Hatchery (hereafter, Tulalip Hatchery), Tulalip Creek ponds, and the Battle Creek pond (Table 2);
- Release of up to 1.0 million subyearling and 500,000 yearling Chinook salmon from Wallace River Hatchery; 2.4 million subyearling Chinook salmon from Tulalip Hatchery; 150,000 coho salmon from Wallace River Hatchery; 54,000 coho salmon from Eagle Creek Hatchery; 2.0 million coho salmon from the Tulalip Creek Hatchery upper and lower Ponds; 12.0 million fall chum salmon from the Battle Creek Pond; and 20,000 coho salmon from the Everett Bay Net-Pen site (Table 2);
- Upstream release of adult Chinook salmon surplus to hatchery broodstock needs at Wallace River Hatchery; and
- Monitoring and evaluation activities to assess the performance of the programs in meeting natural-origin fish harvest loss mitigation and listed fish risk minimization objectives.

Table 2. Existing hatchery facilities associated with the proposed Snohomish River basin salmon harvest augmentation programs and currently operating under baseline conditions.

| Activity | Facility | Location |
|---|---|---|
| Broodstock collection | Wallace River Hatchery | River mile 4.0 Wallace River (at its confluence with May Creek), entering the Skykomish River at RM 36.0 |
| | Sunset Falls Fishway [1] | South Fork Skykomish River at RM 51.5 |
| | Tulalip Creek Lower Pond | River mile 0.0 on Tulalip Creek, tributary to Tulalip Bay |
| | Battle Creek Pond | River mile 0.1 on Battle Creek, tributary to Tulalip Bay |
| | Opportunistic seining in the Wallace River downstream of the hatchery | River mile 4.0 of the Wallace River and downstream to river mile 3.5 |
| Spawning | Wallace River Hatchery | River mile 4.0 on the Wallace River, entering the Skykomish River at RM 36.0 |
| | Tulalip Hatchery | River mile 2.5 on Tulalip Creek, tributary to Tulalip Bay |
| | Tulalip Creek Lower Pond | River mile 0.0 on Tulalip Creek, tributary to Tulalip Bay |
| Incubation | Wallace River Hatchery | River mile 4.0 Wallace River entering the Skykomish River at RM 36.0 |
| | Tulalip Hatchery | River mile 2.5 on Tulalip Creek, tributary to Tulalip Bay |
| | Eagle Creek Hatchery | River mile 0.4 on Eagle Creek, tributary to the Skykomish River at RM 28.25. |
| Rearing | Wallace River Hatchery | River mile 4.0 on Wallace River, entering the Skykomish River at RM 36.0 |
| | Tulalip Hatchery | River mile 2.5 on Tulalip Creek, tributary to Tulalip Bay |
| | Tulalip Creek Upper and Lower Ponds | River mile 0.0 on Tulalip Creek, tributary to Tulalip Bay |
| | Battle Creek Pond | River mile 0.1 on Battle Creek, tributary to Tulalip Bay |

[1] Take (ESA section 3(18)) associated with Fishway operation and maintenance, including trapping, sampling, upstream transport, and release of migrating adult fish above a natural barrier; and monitoring of listed Chinook and steelhead and other non-listed fish populations, were previously evaluated and authorized by NMFS in 2009 through issuance of section 10(a)(1)(A) permit #14433. Take effects associated with the Wallace River Hatchery Chinook salmon broodstock collection component of Fishway operation are addressed through this consultation.

| Activity | Facility | Location |
|---|---|---|
| | Eagle Creek Hatchery | River mile 0.4 on Eagle Creek, tributary to the Skykomish River at RM 28.25. |
| Juvenile release | Wallace River Hatchery | River mile 4.0 Wallace River, entering the Skykomish River at RM 36.0 |
| | Tulalip Creek Upper and Lower Ponds | River mile 0.0 on Tulalip Creek, tributary to Tulalip Bay |
| | Battle Creek Pond | River mile 0.1 on Battle Creek, tributary to Tulalip Bay |
| | Everett Bay Net-Pen | Mouth of the Snohomish River at Port Gardner Bay,<br>Port of Everett Marina |
| | Eagle Creek Hatchery | River mile 0.4 on Eagle Creek, tributary to the Skykomish River at RM 28.25. |
| Adult release | Wallace River Hatchery (weir) | Wallace River, upstream of river mile 4.0 |
| Monitoring and evaluation of adult returns to the hatcheries; escapement to natural spawning areas; and juvenile outmigrant abundance, timing and behavior at screw trap locations and nearshore marine areas | Wallace River Hatchery | River mile 4.0 Wallace River, entering the Skykomish River at RM 36.0 |
| | Tulalip Hatchery | River mile 2.5 on Tulalip Creek |
| | Tulalip Creek Upper and Lower Ponds | River mile 0.0 on Tulalip Creek, tributary to Tulalip Bay |
| | Battle Creek Pond | River mile 0.1 on Battle Creek, tributary to Tulalip Bay |
| | Snohomish watershed and adjacent nearshore marine areas accessible to natural salmon and steelhead migration, spawning and rearing | Snohomish River basin areas, including the Skykomish and Snoqualmie river watersheds from the river mouth through the upstream extent of natural-origin fish access, and adjacent nearshore areas. |

## 1.3 Purpose of and Need for the Action

The purpose and need for the Proposed Action is to ensure that the hatchery programs in Table 1 submitted by the Tulalip Tribes and WDFW for review comply with the requirements of the ESA under limit 6 of the ESA 4(d) rule, and meet NMFS's tribal treaty rights stewardship responsibilities. Compliance with 4(d) rule criteria, under limit 6, would help ensure that the proposed hatchery actions are adequate to conserve and protect ESA-listed salmon and steelhead, increasing prospects for their recovery and return to a viable status. Implementation of the Proposed Action is also intended to provide hatchery fish production to help meet fish loss mitigation responsibilities, partially off-setting adverse impacts to natural-origin salmon and their habitat resulting from past and on-going human developmental activities in the Snohomish River basin, and from climate change.

The operators' goals for the programs are to meet fisheries harvest mitigation responsibilities in the support of Treaty-reserved fishing rights recognized by the Federal courts: (1) conservation of salmon populations in the Snohomish Basin, (2) serve tribal ceremonial, religious, and spiritual values, (3) serve tribal subsistence, and (4) sustain commercial values while providing hatchery fish to contribute to numerous preterminal and terminal area treaty and non-treaty fisheries. The hatchery programs are designed to mitigate for a portion of the lost natural-origin fish production by producing adult Chinook, coho, and fall chum salmon for meaningful commercial, ceremonial, subsistence, and recreational harvest. The programs include population monitoring actions in freshwater and marine areas that would collect data needed to evaluate progress in meeting VSP recovery goals and milestone criteria. These monitoring actions are also used for gauging the efficacy of salmon recovery efforts in the basin, and hatchery program performance in meeting stated objectives, including contribution to harvests, and minimization of hatchery-related genetic, demographic, or ecological effects on ESA-listed fish.

For the Tulalip Tribes and other Puget Sound treaty tribes, the six salmon hatchery programs in this Proposed Action are indispensable for the implementation of the Treaty Right to fish in the face of existing degraded and lost habitat conditions and to provide fish available for harvest integral to Tulalip or other Treaty fisheries. As long as the Snohomish River basin is unable to maintain naturally self-sustaining levels of salmon that ensure that the Tulalip Tribes are able to harvest salmon in traditional areas in sufficient numbers, hatchery programs will likely remain a necessary component of Tulalip tribal salmon management (Tulalip 2012) and management under court orders issued in United States (U.S.) v. Washington (1974). The programs are, therefore, considered essential by the Tribe for meeting a portion of tribal fishery harvest allocations that are guaranteed through treaties, as affirmed in United States v. Washington. Program-origin salmon may also help meet agreements with Canada for harvest sharing and stock assessment under the Pacific Salmon Treaty. The HGMPs were designed to be consistent with the strategies and actions specified in the Snohomish Basin Salmon Conservation Plan, a salmon recovery strategy for the basin (Snohomish Basin Salmon Recovery Forum 2005), with recovery implementation of integrated hatchery, harvest, and hatchery actions and strategies updated annually in 3-Year Work plans. The conservation plan describes how the hatchery programs will operate in conjunction with harvest management, habitat restoration, and habitat protection actions to achieve short-term and long-term goals for natural and hatchery production of salmon in the Snohomish River basin.

## 1.4 Project Area and Analysis Area

The project area is the geographic area where the Proposed Action would take place. It includes the places where Snohomish River basin salmon would be spawned, incubated, reared, acclimated, released, return as adults, and studied through monitoring and evaluation under the proposed hatchery plans (Figure 1).

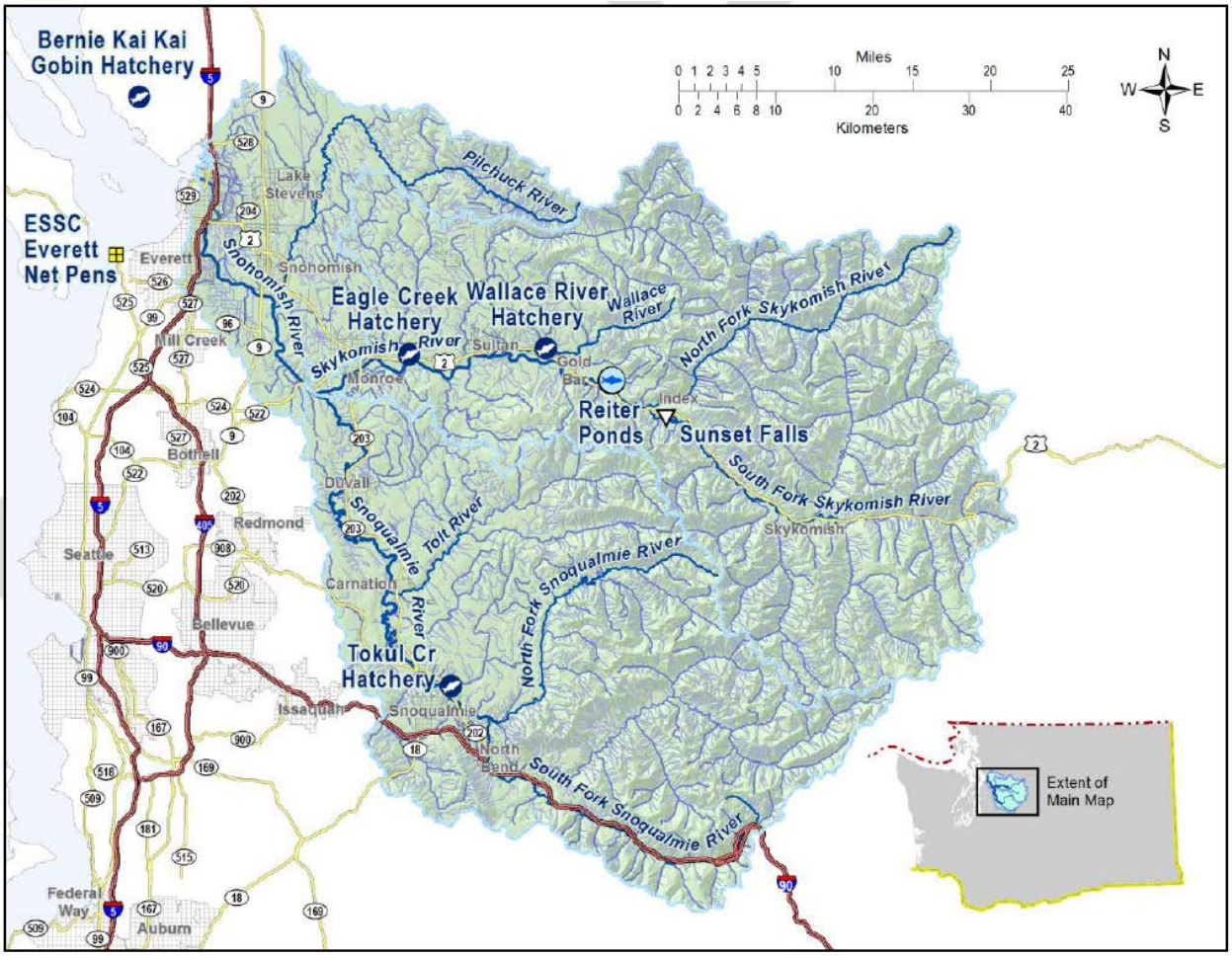


Figure 1. Action area for the proposed continued operation of Snohomish River basin salmon hatchery programs for fisheries harvest augmentation purposes. Map includes locations of all WDFW hatchery programs in the basin. Source: WDFW 2013b.

The following facilities would be used by the Snohomish River basin salmon hatchery programs:

- Wallace River Hatchery (river mile 4.0 on the Wallace River, at its confluence with May Creek, entering the Skykomish River at river mile 36.0)
- Eagle Creek Hatchery (river mile 0.4 on Eagle Creek, which enters the Skykomish River at river mile 28.3)
- Bernie Kai-Kai Gobin Hatchery (river mile 2.5 on Tulalip Creek, tributary to Tulalip Bay)
- Tulalip Creek Upper and Lower Ponds (river mile 0.0 on Tulalip Creek, tributary to Tulalip Bay)
- Battle Creek Pond (river mile 0.1 on Battle Creek, tributary to Tulalip Bay)
- Sunset Falls Fishway (South Fork Skykomish River at RM 51.5)

In addition, adult Chinook salmon would be collected in the Wallace River downstream of the Wallace River Hatchery and May Creek weirs through seining in years when adults do not

volunteer to the traps at required broodstock collection levels. Adult Chinook salmon collected at Wallace River Hatchery would be released into the Wallace River upstream of the hatchery weir to allow the fish to spawn naturally above river mile 4.0. Monitoring and evaluation activities would occur at the hatcheries and in their immediate vicinities (i.e., Tulalip Bay, Wallace River), in Tulalip Creek, Battle Creek, and freshwater and marine areas extending from nearshore areas adjacent to the mouth of the Snohomish River upstream to the limits of anadromous fish access in the Snohomish River basin.

The analysis area is the geographic extent that is being evaluated for a particular resource. The Snohomish River Basin, including its tributaries, estuary, nearshore marine areas, and adjacent tributaries to the estuary encompasses the broad analysis area for this EA analysis. However, while the analysis area is large due to the amount of habitat for the species and resources being analyzed, impacts from the operation of the hatchery programs tend to be localized to areas immediately adjoining the hatchery facilities. The areas immediately adjoining the hatchery facilities and adult fish collection locations constitute the project area where direct and indirect impacts for some resources (e.g., water quality and quantity, instream habitat, wildlife) are analyzed in Chapter 4, Environmental Consequences. For some resources, the analysis area may be different (e.g., larger or smaller) from the project area if the effects of the alternatives might occur outside the project area. The analysis area for each resource is described in Chapter 3, Affected Environment. Analysis areas larger than the action area were defined to consider actions with effects that are potentially cumulative with the Proposed Action and thus, require evaluation of effects outside the Snohomish River Basin. The evaluation of larger analysis areas for cumulative effects is described in Chapter 5, Cumulative Effects.

## 1.5 History of the Programs and Public Involvement to Date

HGMPs reflecting current hatchery operations, and updating previous versions of the plans, were provided to NMFS by WDFW and the Tulalip Tribes in 2012 and 2013. Prior to their submittal to NMFS, WDFW provided HGMPs for the state-managed programs for public review and comment as part of a lawsuit settlement agreement. The state plans were reviewed and updated by WDFW as appropriate in response to public review comments received. The tribal HGMPs were not provided for public review and comment, consistent with the Tulalip Tribes' sovereign status, and their government-to-government resource management standing with the U.S. Federal Government.

NMFS will notify the public of receipt of the updated HGMPs associated with the Proposed Action when the draft EA and associated ESA 4(d) rule, limit 6 pending evaluation and pending determination documents are provided for public review and comment.

## 1.6 Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders

In addition to NEPA and ESA, other plans, regulations, agreements, treaties, laws, and Secretarial and Executive Orders also affect hatchery operations in the Snohomish River basin, and their effects on resources in the project and analysis areas. They are summarized below to provide additional context for the following evaluations of Snohomish River basin salmon hatchery program effects on the environment.

### 1.6.1 Clean Water Act

The Clean Water Act (33 U.S.C. 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. Maintenance of high water quality consistent with the Clean Water Act is essential for ensuring survival and productivity of natural-origin salmon and steelhead. The Act also helps ensure that the hatchery-origin fish produced under the Proposed Action are supplied with clean water during rearing in the hatcheries, and after their release into the natural environment, to protect their health and foster high survival to adult return. Each state implements and carries forth Federal provisions, as well as approves and reviews National Pollutant Discharge Elimination System (NPDES) permit applications, and establishes total maximum daily loads for rivers, lakes, and streams. The states and authorized tribes 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 Washington State Water Pollution Control Act, codified as Revised Code of Washington Chapter 90.48, designates the Washington Department of Ecology (Ecology) as the agency responsible for carrying out the provisions of the Federal Clean Water Act within Washington State. The agency is responsible for establishing water quality standards, making and enforcing water quality rules, and operating waste discharge permit programs. These regulations are described in Washington Administrative Code (WAC) 173. Hatchery operations are required to comply with the Clean Water Act, and WDFW's Wallace River Hatchery operates under a NPDES permit issued by WDOE. The Tulalip Tribal government is authorized to implement Sections 303(c) and 401 of the Clean Water Act. The Tulalip Tribes, through its Natural Resources Department, sets and implements water quality standards and issues certifications under section 401 for all surface waters within the boundaries of the Tulalip Reservation.

### 1.6.2 Bald Eagle and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c), enacted in 1940, and amended several times since then, prohibits the taking 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." As described in Subsection 3.5 - Wildlife, hatchery production as proposed under the Proposed Action has the potential to affect the productivity of eagles protected under this Act through changes in their prey source (salmon and steelhead).

### 1.6.3 Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 U.S.C. 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 significant functioning element in the ecosystem, nor to diminish such species

below their optimum sustainable population. All marine mammals are protected under the Marine Mammal Protection Act.

The Marine Mammal Protection Act prohibits, with certain exceptions, the take of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. The term "take," as defined by the Marine Mammal Protection Act, means to "harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." The Marine Mammal Protection Act further defines harassment as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild."

NMFS is responsible for reviewing Federal actions for compliance with the Marine Mammal Protection Act. As described in Subsection 3.5 - Wildlife, hatchery fish production as proposed under the Proposed Action can indirectly affect marine mammals, including killer whales, sea lions, and harbor seals protected under the Marine Mammal Protection Act by altering the number of available prey (salmon and steelhead).

### 1.6.4 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. As described in Section 3.9 - Environmental Justice, changes in hatchery production have the potential to affect the extent of harvest available for minority and low-income populations that are the focus of Executive Order 12898, including the Tulalip Tribes.

### 1.6.5 Treaties of Point Elliot, Medicine Creek, and Point No Point

Beginning in the mid-1850s, the United States entered into a series of treaties with tribes in the Puget Sound region. The treaties were completed to secure the ceding of land by the tribes to the United States for settlement by its citizens. In the treaties, the tribes retained specified tracts of tribal lands as Indian reservations. In exchange for the Indian lands ceded, tribes received a guarantee of protection by the United States government, the promise to provide services and supplies, and small monetary payments. The cession of lands in the treaties did not cede tribal rights to fish, hunt and gather as they had always done prior to the signing of the treaties. The treaties specifically reserved existing rights of the tribes to harvest fish at all usual and accustomed grounds and stations in common with all citizens of the United States, and to hunt and gather on all open and unclaimed lands. Marine and freshwater areas of the Strait of Juan de Fuca and Puget Sound were affirmed as the usual and accustomed fishing areas for treaty tribes under United States v. Washington (1974).

The Treaty of Point Elliot was entered into by the United States and tribes of the mid and northern Puget Sound. The Tulalip Tribes is the legal successor to the Snohomish, Snoqualmie and Skykomish Tribes, who were signatories to the Treaty of Point Elliot. The Tulalip Tribes treaty protected usual and accustomed fishing grounds include the Snohomish-Snoqualmie-Skykomish River basins and marine waters from the northern tip of Vashon Island to the Canadian border (United States v. Washington, 459 F. Supp. 1020, 1038 (W.D. Wash. 1978); U.S. v. Washington, 626 F. Supp. 1405, 1527 (W.D. Wash. 1985), Aff'd, 841 F.2d 317 (9th Cir. 1988). The Treaty was signed on January 22, 1855, at Point Elliott, now Mukilteo, Washington, and ratified by the Senate in 1859. (12 Stat. 927). Ensuring that the salmon fishing rights of the Tulalip Tribes reserved under the Treaty of Point Elliot signed by the U.S. Federal Government is part of NMFS's tribal treaty rights stewardship mandate. The Treaty supports implementation of listed salmon and steelhead recovery plans (Subsection 1.6.12), and affects determinations made in this document regarding Socioeconomic, Cultural Resource, and Environmental Justice resource effects of the Proposed Action and the alternatives.

### 1.6.6 United States v. Washington

United States v. Washington, Phase I, (1974) is a Federal court proceeding that enforces and implements reserved treaty fishing rights to salmon and steelhead returning to the usual and accustomed fishing grounds and stations of the treaty tribes. These fishing rights and attendant rights of access were reserved by the tribes in the treaties of the 1850s. The court in United States v. Washington (1974) Phase I ruled that the tribes were entitled to 50 percent of all of the harvestable fish destined for the tribes' usual and accustomed and fishing places. The ruling vests the tribes with the obligation and authority to co-manage fisheries resources with the State of Washington and federal resource agencies. Under Phase II of United States v. Washington (1985), the Federal Court of Appeals held that the tribes' treaty allocation includes both natural and hatchery origin fish. The Court noted that hatcheries were developed to provide some replacement for natural fish declines resulting from "the non-Indian degradation of the habitat and commercialization of the fishing industry." Since this decision, habitat degradation has accelerated the declines of natural origin fish, making the hatchery fish more important to the tribes' continued exercise of their treaty rights. Without hatcheries, there would be few, if any, fish for the tribes to harvest under the treaty right (Stay 2012; NWIFC 2013).
Joint state-tribal resources management plans falling within Limit 6 of the ESA's 4(d) rule, including the Tulalip tribal and Washington State hatchery actions described as part of the Proposed Action, are implemented and enforced within the parameters of United States v. Washington. The need for compliance with this Federal Court ruling directs determinations regarding effects on Socioeconomic, Cultural Resource, and Environmental Justice resources considered in this document.

### 1.6.7 Secretarial Order 3206 - American Indian Tribal Rights, Federal-Tribal Trust Responsibilities and the ESA

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 (Sec. 5, Principle 1)
- Recognize that Indian lands are not subject to the same controls as Federal public lands (Sec. 5, Principle 2)
- Assist Indian tribes in developing and expanding tribal programs so that healthy ecosystems are promoted and conservation restrictions are unnecessary (Sec. 5, Principle 3)
- In cases that involve the potential for incidental take under the ESA, the Services will analyze and determine whether conservation restrictions meet the following standard:
- the restriction is reasonable and necessary for conservation of the species at issue; (2) the conservation purpose of the restriction cannot be achieved by reasonable regulation of non-Indian activities; (3) the measure is the least restrictive alternative available to achieve the required conservation purpose; (4) the restriction does not discriminate against Indian activities, either as stated or applied; and, (5) voluntary tribal measures are not adequate to achieve the necessary conservation purpose.
- Be sensitive to Indian culture, religion, and spirituality (Sec. 5, Principle 4).

Secretarial Order 3206 is taken into account in determinations made with regards to effects on resources evaluated in this EA, including Salmon and Steelhead, Socioeconomics, Cultural Resources, and Environmental Justice.

### 1.6.8 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 treaties, 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, outlines the Federal Government's pledge to work on a government-to government basis with tribes on issues concerning Indian tribal self-government, tribal trust resources and Indian tribal treaty and other rights. 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). As an agency mandate, NMFS's implementation of its federal treaty trust responsibility bears on effects determinations made in this EA with regards to Salmon and Steelhead, Socioeconomics, Cultural Resources, and Environmental Justice effects of the Proposed Action and alternatives

### 1.6.9 Washington State Endangered, Threatened, and Sensitive Species Act

This EA will consider the effects of hatchery programs and harvest actions on state endangered, threatened, and sensitive species. The State of Washington has species of concern listings (Washington Administrative Code Chapters 232-12-014 and 232-12-011) that include all state endangered, threatened, sensitive, and candidate species. These species are managed by WDFW, as needed, to prevent them from becoming endangered, threatened, or sensitive. The state-listed species are identified on WDFW's website (http://wdfw.wa.gov/conservation/endangered/); the most recent update occurred in June 2008. The criteria for listing and de-listing, and the requirements for recovery and management plans for these species are provided in Washington Administrative Code Chapter 232-12-297. The state list is separate from the Federal ESA list; the state list includes species status relative to Washington state jurisdiction only. Critical wildlife habitats associated with state or federally listed species are identified in Washington Administrative Code Chapter 222-16-080. Species listed under the state endangered, threatened, and sensitive species list are reviewed in this EA. As described in Subsection 3.5 - Wildlife, hatchery salmon production as proposed under the Proposed Action can directly and indirectly affect mammals and birds protected under the Washington State Endangered, Threatened, and Sensitive Species Act through ecological interactions, including predation and resource competition, and by serving as prey.

### 1.6.10 Hatchery and Fishery Reform Policy

WDFW's Hatchery and Fishery Reform Policy (Policy C-3619) was adopted by the Washington Fish and Wildlife Commission in 2009 (WFWC 2009). Its purpose is to advance the conservation and recovery of wild salmon and steelhead by promoting and guiding the implementation of hatchery reform. The policy applies to the WDFW hatchery actions included as Proposed Actions evaluated in this EA. Consistent with this state policy, the WDFW HGMPs submitted for NMFS review were assembled with it's the intent to improve hatchery effectiveness, ensure compatibility between hatchery production and salmon recovery plans and rebuilding programs, and support sustainable fisheries.

### 1.6.11 Tribal Statement on Treaty Rights at Risk and Tribal Policy Statement for Salmon Hatcheries in the Face of Treaty Rights at Risk

The Puget Sound Treaty Indian Tribes (2011) developed an initiative entitled "Tribal Statement on Treaty Rights at Risk (TRAR) Initiative" documenting the ongoing risk to treaty rights due to the failure to adequately address continuing loss and degradation of the habitat that supports salmon and other treaty-reserved resources. The tribes presented the initiative to Congress and the federal administration, and requested that federal agencies address these concerns and to document the degree to which they have been addressing each point. After developing the TRAR Initiative, the tribes met with Council on Environmental Quality (CEQ) representatives who

coordinate development of environmental policies and initiatives among the Federal agencies to express their concern that ongoing salmon recovery efforts are being outpaced by development and habitat-degradation in both freshwater and the marine environment, as documented in the State of Our Watersheds Report (http://nwifc.org/publications/sow/). In response, the CEQ mandated the heads of the Federal agencies with management jurisdiction in Washington State to work with the tribes to make sure the laws, regulations and statutes are aligned and enforced to protect Trust resources.

The Puget Sound Treaty Tribes' Tribal Policy Statement for Salmon Hatcheries in the Face of Treaty Rights at Risk (NWIFC 2013) was submitted to NMFS and WDFW by the Tribes for the purpose of reaffirming "the role salmon and steelhead hatcheries play in implementing the treaty right to fish and in recovering salmon populations in the face of continuing loss of salmon habitat by degradation and climate change. The Policy acknowledges that State and federal governments historically developed and used hatcheries as a means of mitigating for the loss of habitat and natural production. The Policy states that "As long as watersheds, the Salish Sea estuary, and the ocean are unable to maintain self-sustaining salmon populations in sufficient abundance, hatcheries will remain an integral and indispensable component of salmon management. Hatcheries are necessary for tribes to be able to harvest salmon in their traditional areas to carry out the promises of the treaties fully and meet the requirements of United States vs. Washington and Hoh vs. Baldrige." Consistent with the aforementioned CEQ mandate, NMFS endeavors to ensure that this document takes into account the need to protect tribal Trust resources, including the need for hatcheries to meet treaty reserved fishing rights, in rendering effect determination levels for the elements affected by the Proposed Action.

### 1.6.12 Recovery Plans for Puget Sound Salmon and Washington Salmon Recovery Act (77.85 RCW)

Federal recovery plans adopted by NMFS are in place for the ESA-listed Puget Sound Chinook Salmon (NMFS 2007) and Hood Canal Summer Chum Salmon ESUs (Hood Canal Coordinating Council 2005). Broad partnerships of Federal, state, local, and tribal governments and community organizations collaborated in the development of the two recovery plans under Washington's Salmon Recovery Act. The comprehensive recovery plans include conservation goals and proposed habitat, hatchery, and harvest actions needed to achieve the conservation goals for each watershed within the geographic boundaries of the two listed ESUs. Germane to the proposed hatchery actions is the Snohomish watershed (WRIA 7) chapter presented in Volume II of the Shared Strategy for Puget Sound salmon recovery plan (SSPS 2005), as revised in annual Three-Year Work Plans that identify current integrated recovery plan activities for hatchery, harvest, and habitat actions, including strategies and proposed near-term projects. Although listed under the ESA in 2007, a NMFS recovery plan for the Puget Sound Steelhead DPS is under development, but has not yet been completed.

Consistent with their government-to-government salmon resource management standing with the U.S. federal government through the Treaty of Point Elliot (Subsection 1.6.5, Treaties of Point Elliot, Medicine Creek, and Point No Point), the Tulalip Tribes have developed an approach for implementing the Snohomish River basin salmon recovery plan (SSPS 2005). This recovery plan implementation approach - the "Snohomish Chinook Recovery Plan: Phases of Recovery and Integrated Adaptive Management Strategy" (Rawson and Crewson 2016) - is proposed as a

means to harmonize what are presently independently derived and regulated habitat actions in the project and analysis areas (see Subsections 1.6.13 through 1.6.24 below) with local salmon hatchery and harvest management actions and regulatory processes. Through the approach, a framework is applied within which "All H" actions and processes can be considered and evaluated jointly and concurrently. Emphasized in the approach is that recovery of listed Chinook salmon and steelhead populations will require significant management actions in all of the respective "Hs" - habitat, hydropower, harvest, and hatcheries. This Tulalip Tribes' WRIA 7 recovery plan implementation approach has been proposed for consideration in NMFS's evaluation in this EA of the effects on the environment of the Proposed Actions.

A key premise of the tribal approach is that the effectiveness of individual habitat, hydropower, harvest and hatchery management actions for protecting or recovering listed salmon cannot be evaluated without knowing the status of actions in each of the other "H" areas. This is because the outcome of recovery efforts to improve the status of listed salmon populations depends on the combined and cumulative effect of "All H" actions. For example, the degree to which fish habitat is protected and restored to properly functioning conditions bears on the status of listed salmon and steelhead population abundance, productivity, diversity and spatial distribution. The condition of habitat, and progress in restoring it, determines the short and long term status of the populations that may be affected by hatchery actions, and therefore the magnitude of hatchery-related effects on population and ESU viability, and the effectiveness of hatchery management actions to lessen risks.

In making determinations about how natural salmon and steelhead population and ESU viability are affected by the proposed hatchery actions, NMFS assumes that concurrent habitat, hydropower, and harvest management actions would be undertaken to support recovery of listed salmon in the Snohomish River basin. However, despite on-going implementation of habitat restoration, and hydropower, harvest, and hatchery management actions aimed at listed salmon and steelhead recovery in the project and analysis areas, the abundance and productivity of natural fish continues to decline (Subsection 3.3 - Salmon and Steelhead). Implementation of these recovery-aimed "H" actions in isolation has failed to stem the total decline in habitat extent and condition in Puget Sound watersheds, including the Snohomish River basin (Judge 2011). This current lack of integration of "All H" actions does not appear to be moving the listed natural fish populations in the watershed beyond what is described in the tribal approach, which follows Hatchery Scientific Review Group guidance (Rawson and Crewson 2016), as the "preservation stage", considering their current and recent past viability status, and the poor to fair condition of habitat

The Tribes' approach suggests assessment of hatchery program effects on the listed natural populations must consider the current, degraded condition of habitat in conjunction with population status to identify those hatchery management actions that will be most effective in addressing threats and moving the populations out of the preservation stage. If habitat remains in fair or poor condition, maintaining the Chinook salmon populations in conditions of low abundance and productivity (the "preservation stage"), then it is unlikely that effects of on-going salmon hatchery programs are substantially hindering recovery, and that it is also unlikely any modifications to the hatchery program actions would help the populations recover. Protection and restoration of habitat must be the first priority for recovery actions until the populations can

be moved out of the preservation phase. Under Secretarial Order 3206, NMFS will carry out environmental effects review responsibilities for actions proposed for ESA review in a manner that harmonizes the Federal trust responsibility to tribes, tribal sovereignty, and statutory missions of NMFS, 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. Consistent with the Secretarial Order, and the Tribes' government-to-government salmon resource management standing, the tribal perspective regarding the status of listed Snohomish River basin salmon and steelhead populations, and the habitat-related factors affecting their recovery, are taken into account in evaluating the effects of the proposed salmon hatchery actions and alternatives to those actions in this document.

### 1.6.13 Federal Coastal Zone Management Act

The U.S. Congress recognized the importance of meeting the challenge of continued growth in the coastal zone by passing the Coastal Zone Management Act (CZMA) in 1972. This act, administered by NOAA, provides for the management of the nation's coastal resources, including the Great Lakes. The goal is to "preserve, protect, develop, and where possible, to restore or enhance the resources of the nation's coastal zone." The CZMA outlines three national programs, the National Coastal Zone Management Program, the National Estuarine Research Reserve System, and the Coastal and Estuarine Land Conservation Program (CELCP). The National Coastal Zone Management Program aims to balance competing land and water issues through state and territorial coastal management programs, the reserves serve as field laboratories that provide a greater understanding of estuaries and how humans impact them, and CELCP provides matching funds to state and local governments to purchase threatened coastal and estuarine lands or obtain conservation easements. The degree to which the requirements of the Federal Coastal Zone Management Act are applied to protect critical salmon and steelhead coastal habitat in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of Act requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.14 Washington Shoreline Management Act (90.58 RCW)

Washington's Shoreline Management Act (SMA) was passed by the State Legislature in 1971 and adopted by voters in 1972. The overarching goal of the Act is "to prevent the inherent harm in an uncoordinated and piecemeal development of the state's shorelines." The Act applies to all 39 counties and more than 200 towns and cities that have "shorelines of the state" (RCW 90.58.030(2)) within their boundaries. These shorelines are defined as: all marine waters; streams and rivers with greater than 20 cubic feet per second mean annual flow; lakes 20 acres or larger; upland areas called shorelands that extend 200 feet landward from the edge of these waters; and the following areas when they are associated with one of the above: biological wetlands and river deltas; and some or all of the 100-year floodplain including all wetlands within the 100-year floodplain. The Act also states that "the interests of all the people shall be paramount in the management of shorelines of statewide significance." These special shorelines are defined as: Pacific Coast, Hood Canal and certain Puget Sound shorelines; all waters of Puget Sound and the Strait of Juan de Fuca; lakes or reservoirs with a surface acreage of 1,000 acres or

more; larger rivers (1,000 cubic feet per second or greater for rivers in Western Washington, 200 cubic feet per second and greater east of the Cascade crest); and wetlands associated with all the above. There are three basic policy areas to the Act: shoreline use, environmental protection and public access. The Act emphasizes accommodation of appropriate uses that require a shoreline location, protection of shoreline environmental resources and protection of the public's right to access and use the shorelines (RCW 90.58.020). Under the SMA, each city and county with "shorelines of the state" must prepare and adopt a Shoreline Master Program (SMP) that is based on state laws and rules but is tailored to the specific geographic, economic and environmental needs of the community. The local SMP is essentially a shoreline-specific combined comprehensive plan, zoning ordinance, and development permit system. The degree to which the requirements of the Washington Shoreline Management Act are applied to protect shoreline habitat of critical importance to salmon and steelhead habitat in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of Act requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.15 Washington Hydraulic Project Approval (77.55 RCW)

In 1943, the Washington State Legislature passed a state law now known as the "Hydraulic Code" (Chapter 77.55 RCW). This law gave WDFW the authority to approve proposed construction projects if the projects adequately protect fish life. The law requires that any person, organization, or government agency wishing to conduct any construction activity that will use, divert, obstruct, or change the natural flow or bed of state waters must do so under the terms of a permit issued by the Washington Department of Fish and Wildlife. State waters include all marine waters and fresh waters of the state, except those watercourses that are entirely artificial, such as irrigation ditches, canals, and storm water run-off devices. Affected are construction or other work activities conducted in or near state waters that will “use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state.” (RCW 77.55.011(11)). Under the Hydraulic Code, anyone planning these types of activities in or near state waters is required to obtain an environmental permit commonly known as a Hydraulic Project Approval (HPA). Thousands of HPAs are issued statewide each year for activities ranging from work on bulkheads, piers, and docks to culvert replacement and mineral prospecting. The Washington Department of Fish and Wildlife (WDFW) administers the HPA program to ensure that approved projects are specifically designed to protect fish life. The effectiveness of the Washington Hydraulic Project Approval process in protecting fish life -including salmon and steelhead in the project and analysis areas - will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Effectiveness of the process will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.16 Washington State Water Pollution Control Act (90.48 RCW)

Enacted in 1973, the Washington State Water Pollution Control Act (90.48 RCW) was “declared to be the public policy of the state of Washington to maintain the highest possible standards to insure the purity of all waters of the state consistent with public health and public enjoyment

thereof, the propagation and protection of wild life, birds, game, fish and other aquatic life, and the industrial development of the state, and to that end require the use of all known available and reasonable methods by industries and others to prevent and control the pollution of the waters of the state of Washington. Consistent with this policy, the state of Washington will exercise its powers, as fully and as effectively as possible, to retain and secure high quality for all waters of the state. The state of Washington in recognition of the federal government's interest in the quality of the navigable waters of the United States, of which certain portions thereof are within the jurisdictional limits of this state, proclaims a public policy of working cooperatively with the federal government in a joint effort to extinguish the sources of water quality degradation, while at the same time preserving and vigorously exercising state powers to insure that present and future standards of water quality within the state shall be determined by the citizenry, through and by the efforts of state government, of the state of Washington."

Under the Act, the Washington Department of Ecology (WDOE) has jurisdiction to control and prevent the pollution of streams, lakes, rivers, ponds, inland waters, salt waters, water courses, and other surface and underground waters of the state of Washington. Any person who conducts a commercial or industrial operation of any type which results in the disposal of solid or liquid waste material into the waters of the state, including commercial or industrial operators discharging solid or liquid waste material into sewerage systems operated by municipalities or public entities which discharge into public waters of the state, shall procure a permit from WDOE before disposing of such waste material. WDOE may by rule eliminate the permit requirements for disposing of wastes by upland finfish rearing facilities unless a permit is required under the federal clean water act's national pollutant discharge elimination system. As discussed in Subsection 3.2, Fish Habitat, hatcheries proposed for operation under the Proposed Action must comply with WDOE water quality standards, or for the tribal programs, U.S. EPA standards. In addition, the degree to which the requirements of the Washington State Water Pollution Control Act are applied to protect water quality in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of Act requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.17 Washington State Growth Management Act: (RCW 36.70A)

The Washington State Growth Management Act requires state and local governments to manage Washington's growth by identifying and protecting critical areas and natural resource lands, designating urban growth areas, preparing comprehensive plans and implementing them through capital investments and development regulations. This approach to growth management is unique among states. Known as the GMA, the Act (Chapter 36.70A RCW) was adopted by the Legislature in 1990. The GMA was adopted because the Washington State Legislature found that uncoordinated and unplanned growth posed a threat to the environment, sustainable economic development and the quality of life in Washington. Rather than centralize planning and decision-making at the state level, the GMA focuses on local control. The GMA establishes state goals, set deadlines for compliance, offers direction on how to prepare local comprehensive plans and regulations and sets forth requirements for early and continuous public participation. Within the framework provided by the mandates of the Act, local governments have many choices regarding the specific content of comprehensive plans and implementing development

regulations. The Growth Management Hearings Board hears and determines allegations that a government agency has not complied with the GMA or the related Shoreline Management Act (SMA, Chapter 90.58 RCW). A 1991 law amended the GMA to create three regional boards, but a 2010 law consolidated them into one. SMA jurisdiction was added in 1996. The board's administrative rules of practice and procedure are found in the Washington Administrative Code (Title 242-02 WAC). Hearings Board members are appointed by the governor to staggered three year terms (Source: http://www.gmhb.wa.gov/Reader.aspx?pg=About.htm). While the GMA does not address linkages between the status of salmon populations and growth management, the Act has value as an indirect means for managing habitat for salmon protection. In 2013, the Tulalip Tribes and Snohomish County adopted an MOU establishing a process for coordinated long-range planning and information sharing. A key goal of the coordinated planning process envisioned in the 2013 Memorandum of Understanding (MOU) is to reduce inconsistencies between the Tribes Comprehensive Land Use Plan and the Snohomish County Growth Management Act Comprehensive Plan for all lands within the boundaries of the Tulalip Indian Reservation. The 2013 MOU authorized staff from the Tribes and the County to form an MOU Workgroup tasked with developing a work plan to implement the 2013 MOU and achieve coordinated planning goals. The degree to which growth management and land use regulations under the GMA are applied to protect fish habitat and processes affecting that habitat in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of GMA requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.18 Federal Energy Regulatory Commission (FERC) Permit Approvals and Renewals

The Federal Energy Regulatory Commission, or FERC, is an independent agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also reviews proposals to build liquefied natural gas (LNG) terminals and interstate natural gas pipelines as well as licensing hydropower projects. The Energy Policy Act of 2005 gave FERC additional responsibilities as outlined and updated in its Strategic Plan. As part of that responsibility, FERC: regulates the transmission and wholesale sales of electricity in interstate commerce; reviews certain mergers and acquisitions and corporate transactions by electricity companies; regulates the transmission and sale of natural gas for resale in interstate commerce; regulates the transportation of oil by pipeline in interstate commerce; approves the siting and abandonment of interstate natural gas pipelines and storage facilities; reviews the siting application for electric transmission projects under limited circumstances; ensures the safe operation and reliability of proposed and operating LNG terminals; licenses and inspects private, municipal, and state hydroelectric projects; protects the reliability of the high voltage interstate transmission system through mandatory reliability standards; monitors and investigates energy markets; enforces FERC regulatory requirements through imposition of civil penalties and other means; oversees environmental matters related to natural gas and hydroelectricity projects and other matters; and administers accounting and financial reporting regulations and conduct of regulated companies.

FERC regulates over 1,700 non-federal dams in the United States. FERC staff ensures compliance with numerous terms and conditions contained in each of the licenses and

exemptions issued for those dams. With respect to hydroelectric projects, FERC safeguards the environment by: ensuring that planned projects will minimize damage to the environment; requiring that all hydropower applicants communicate with federal and state natural resource management agencies, Indian tribes, and state water quality agencies prior to submitting an application to FERC; ensuring that all license applicants perform the necessary studies to base an informed decision on the project; issuing draft Environmental Assessments (EAs) or draft Environmental Impact Statements (EIS) for comment; incorporating license requirements designed to reduce environmental impacts; visiting projects that are requesting relicenses or license amendments. Scoping meetings are held to determine the most important environmental resources to address in an EA or an EIS; and maintaining a licensing handbook PDF with guidelines for preparing the Exhibit E, the environmental information exhibit required to be included with each application. The Commission's major hydropower activity is relicensing existing projects whose licenses are about to expire. FERC staff prepares either an EA or an EIS and bases recommended license conditions on the these reviews. FERC regulatory actions involving transmission of electricity, natural gas, and oil, and regulation and licensing of liquefied natural gas terminals and pipelines and hydropower projects may affect salmon and steelhead populations in the project and analysis areas. The effectiveness of FERC regulatory actions in protecting fish habitat and processes affecting that habitat in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of FERC requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.19 Army Corps of Engineers (ACOE) Project Approvals:

The ACOE regulatory program implements section 404 of the Clean Water Act. Section 404 regulates the discharge of dredged or fill material into the nation's waters and establishes requirements that must be met before ACOE can issue permits to private parties and governmental agencies for construction in wetlands, streams, rivers, and other aquatic habitats. ACOE shares responsibility for managing the section 404 program with the U.S. Environmental Protection Agency (EPA). Section 404 of the Clean Water Act prohibits the discharge of dredged or fill material into waters protected by the Act without a valid permit. Waters protected by the Clean Water Act include wetlands, rivers, streams, lakes, ponds, and coastal waters (collectively, "protected waters"). Activities requiring section 404 permits include the filling of protected waters to allow construction of housing developments, residential subdivisions, retail establishments, hotels, marinas, and roads. ACOE civil works projects also must comply with the substantive and analytical requirements of section 404, although the ACOE will not issue itself an actual permit. ACOE must comply with two sets of Clean Water Act regulations before it can issue a section 404 permit or approve a Corps civil works project — the EPA 404(b)(1) Guidelines and the Corps' own § 404 regulations. In most cases, a § 404 permit also cannot be issued until the proposed activity has been reviewed under NEPA. ACOE must consult with NMFS regarding any project that has the potential to adversely affect listed salmon or destroy or adversely modify designated critical habitat for a listed salmon species. Numerous projects within the project and analysis areas affecting listed salmon and their habitat have been reviewed by ACOE and forwarded to NMFS for informal or formal ESA consultation. The ability of NMFS to effectively review and regulate Snohomish River basin projects brought before the

agency by the Corps for ESA consultation, such that the projects are adequately protective of listed salmon and steelhead and their habitat, will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. NMFS determinations regarding ACOE project actions will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.20 Washington State Water Code (RCW 90.03.005)

Under RCW 90.03.005 "State water policy—Cooperation with other agencies—Reduction of wasteful practices", it is the state's policy to promote the use of the public waters in a fashion which provides for obtaining maximum net benefits arising from both diversionary uses of the state's public waters and the retention of waters within streams and lakes in sufficient quantity and quality to protect instream and natural values and rights. Consistent with this policy, the state supports economically feasible and environmentally sound development of physical facilities through the concerted efforts of the state with the United States, public corporations, Indian tribes, or other public or private entities. Further, based on the tenet of water law which precludes wasteful practices in the exercise of rights to the use of waters, the WDOE shall reduce these practices to the maximum extent practicable, taking into account sound principles of water management, the benefits and costs of improved water use efficiency, and the most effective use of public and private funds, and, when appropriate, to work to that end in concert with the agencies of the United States and other public and private entities. WDOE's effectiveness in administering the tenets of this water code to reduce wasteful water use practices that adversely affect fish habitat and habitat processes in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of the requirements under this water code will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.21 Washington State Water Code (RCW 90.03.247)

Under RCW 90.03.247 "Minimum flows and levels", whenever an application for a permit to make beneficial use of public waters is approved relating to a stream or other water body for which minimum flows or levels have been adopted and are in effect at the time of approval, any permit issued by the state shall be conditioned to protect the levels or flows. No agency may establish minimum flows and levels or similar water flow or level restrictions for any stream or lake of the state other than WDOE, whose authority to establish is exclusive, as provided in chapter 90.03 RCW and RCW 90.22.010 and 90.54.040. The provisions of other statutes, including but not limited to RCW 77.55.100 and chapter 43.21C RCW, may not be interpreted in a manner that is inconsistent with this section. In establishing such minimum flows, levels, or similar restrictions, the department shall, during all stages of development by the department of ecology of minimum flow proposals, consult with, and carefully consider the recommendations of, WDFW, the Department of Community, Trade, and Economic development, the Department of Agriculture, and representatives of the affected Indian tribes. Nothing herein shall preclude the WDFW, the Department of Community, Trade, and Economic development, or the Department of Agriculture from presenting its views on minimum flow needs at any public hearing or to any person or agency, and the WDFW, the Department of Community, Trade, and

Economic development, the Department of Agriculture are each empowered to participate in proceedings of the FERC and other agencies to present its views on minimum flow needs. WDOE's effectiveness in administering the tenets of this water code to protect flows and levels in freshwater habitat critical for fish survival and productivity in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of the requirements under this water code will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.22 Snohomish County Critical Area Ordinances and Land-use Codes

The Snohomish County Critical Area Ordinance provides critical area regulations pursuant to the Washington State GMA for the designation and protection of wetlands, and fish and wildlife habitat conservation areas including streams; lakes; marine waters; and primary association areas for critical species. The ordinance applies to development activities, actions requiring project permits, and clearing, with certain exceptions. It is the intent of the ordinance to provide the protection required by the GMA for wetlands and for fish and wildlife habitat conservation areas while simultaneously protecting property rights. In recognition that the implementation of some provisions of the ordinance would inevitably entail some restriction of property rights, the ordinance would always be construed and interpreted so that property rights be restricted no further than strictly necessary for the critical area protection required under the GMA. Numerous land use codes have been enacted in Snohomish County addressing development, permit exemptions, residential building permits, garage and storage building permits, and other local activities that may potentially affect the environment, including habitat processes important for fish. The degree to which local (Snohomish County) ordinances and land use codes are applied, consistent with GMA regulations, to protect fish habitat and processes affecting that habitat in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Local implementation, at a minimum, of GMA land use regulations will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

### 1.6.23 The Minimum Water Flows and Levels Act of 1967 (RCW 90.22):

This Act authorizes WDOE to establish minimum flows for protecting fish, game, birds, other wildlife, recreational & aesthetic values and/or water quality. Under RCW 90.22.010 "Establishment of minimum water flows or levels-Authorized-Purposes", WDOE may establish minimum water flows or levels for streams, lakes or other public waters for the purposes of protecting fish, game, birds or other wildlife resources, or recreational or aesthetic values of said public waters whenever it appears to be in the public interest to establish the same. In addition, WDOE shall, when requested by WDFW to protect fish, game or other wildlife resources under the jurisdiction of the agency, or if the WDOE finds it necessary to preserve water quality, establish such minimum flows or levels as are required to protect the resource or preserve the water quality described in the request or determination. Any request submitted by WDFW shall include a statement setting forth the need for establishing a minimum flow or level. When WDOE acts to preserve water quality, it shall include a similar statement with the proposed rule

filed with the code reviser. This section shall not apply to waters artificially stored in reservoirs, provided that in the granting of storage permits by WDOE in the future, full recognition shall be given to downstream minimum flows, if any there may be, which have theretofore been established hereunder. The efficacy of WDOE's establishment of minimum allowable flow levels designed to protect fish habitat and habitat processes in the project and analysis areas will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of Act requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

#### 1.6.24 Water Resources Act of 1971 (RCW 90.54):

Under the Water Resources Act of 1971, WDOE is mandated to protect, and where possible, enhance the quality of the natural environment by retaining base flows in the state's waterways for the preservation of wildlife, fish, scenic, aesthetic, and other environmental values. The Act sets forth "fundamentals of water resource policy for the state to ensure that waters of the state are protected and fully utilized for the greatest benefit to the people of the state of Washington and, in relation thereto, to provide direction to the department of ecology, other state agencies and officials, and local government in carrying out water and related resources programs". It is the intent of the legislature to work closely with the executive branch, Indian tribes, local government, and interested parties to ensure that water resources of the state are wisely managed." The effectiveness of WDOE's establishment and maintenance of base flows in freshwater reaches to protect fish habitat and habitat processes within the project and analysis areas actions will determine the extent to which hatchery salmon released into the natural environment through the Proposed Action survive, and in turn how the hatchery salmon affect the resources evaluated in this EA. Implementation of base flow requirements will also affect the viability status of natural salmon and steelhead populations, and resource elements affected by those natural fish.

## 2 ALTERNATIVES INCLUDING THE PROPOSED ACTION

Four alternatives and their effects are considered in this EA: (1) NMFS does not make a determination for the proposed HGMPs under the 4(d) Rule; (2) NMFS determines that the proposed HGMPs meet the requirements of the 4(d) Rule; (3) NMFS determines that the proposed HGMPs do not meet the requirements of the 4(d) Rule, and the programs are terminated; and, (4) the HGMPs are modified to reduce hatchery production. No other alternatives that would meet the purpose and need were identified that would be appreciably different from these four alternatives.

### 2.1 Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

Under this alternative, NMFS would not make a determination under the 4(d) Rule and the Tulalip Tribes and WDFW would continue to operate the Snohomish River basin salmon hatchery programs as under baseline conditions. Because the HGMPs would not be approved, the hatchery actions proposed by the Tulalip Tribes and WDFW would not be exempt from section 9 take prohibitions. No new environmental protection or enhancement measures would be implemented.

The No-action Alternative represents NMFS's best estimate of what would happen in the absence of the proposed Federal action – a determination that the submitted plans meet the requirements of the 4(d) Rule[2].

## 2.2 Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

Under this alternative, the six HGMPs would be approved under limit 6 of the 4(d) rule and they would be implemented as proposed (Subsection 1.2. Description of the Proposed Action). For the purpose of this analysis, NMFS would treat the Proposed Action Alternative as resulting in the hatchery production of Chinook salmon, coho salmon, and fall chum salmon as proposed in the six HGMPs primarily to:

- produce harvestable adult salmon to support Tulalip tribal commercial, ceremonial, and subsistence fisheries, and
- produce harvestable adult salmon to support WDFW-managed pre-terminal and terminal area fisheries.

Implementation of the HGMPs would continue until historical natural salmon population productivity and abundance are restored and ESA-listed Snohomish basin salmon populations are recovered. Implementation would be consistent with the NMFS salmon recovery plan for the Snohomish watershed (SSPS 2005), as modified in the annual expression of the Three Year Work Plan updating, as necessary, the recovery plan. Monitoring of the "viable salmonid population" (VSP - McElhany et al. 2000) status of the listed populations would be an important component of recovery plan and HGMP implementation.

Because the hatchery programs described in the Proposed Action are already occurring, and NMFS assumes they would continue to occur even if not approved under the ESA (i.e., the No-Action alternative), the anticipated effects on the affected environment of the Proposed Action are largely identical to those of the No-Action alternative and, therefore, would not differ in any substantial way from the No-Action alternative. This is especially so because the programs as currently operated, and as they would be operated under the No-Action alternative, are fully represented in the HGMPs. Therefore, the difference between the Proposed Action and the No-Action alternative is defined by the increased likelihood of continued operation of the programs due to the ESA compliance step. The specific benefits afforded by ESA compliance are largely speculative but may include increased potential funding for components of the program and increased certainty of monitoring, evaluation, and reporting.

[2] NMFS recognizes the possibility that the No-Action alternative could result in discontinuation of the hatchery programs. However, this is not NMFS's best estimate of what would occur, and discontinuation is the subject of Alternative 3.

## 2.3 Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin

Under this alternative, the hatchery programs would be terminated based on a finding that the six HGMPs proposed by the Tulalip and WDFW do not meet the criteria under limit 6 of the 4(d) rule. This alternative assumes that the Tulalip Tribes and WDFW would terminate the programs because they do not qualify for an exemption from section 9 take prohibitions. Were that to occur, all salmon currently being raised in hatchery facilities would be released or killed, and no additional broodstock would be collected.

Under this alternative, the hatchery programs would no longer function to produce fish as mitigation for lost natural salmon production, with consequent impacts to tribal treaty fishing rights and non-treaty fishing recreational and commercial opportunities. Additionally, NMFS' 4(d) regulations do not provide NMFS with blanket authority to require the outcome of this alternative as a consequence of its 4(d) determination. NMFS' 4(d) regulations require NMFS to make a determination that the HGMPs as proposed either meet or do not meet the standards prescribed in the rule. Nonetheless, NMFS supports analysis of this alternative to assist with a full understanding of potential effects on the human environment under various management scenarios, including those that do not achieve all of the applicants' specific objectives.

## 2.4 Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin

Under this alternative, the six HGMPs would be approved under limit 6 of the 4(d) rule, with the provision that the number of fish released from each of the hatchery programs would be reduced relative to the Proposed Action. As the basis for analyzing a reduced production scenario, NMFS has applied a 50 percent reduction in the annual maximum juvenile fish release goals described as Proposed Actions for the Chinook salmon, coho salmon, and fall chum salmon hatchery programs. Under Alternative 4, the annual maximum salmon release levels would be as follows:

Chinook salmon:

Wallace River Hatchery – 500,000 subyearlings; 250,000 yearlings
Tulalip Hatchery – 1,200,000 subyearlings

Coho salmon:

Wallace River Hatchery – 75,000 yearlings
Eagle Creek Hatchery - 27,000 yearlings
Tulalip Bay Hatchery – 1,000,000 yearlings
Everett Bay Net-Pens – 10,000 yearlings

Fall chum salmon:

Tulalip Bay Hatchery – 6,000,000 fry

Under this alternative, the reduced natural salmon loss mitigation function associated with the reduced hatchery programs would impact tribal treaty fishing rights and non-treaty recreational and commercial fishing opportunities. Additionally, NMFS' ESA section 4(d) regulations do

not provide NMFS with blanket authority to require the outcome of this alternative as a consequence of its 4(d) determination. NMFS' 4(d) regulations require NMFS to make a determination that the HGMPs as proposed either meet or do not meet the standards prescribed in the rule. Nonetheless, NMFS supports analysis of this alternative to assist with a full understanding of potential effects on the human environment under various management scenarios, including those that do not achieve all of the applicants' specific objectives.

Table 3 summarizes total annual juvenile salmon released by hatchery program, species, and life stage that would result from implementation of the four alternatives considered in this EA.

Table 3. Annual Snohomish River basin juvenile hatchery salmon production levels (millions) by alternative, program, and species relative to baseline conditions.

| Species/HGMP | Baseline | Alternative 1 | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|---|
| Chinook Salmon | | | | | |
| Wallace River | 1.0 (subyrlgs)<br>0.5 (yearlings) | 1.0 (subyrlgs)<br>0.5 (yearlings) | 1.0 (subyrlgs)<br>0.5 (yearlings) | 0 (subyrlgs)<br>0 (yearlings) | 0.5 (subyrlgs)<br>0.25 (yearlings) |
| Tulalip | 2.4 (subyrlgs) | 2.4 (subyrlgs) | 2.4 (subyrlgs) | 0 (subyrlgs) | 1.2 (subyrlgs) |
| Coho Salmon | | | | | |
| Wallace River | 0.15 (yrlgs) | 0.15 (yrlgs) | 0.15 (yrlgs) | 0 (yearlings) | 0.075 (yrlgs) |
| Eagle Creek | 0.054 (yrlgs) | 0.054 (yrlgs) | 0.054 (yrlgs) | 0 (yearlings) | 0.027 (yrlgs) |
| Tulalip | 2.0 (yearlings) | 2.0 (yearlings) | 2.0 (yearlings) | 0 (yearlings) | 1.0 (yearlings) |
| Everett Bay | 0.02 (yrlgs+) | 0.02 (yrlgs+) | 0.02 (yrlgs+) | 0 (yrlgs+) | 0.01 (yrlgs+) |
| Fall-run Chum Salmon | | | | | |
| Battle Creek | 12.0 (fry) | 12.0 (fry) | 12.0 (fry) | 0 (fry) | 6.0 (fry) |

## 2.5 Alternatives Considered But Not Analyzed in Detail

### 2.5.1 Operate Hatchery Programs for Listed Species Only

NMFS would treat this alternative as resulting in the hatchery production of only Chinook salmon as proposed in the two HGMPs for that species. The four other HGMPs for the other species that would propagate coho and fall chum salmon that are not listed under the ESA would not be approved under the 4(d) Rule to limit potential incidental take effects on listed fish species. With this lack of approval, the hatchery actions for coho and fall chum salmon proposed by Tulalip Tribes and WDFW would not be implemented and the programs would be terminated. Termination of the proposed hatchery actions for these two non-listed species would mean that there would be no programs in the action area that would produce adult coho and fall chum salmon for harvest in treaty-reserved tribal fisheries, and for non-Indian fisheries recreational and commercial fishing opportunities, as mitigation for lost natural-origin coho and fall chum salmon production. This alternative will not be analyzed in detail because it would not identify effects information that would be substantively different from information provided through detailed review of the four alternatives described above, including hatchery program termination.

### 2.5.2 Operate Hatchery Programs for Non-Listed Species Only

NMFS would treat this alternative as resulting in the hatchery production of only non-listed coho and fall chum salmon as proposed in the four HGMPs for those species. The two HGMPs for Chinook salmon would propagate a species that is listed under the ESA and would not be approved under the 4(d) Rule to limit potential direct take effects on the two ESA-listed natural-origin Snohomish River basin Chinook salmon populations. Under this alternative, the hatchery actions for Chinook salmon proposed by Tulalip Tribes and WDFW would not be implemented and the programs would be terminated. Termination of the proposed hatchery actions for this listed species would mean that there would be no programs in the action area that would produce adult Chinook salmon for harvest in treaty-reserved tribal fisheries, and for non-Indian fisheries recreational and commercial fishing opportunities, as mitigation for lost natural-origin Chinook salmon production. This alternative will not be analyzed in detail because it would not identify effects information that would be substantively different from information provided through detailed review of the four alternatives described above, including hatchery program termination.

### 2.5.3 Approve Proposed Hatchery Programs under Section 10 of the Endangered Species Act

Under this alternative, NMFS would consider the effects of the six HGMPs under a different section of the statute - ESA section 10(a)(1)(A) instead of ESA section 4(d). The analysis of impacts under this alternative would not differ from the analysis that would occur under the Proposed Action Alternative 2.2.

### 2.5.4 Approve Proposed Hatchery Programs under Section 10 of the Endangered Species Act with Additional Best Management Practices

Under this alternative, the Secretary would approve the six proposed hatchery programs under ESA section 10(a)(1)(A) permits (for Chinook salmon programs) or section 10(a)(1)(B) permits (for coho and fall chum salmon programs), but any permits issued would require implementation of additional best management practices (BMPs) to further reduce the risk of adverse impacts of the hatchery programs on natural-origin salmon and steelhead populations. Because the proposed HGMPs have already incorporated all best management practices identified by independent reviewers and because the HGMPs allow for the incorporation of additional BMPs in the future as a result of monitoring and evaluation activities, this alternative would not be meaningfully different from the Proposed Action.

### 2.5.5 Hatchery Programs with Increased Production Levels

Under this alternative, the programs would produce higher numbers of juvenile hatchery fish than those proposed, and NMFS would consider production levels increased from those described in the six HGMPs. However, higher production levels would exceed production capacities for the hatcheries, in particular, fish rearing density limits for the facilities, which could potentially impair fish health and reduce the survival of the artificially propagated fish and thus, not meet the purpose and need.

# 3 AFFECTED ENVIRONMENT

## 3.1 Introduction

Chapter 3, Affected Environment, describes baseline conditions for eight resources that may be affected by implementation of the EA alternatives:

- Fish Habitat (Subsection 3.2)
- Salmon and Steelhead (Subsection 3.3)
- Other Fish Species (Subsection 3.4)
- Wildlife (Subsection 3.5)
- Socioeconomics (Subsection 3.6)
- Cultural Resources (Subsection 3.7)
- Human Health and Safety (Subsection 3.8)
- Environmental Justice (Subsection 3.9)

No other resources were identified during internal scoping that would potentially be impacted by the Proposed Action or alternatives.

Under baseline (current) conditions, the proposed hatchery programs (Table 4) operate in connection with the condition of habitat in the Snohomish River basin (Section 3.2) and the capacity of that habitat to support salmon. Under baseline conditions, artificial propagation exists to partially offset losses in the natural production of salmon caused by the loss and degradation of estuarine and freshwater habitat. The State of Washington began producing hatchery Chinook salmon in the Skykomish River in 1905, assisted by local Indian tribes. WDFW's current Wallace River Hatchery Chinook salmon hatchery program was initiated in 1972, and the Tulalip Bay Hatchery program propagating summer-run Chinook salmon stock transferred from the WDFW hatchery commenced in 1998. Hatchery-origin coho salmon have been released from Wallace River Hatchery since the 1920s, and releases of the species from Tulalip's Bernie Kai-Kai Gobin Salmon Hatchery began in 1981 (Tulalip 2013a). A non-native stock-origin fall chum salmon program using stock transferred from Hood Canal and (later) Deep South Sound was initiated through fry releases in Tulalip Bay beginning in 1976. Located near the mouth of the Snohomish River in the Port of Everett Marina (Port Gardner Bay), the Everett Bay Net-Pen coho salmon program was initiated in 2001 to provide recreational fishing opportunity in the Port Gardner area.

### 3.1.1 Critical Habitat

When NMFS lists a species under ESA protective provisions, habitat deemed critical for the survival and recovery of the listed fish is designated to help facilitate return of the species to a viable status. Within the action area, critical habitat was designated for Puget Sound Chinook salmon (70 FR 52630, September 2, 2005), and critical habitat for the Puget Sound steelhead DPS was designated on February 24, 2016 (81 FR 9252). Because NMFS status reviews indicated ESA-listing was not warranted for the species, no critical habitat designations have been made for fall chum salmon, pink salmon, or coho salmon in the action area.

Table 4. Annual juvenile hatchery salmon release levels by location, species, and life stage, and estimated adult return levels under baseline conditions.

| Species | Hatchery Program & Year Initiated | Target Annual Juvenile Release Levels by Life Stage (2014) | Hatchery-Origin Adult Return Levels [1] |
|---|---|---|---|
| Chinook salmon | Wallace River Hatchery: 1972 | 1.0 million subyearlings; 500,000 yearlings | 11,700 |
| | Tulalip Hatchery: 1998 | 2.4 million subyearlings | 11,040 |
| Coho salmon | Wallace River Hatchery: 1920s | 150,000 yearlings | 8,955 |
| | Eagle Creek Hatchery: 1990 | 54,000 yearlings | 3,224 |
| | Tulalip Bay Hatchery: 1981 | 2.0 million yearlings | 120,000 |
| | Everett Bay Net-Pen: 2001 | 20,000 yearlings | 658 |
| Fall chum salmon | Tulalip Bay Hatchery: 1976 | 12.0 million fry | 60,000 |

[1] Total adult production estimates are derived assuming juvenile hatchery-origin fish survival rates to adult return (escapement and total contribution to fisheries) of 0.46 percent for subyearling Chinook salmon and 1.42 percent for yearling Chinook salmon (Tulalip 2012); 5.97 percent for Wallace River and Eagle Creek hatchery yearling coho salmon (WDFW 2013b); 6.0 percent for Tulalip Bay Hatchery yearling coho salmon (Tulalip 2013a); 3.29 percent for Everett Bay Net Pen delayed released coho salmon (WDFW 2013c), and 0.5 percent for fall chum salmon (Tulalip 2013b).

In the Snohomish River basin, Puget Sound Chinook salmon critical habitat includes the Snohomish, Skykomish, and Snoqualmie Rivers and their tributaries, extending upstream to the limits of Chinook salmon access. Critical habitat for Puget Sound steelhead in the Snohomish River basin includes the same areas, expanded upstream in the rivers and tributaries to include upper watershed areas accessible to steelhead, which as a species are able to reach those areas. Critical habitat for both species includes adjacent nearshore and offshore marine areas, including Ebey Slough, Port Gardner Bay, and Puget Sound. Critical habitat for listed salmon and steelhead within the Snohomish River basin action area also includes the estuarine areas and the stream channels of the Snohomish River basin, and includes a lateral extent as defined by the ordinary high-water line (33 CFR 319.11).

Within these critical habitat areas, NMFS identifies primary constituent elements (PCEs), which are sites and habitat components that support one or more fish life stages (70 FR 52630; 78 FR 2726). These features are essential to the conservation of listed salmon, and because of shared life history traits for sustenance of non-listed salmon populations, because they encompass sites with conditions that support spawning, incubation, rearing, migration and foraging. PCEs identified for Puget Sound Chinook salmon (70 FR 52731, September 2, 2005) that may also be applied to listed steelhead and non-listed salmon populations in the Snohomish River basin, include:

(1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development;
(2) Freshwater rearing sites with: (i) Water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) Water quality and forage habitat that supports juvenile development; and (iii) Natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

(3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival;
(4) Estuarine areas free of obstruction and excessive predation with: (i) Water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) Juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
(5) Nearshore marine areas free of obstruction and excessive predation with: (i) Water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and (ii) Natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
(6) Offshore marine areas with water-quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

In the Puget Sound areas designated as critical habitat, major management activities affecting PCEs for fish habitat are forestry, grazing, agriculture, channel/bank modifications, road building/maintenance, urbanization and associated pollution, sand and gravel mining, dams, irrigation impoundments and withdrawals, river, estuary, and ocean traffic, wetland loss, and forage fish/species harvest (NMFS 2005a). Specific to the action area, the Snohomish Basin Salmonid Recovery Technical Committee (SBSRTC 1999) identified the following highest priority problems that contribute to the degradation of habitat and the subsequent decline in Chinook salmon abundance and productivity in the Snohomish basin:

- Loss of channel area and complexity due to bank protection and diking of the river and major tributaries, cutting off the channel from its floodplain;
- Dearth of in-channel large woody debris;
- Flood flows that scour redds at high frequencies;
- Increased sediment input to streams as a result of slope failures;
- Poor quality riparian forests;
- Loss of wetlands due to draining for land conversion that eliminates habitat and reduces water retention;
- In redd mortality due to siltation or water quality contamination;
- Urbanization (road construction, commercial and residential construction, additional bank hardening) that further reduces Chinook salmon viability in the basin; and
- Artificial barriers (dams, tide gates, diversions, culverts, pump stations) that prevent juveniles from reaching accessing rearing habitat.

## 3.2 Fish Habitat

The Snohomish River basin is one of the fastest growing areas in the Puget Sound region. The human population in the basin is projected to increase by 53 percent from 206,000 in 1995 to 315,000 in 2020 (SRBSRTC 1999), with projected human population growth of 59 percent from 2000 to 2030 (SSPS 2005). Ongoing threats to salmon and steelhead populations are habitat loss

and degradation associated with human population growth and development. Within the action area, areas along the mainstem rivers and lowland tributaries are most likely to be affected by these growth and development pressures. When riverine lands are converted to residential and urban areas, forest cover and ecosystem processes are altered or lost. The change is almost always permanent (SSPS 2005).

Underline current baseline conditions, degradation and fragmentation of fish habitat associated with human developmental activities, with consequent effects on connectivity, are primary limiting factors and threats affecting listed and non-listed fish populations in the Snohomish River basin. An analysis of nearly three dozen datasets; a dozen types of human activities; and more than a decade of satellite imagery indicated that in 2011, human development covered 21.3 percent of all lands in Snohomish County, or a total of 283,579 acres of land (Center for American Progress 2016; Conservation Science Partners 2016). These data indicated that between 2000 and 2011, the county lost 16,462 acres of natural areas due to development. The proportion of natural areas lost each year in Snohomish County (encompassing the Snohomish River and Skykomish River watersheds) is 8.8 percent higher than the average annual rate of loss for all Washington counties. In King County, which encompasses a large portion of the upper Snoqualmie River watershed, natural area loss is 105.6 percent higher than the average loss across all Washington counties. Within the Snohomish River basin, the nearshore, estuary, main-stem river and key tributary salmon and steelhead habitats have been adversely affected, or are threatened, by a number of activities that are leading to the loss of natural areas composing and sustaining these fish habitat areas (this and following from Snohomish River Basin Salmon Conservation Plan 2005).

Approximately 70 percent of the Snohomish River basin nearshore shoreline has experienced significant modification, and subsequent population declines in plant and animal species important for various salmonid life stages. Sediment delivery and transport, riparian conditions, and intertidal habitat conditions have been extensively modified along the Snohomish nearshore, most notably due to construction of the Burlington Northern/Santa Fe railroad in the 1890s, construction of bulkheads, riprap, and piers in the industrial waterfront, and dredging of berths and the federal navigation channel. The most substantial habitat impacts in the nearshore result from the railroad, and from shoreline armoring needed to protect numerous homes – structures that likely never be removed. The largest threat to habitat facing the estuary is urbanization downstream of Interstate-5. Permanent habitat losses have already occurred, and few sites remain undeveloped. A second habitat threat in this area is the proposed expansion of Interstate-5 to include high occupancy vehicle lanes in both directions and larger rights-of-way. There are also dikes and water control structures throughout the estuary that significantly limit the aquatic habitat that is accessible by fish.

Dikes, bank armoring, roads, railroads, and bridges confine the mainstem Snohomish, Skykomish, and South Fork Skykomish Rivers, disconnect off-channel habitat, reduce edge habitat complexity, and increase peak flows downstream. Riparian forest cover has been substantially degraded within these areas, reducing large woody debris recruitment and further simplifying the habitat. Other habitat problems in the mainstem rivers include excessive erosion of stream banks, blocking culverts on small streams, and degraded water quality (i.e., high temperature, low dissolved oxygen, high fecal coliform counts, and high levels of toxic metals).

Forestry comprises 50 percent of the land base in the mainstem Skykomish River Basin (Figure 2 – SSPS 2005). Forest practices such as timber harvest are the most dominant land use in the highest elevation areas of the Basin, including the Upper North Fork Skykomish and South Fork Skykomish watershed areas upstream of Sunset Falls. Approximately 30 percent of land use in this sub-basin is currently in residential development. Residential land use generally occurs in areas removed from river shorelines, which are zoned primarily for agricultural production. However, rural residential development occurs sporadically directly adjacent to mainstem river reaches near several small cities.

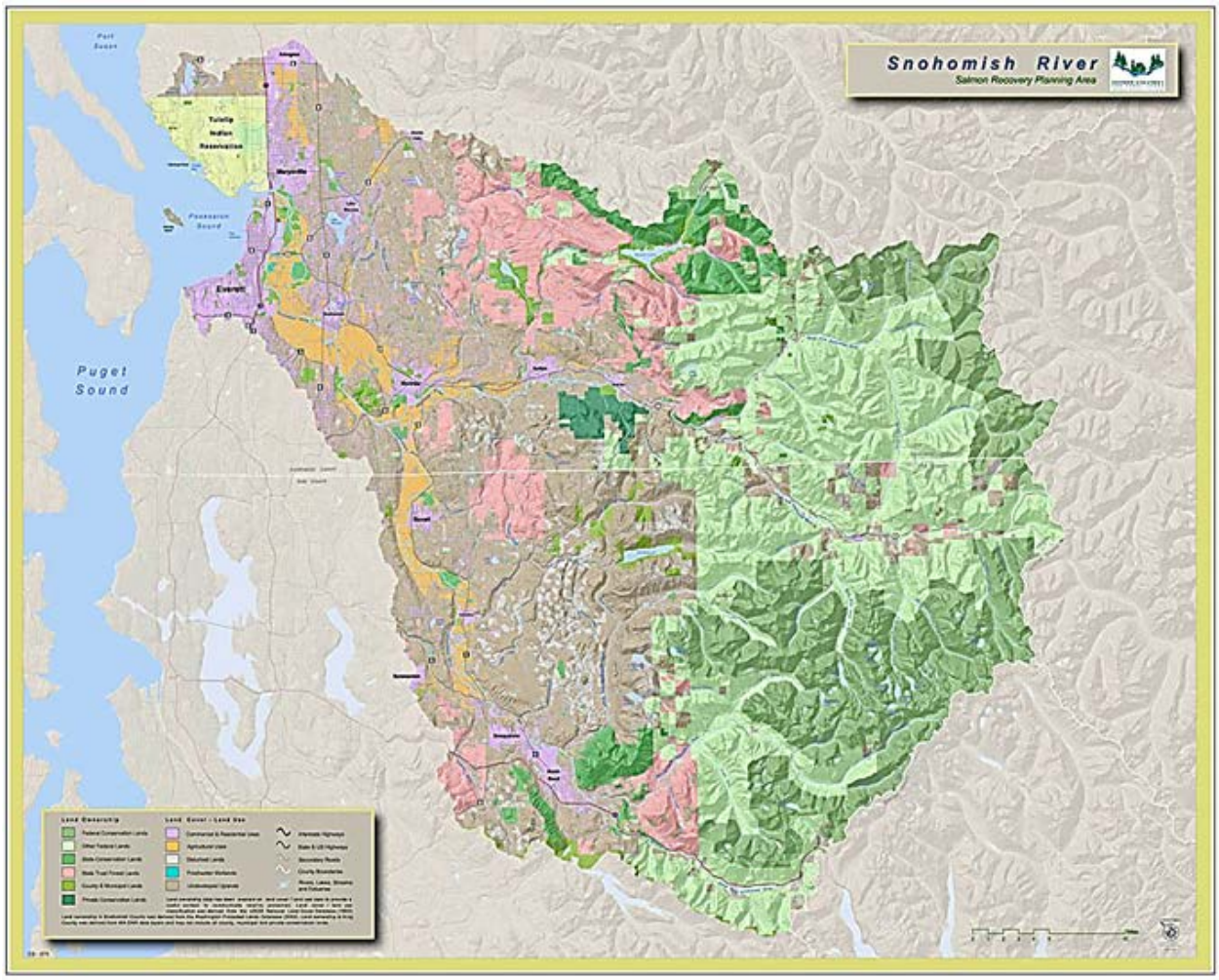


Figure 2. Land ownership, land use, and land cover in the Snohomish River basin. Source: SSPS (2005), Volume II.

An important element of fish habitat under the baseline is anadromous fish access to areas essential for spawning, rearing, and migration. Adult and juvenile salmonid access to historically used freshwater fish habitat is significantly impaired in many areas of the watershed by a variety of fish passage barriers associated with the aforementioned human development activities, including culverts, dams, dikes, levees, and adverse water quality conditions (Haring 2002; Snohomish River Basin Salmon Conservation Plan 2005). Dikes and levees preclude or inhibit access to floodplain wetland habitats that could provide salmonid rearing areas. The

effects of dikes and levees have been profound, as much of the historic salmon production capacity in the action area is thought to have been associated with the vast presence of accessible floodplain and estuarine wetlands. Bortelson et al. (1980) estimate post-European contact development activities have resulted in a 74 percent reduction in presence of floodplain wetlands, and a 32 percent loss of intertidal wetlands in the Snohomish River watershed. Estimates of lost natural Chinook and coho salmon production capacity associated with the loss of floodplain habitat access are 40-61 percent and 50 percent, respectively (Haas and Collins 2001). Flooding that overtops dikes and levees does allow juvenile and adult salmonid access into areas behind the structures on an infrequent basis (Snohomish dikes/levees are designed to overtop at a 5-year flood, plus one foot (Haring 2002)). Stranding, low dissolved oxygen levels, and other water quality problems may preclude outmigration of juvenile fish that access these normally blocked habitats, and any progeny of spawning adult fish, back to the river after floodwaters recede. On the positive side, establishment through the Sunset Falls Fishway project of anadromous fish access to the South Fork Skykomish River upstream of Sunset Falls has resulted in anadromous use of 72.9 miles (roughly 10 percent of the Snohomish basin-wide distribution) of historically inaccessible habitat (Haring 2002; NMFS 2009).

Major factors affecting water quantity in the action area associated with human development are instream water withdrawals, altered hydrology associated with increased impervious surfaces, and altered hydrology from increased rain-on-snow runoff (Haring 2002), with the latter factor potentially related to climate change. Several areas within the Snohomish River basin are at increased susceptibility to effects from groundwater withdrawals, particularly in areas that are experiencing increased commercial and residential development (Haring 2002). Since 1980, withdrawal of basin groundwater through exempt wells has proliferated from 2,300 wells to greater than 13,000 wells (SSHIAP 2012). Although the effects of these wells are unmonitored, these withdrawals can substantially affect the amount of water available to salmon during critical low flow periods. Under the current baseline, the major water withdrawals in the watershed are City of Snohomish withdrawal from the Pilchuck River, City of Everett withdrawals from the upper end of Ebey Slough and the Sultan River, and Seattle City Light withdrawal from the South Fork Tolt River (Haring 2002). Water withdrawals on the Sultan and South Fork Tolt Rivers have reduced peak flows and increased low summer flows downstream of the dams on those rivers. Withdrawals from the Pilchuck River reduce summer-time low flows downstream of the diversion dam on the river.

Directly associated with watershed development and resultant landscape changes in natural areas, the increased intensity and frequency of peak flows during river flooding in recent years is considered to be another limiting factor associated with water quantity (Snohomish Basin Management Unit Status Profile; Tulalip and WDFW 2014). Observed variation in fish survival appears to be more strongly influenced by peak flows during incubation ($r^2 = 0.31$ for the Skykomish Chinook population and 0.63 for the Snoqualmie Chinook population). Peak flows have the potential to kill large numbers of deposited eggs either through suffocation from sediment deposition or by displacement from gravel scour (Healy 1991). Habitat perturbations previously mentioned such as loss of off-channel habitat and instream structure, bank hardening and channelization, and large fluctuations in discharge when transitioning from drought conditions to fall flooding, are thought to exacerbate mortality from flooding. Low flows during spawning in the fall during drought years could magnify these effects by forcing Chinook salmon

to spawn almost exclusively in mainstem thalweg areas. Low flow summer periods are becoming increasingly frequent, exacerbating the vulnerability of eggs and juvenile fish to the effects of peak flows, which are also becoming more frequent and of higher magnitude as previously described. These hypotheses are supported by the observations reported above for the Snohomish River basin and other watersheds (e.g., Skagit and Stillaguamish).

While Skykomish Chinook displayed relatively higher survival than Snoqualmie Chinook during the recent years (2001-2011), peak discharge events in the Skykomish River were relatively lower during incubation (Snohomish Basin Management Unit Status Profile (SSPS 2005); Tulalip and WDFW 2014). Additionally, brood year 2009 had the second lowest escapement estimate from 2000-2011 and yet the highest estimates for egg-to-migrant survival rate. This high survival may be a result of low discharge, relative change in discharge, or one of the other factors affecting hydrologic conditions previously listed. Variability across sub-basins in the timing and magnitude of peak discharge, and their effect during incubation and early rearing, may not be fully captured in these analyses due to differences in precipitation regimes and hydrologic responses between sub-basins.

With regards to water quality conditions for salmonids under the baseline, increased water temperatures in the mainstem and many tributaries resulting from development of natural lands affect habitat suitability for spawning and rearing, and also increase suitability for predator species that are known to prey on juvenile salmonids (Haring 2002). High water temperatures are a concern in mainstem and tributary areas, typically associated with impaired riparian function. Low dissolved oxygen may be adversely affecting salmonid survival in some estuarine sloughs and tributaries in the watershed, particularly upstream of drainage district pump plants, and in areas with high nutrient input, such as reaches with unrestricted livestock access. These detrimental water quality conditions for salmonids may be worsened as a result of climate change.

Turning to the marine environment, salmonid populations in the Snohomish River basin have been particularly affected by habitat loss in the estuary. The quantity and quality of salmon and steelhead rearing habitat available in the estuary is a small fraction of pre-development conditions (Snohomish County 2013). Historically, the Snohomish River estuary included a rich complex of tidal channels and productive marshes. Under current conditions, only one-sixth of the historical tidal marsh area downstream of the head of Ebey Slough remains intact and accessible to salmonids (Snohomish County 2013). The lack of critical estuarine tidal marsh habitat is considered a limiting factor for Snohomish River basin Chinook salmon recovery (SBSRTC 1999). These conditions compromise prospects for restoration of natural- origin Chinook salmon population viability, because ocean-type Chinook salmon stocks are extremely dependent on a properly functioning estuary due to their predominantly fry migrant life history. In an analysis of hatchery coded-wire tag data from the west coast, Magnusson and Hilborn (2003) reported that average Chinook salmon survival rates produced in watersheds that are fully intact habitat are greater by a factor of at least three than survival rates for fish produced in watersheds with estuarine habitat that has been fully developed (i.e., habitat is degraded or eliminated altogether). This study documents the importance of estuaries for juvenile Chinook salmon survival and highlights that hatchery fish (released as seawater-ready smolts) also need functioning habitat.

Under the current baseline, variance in marine area productivity and survival conditions is also a likely factor affecting fish habitat in ocean rearing areas, and resultant survival rates for natural and hatchery salmonids originating from the action area. Largescale natural shifts in marine area productivity conditions for salmonids have been shown to occur interannually (Beamish et al. 1997), at the decadal scale (Mantua and Hare 2002), and in response to El Nino events (Ruggerone and Goetz 2004). Shifts in marine area productivity may be becoming more dramatic due to climate change. Climate change has been implicated as a driving force for depression of productivity and fish habitat conditions in freshwater areas, and in the ocean where salmonids originating from the action area spend the majority of their lives (CIG 2004; ISAB 2007; Scheuerell and Williams 2005; Zabel et al. 2006; Mantua et al. 2009). The distribution and productivity of salmonid populations in the Pacific Northwest region are likely to be affected (Beechie et al. 2006). Average annual Northwest air temperatures have increased by approximately 1ºC since 1900, or about 50 percent more than the global average over the same period (ISAB 2007). The latest climate models project a warming of 0.1 ºC to 0.6 ºC per decade over the next century. According to the Independent Scientific Advisory Board (ISAB), these effects pose the following impacts over the next 40 years:

- Warmer air temperatures will result in diminished snowpacks and a shift to more winter/spring rain and runoff, rather than snow that is stored until the spring/summer melt season.
- With a smaller snowpack, these watersheds will see their runoff diminished earlier in the season, resulting in lower stream-flows in the June through September period. River flows in general and peak river flows are likely to increase during the winter due to more precipitation falling as rain rather than snow.
- Water temperatures are expected to rise, especially during the summer months when lower stream-flows co-occur with warmer air temperatures. As climate change progresses and stream temperatures warm, thermal refugia will be essential to persistence of many salmonid populations. Thermal refugia are important for providing salmon and steelhead with patches of suitable habitat while allowing them to undertake migrations through or to make foraging forays into areas with greater than optimal temperatures. To avoid waters above summer maximum temperatures, juvenile rearing may be increasingly found only in the confluence of colder tributaries or other areas of cold water refugia (Mantua et al. 2009).

These changes will not be spatially homogeneous across the entire Pacific Northwest. Low-lying areas are likely to be more affected. Within the Snohomish River basin, precipitation is not evenly distributed throughout the watershed, primarily due to the Cascade Mountains; precipitation ranges from 35 inches per year near Possession Sound to 180 inches per year near Mount Hinman and Mount Daniel (Haring 2002 citing Gersib 1999). The Snohomish, Skykomish, and Snoqualmie rivers all include significant portions of their watershed area in high elevation zones which contribute to their two distinct periods of high monthly flows. The highest average monthly streamflows occur from November through January, and again in May and June (USGS stream gage records for gage 12150800 and following). The high monthly streamflows in May and June are a result of melting snow and warming spring air temperatures. In general, peak flows are not associated with spring snow melt and occur during intense rain

events or rain-on-snow events. Within the Snohomish River, 70-percent of annual peak stream flows occur from November through January. The lowest flows occur in August and September.

Since climate change would likely reduce snowpack, run-off from snow melt in spring and summer would be reduced, and associated factors (e.g., re-channeling of the river bed, movement of silt out of the system, transport of woody debris) would be affected. Battin et al. (2007) found that the greatest threats from climate change to Snohomish basin Chinook salmon were associated with projected increases in peak flows. Battin et al. (2007) projected that the greatest, most severe impacts from climate change would occur in the higher elevation subbasins. Climate change may have long-term effects that include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, and increased competition among species (ISAB 2007).

Within the "Fish Habitat" resource, the only baseline conditions bearing on the PCEs identified in Subsection 3.1.1 that are potentially affected by implementation of the currently operating salmon hatchery programs are water quantity and water quality. Current effects on PCEs from hatchery fish predation and hatchery facilities ("excessive predation"; "migration corridors free of obstruction", respectively) are addressed in Subsection 3.3, Salmon and Steelhead, and Subsection 3.4, Other Fish Species, where effects on fish population viability are the focus.

Taking into account other human activities in the action area affecting water quantity and water quality aspects of fish habitat, any potentially measurable hatchery-related effects would be confined to certain sites within the action area that are in close proximity to the hatchery locations. These two components of fish habitat as they relate to effects of on-going salmon hatchery operations on baseline conditions are described below.

### 3.2.1 Water Quantity

Hatchery programs such as those currently operating in the Snohomish River basin withdraw water from a well (groundwater) or neighboring tributary streams (surface water) to use in the hatchery facility for salmon broodstock holding, egg incubation, juvenile salmon rearing, and juvenile acclimation. All water, minus evaporation, that is diverted from a river or taken from a well is discharged back to the source, after it circulates through the hatchery facility (non-consumptive use). When the hatchery programs use groundwater, they may reduce the amount of water for other users in the same aquifer. The hatchery programs that use surface water have the potential to dewater the stream between the water intake and discharge structures, which may impact fish and wildlife if migration is impeded, habitat capacity is reduced, or dewatering leads to increased water temperatures. Generally, water intake and discharge structures for the current hatchery programs are located as close together as possible to minimize the area of the stream that may be impacted by a water withdrawal.

Six hatchery facilities are currently used by the Snohomish River basin salmon hatchery programs. Four of the facilities use surface water exclusively (Wallace River Hatchery; Eagle Creek Hatchery, Tulalip Creek Ponds, and Battle Creek Pond); one facility uses a combination of groundwater and surface water (Tulalip (Bernie Kai-Kai Gobin) Hatchery); and one facility relies on passive tidal flow of marine water for fish rearing (Everett Bay Net-Pen) (Table 5).

Table 5. Water source and use by Snohomish River basin salmon hatchery facilities.

| Hatchery Facility | Surface Water Use Min/max (cfs) | Surface Water Source | Ground-water Use min / max (cfs | Annual Surface Water Flow Range (min/mean/max) (cfs) [1] | Potential Maximum Total Surface Water Withdrawn ( percent) [3] | Effluent Discharge Location (River Mile) | NPDES Permit Number |
|---|---|---|---|---|---|---|---|
| Wallace River Hatchery | 40<br>14 | Wallace R.<br>May Creek | 0 | - / 163 / - | 50<br>100 | Wallace River (4.0) | WAG 13-3006 |
| Eagle Creek Hatchery | 0.7 - 0.9 | Unnamed spring | 0 | 0.71 / 0.79 /0.87 | Unknown | Eagle Creek (0.4) | Not required |
| Tulalip Hatchery | 4.5 - 16 | West Fork Tulalip Creek; East Fork Tulalip Creek | 0.0 / 1.6 | 0.82 / 10.6 / 106 [2] | 100<br>100 | Tulalip Creek (2.1) | WAG-13- 0012 |
| Tulalip Creek Ponds | 5.2 – 41 | Tulalip Creek | 0 | 2.0 / 13.4 / 179 | 100 | Tulalip Bay (0.0) | WAG - 13-0013 |
| Battle Creek Pond | 2.2 – 15 | Battle Creek | 0 | 0.12 / 5.9 / 137 | 100 | Tulalip Bay (0.0) | WAG - 13-0014 |
| Everett Bay Net-Pen | N/A | Puget Sound | 0 | N/A | N/A | Port Gardner Bay | Not required |

[1] Source of surface water flow data for the Wallace River is WDFW's "A catalog of Washington streams and salmon utilization" (Williams et al. 1975). Data for Tulalip Bay tributaries are from Tulalip (2012; 2013a; 2013b).
[2] Combined records for the West and East Forks of Tulalip Creek.
[3] Water withdrawals up to permitted hatchery maximums may occur during the spring months, when fish are at their largest size prior to release and have their greatest rearing water needs. This period coincides with the time of the year when surface water flows are at their highest. Water needs for fish rearing are lowest in the late-summer and fall months, when juvenile fish are smallest in size, coinciding with summer low flow periods. For these reasons, removal of high proportions of total flows, up to maximum permitted levels, are unlikely.

Up to 50 percent of the water in the Wallace River and 100 percent of the water in May Creek may be temporarily diverted into Wallace River Hatchery to support Chinook and coho salmon hatchery programs (Table 5). Although minimum flow levels are unknown, seasonal withdrawal needs for the Eagle Creek program will not likely lead to substantial reductions in total flow in the 150 feet between the water intake and lowest rearing pond of the unnamed spring used as the hatchery supply. Up to 100 percent of the water in the East Fork and West Fork of Tulalip Creek is impounded for use in fish rearing for the Tulalip Hatchery and Tulalip Creek Ponds programs. Up to 100 percent of the flow in Battle Creek is also impounded for rearing chum salmon fry through the Tulalip Tribes' Battle Creek Pond program. The Everett Bay Net-Pen program uses seawater, passively supplied through tidal flow, for rearing coho salmon, and the amount

coursing through the net-pen is not detectable relative to the total amount of water in the Puget Sound. All hatchery facilities have current surface water rights (Ecology 2012).

The streams and wells at Tulalip Hatchery supplying surface water and groundwater to support the tribal summer Chinook, coho, and fall chum salmon programs are located on tribal Trust lands, and are therefore under the regulatory purview of the Tulalip Tribes regarding limits and permitted withdrawal levels.

### 3.2.2 Water Quality

The current salmon hatchery programs in the Snohomish River basin may impact several water quality parameters in the Snohomish River basin. The concentration of large numbers of fish within the hatcheries may produce effluent with ammonia, organic nitrogen, total phosphorus, biological oxygen demand, pH, and suspended solids (Sparrow 1981; Ecology 1989; Kendra 1991; Cripps 1995; Bergheim and Åsgård 1996; Michael 2003). Periodic chemical use within hatcheries could result in the release of antibiotics, fungicides, and disinfectants into receiving waters (Boxall et al. 2004; Pouliquen et al. 2008; Martinez-Bueno et al. 2009). Other chemicals and organisms that could potentially be released by the current hatchery operations in general are polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites (Missildine 2005; HSRG 2009), fish disease pathogens (HSRG 2005; HSRG 2009), steroid hormones (Kolodziej et al. 2004), anesthetics, pesticides, and herbicides.

The direct discharge of current salmon hatchery facility and marine net-pen effluent is regulated by the Environmental Protection Agency (EPA) under the Clean Water Act (33 U.S.C. 1251, 1977, as amended in 1987) through National Pollutant Discharge Elimination System (NPDES) permits (Subsection 1.6.1, Clean Water Act). For discharges from the hatcheries not located on Federal or tribal lands within Washington, the EPA has delegated its regulatory oversight to the State. The Washington Department of Ecology is responsible for issuing and enforcing NPDES permits that ensure water quality standards for surface and marine waters remain consistent with public health and enjoyment, and the propagation and protection of fish, shellfish, and wildlife (WAC 173-201A). The EPA administers NPDES permits for the Tulalip Tribes' projects located on tribal lands. NPDES permits are not needed for the current hatchery and net-pen facilities that release less than 20,000 pounds of fish per year or feed fish less than 5,000 pounds of fish feed per year. Additionally, the Tulalip Tribes may adopt their own water quality standards for permits for the hatchery facilities on their tribal lands (i.e., tribal wastewater plans).

All hatchery facilities currently used by the Snohomish River basin salmon hatchery programs are compliant with NPDES permits issued by WDOE or EPA, or do not require a NPDES permit (Table 5 and Table 6). All hatchery effluent at Wallace River Hatchery is passed through a pollution abatement pond to settle out any uneaten food and fish waste before being discharged into receiving waters (WDFW 2012). Effluent discharge from the Tulalip Tribes' hatchery programs is in compliance with the NPDES permit requirements under the Clean Water Act (Tulalip 2012).

As part of administering elements of the Clean Water Act, the Washington Department of Ecology is required to assess water quality in streams, rivers, and lakes. These assessments are published in what are referred to as the 305(d) report and the 303(d) list (the numbers referring to

the relevant sections of the original Clean Water Act text). The 305(d) report reviews the quality of all waters of the state, while the 303(d) list identifies specific water bodies considered impaired (based on a specific number of exceedances of state water quality criteria in a specific segment of a water body). The EPA reviewed and approved Washington Department of Ecology's 2008 303(d) list on January 29, 2009.

Table 6. NPDES permit compliance status by hatchery facility and applicable "Category 5" 303(d) listings in adjacent receiving waters.

| Hatchery Facility | NPDES Permit Compliant | Discharges Effluent into a 303(d) Listed Water Body[1] | Impaired Parameters | Cause of Impairment |
|---|---|---|---|---|
| Wallace River Hatchery | Yes | Yes (Wallace, Skykomish and Snohomish Rivers) | Temperature, dissolved oxygen, bacteria, 2,3,7,8-TCDD, & PCB. | Human development activities; industrial pollution |
| Eagle Creek Hatchery | N/A [2] | No | None | N/A |
| Tulalip Hatchery | Yes | No | None | N/A |
| Tulalip Creek Ponds | Yes | No | None | N/A |
| Battle Creek Pond | N/A [2] | No | None | N/A |
| Everett Bay Net-Pen | N/A [2] | No | None | N/A |

1/ Source: http://www.ecy.wa.gov/programs/wq/303d/currentassessmt.html - assessments for Snohomish County, WRIA 7.
2/ Not applicable because an NPDES permit is not required for hatchery or net-pen facilities that release less than 20,000 pounds of fish per year or apply less than 5,000 pounds of fish feed per year.

Within the analysis area, the Wallace River, Skykomish River and Snohomish River currently have water quality parameters that warrant inclusion under "category 5" on the 303(d) list for watersheds in Snohomish County. Activities within the analysis area that contribute to the degradation of water quality include human development (urban expansion, agricultural practices, and forest practices) and industrial activities.

### 3.3 Salmon and Steelhead

The current abundance, spatial structure, genetic and life history diversity, and productivity of natural-origin salmon and steelhead populations in the Snohomish River basin are all severely diminished relative to historical levels (Myers et al. 1998; SSPS 2005; Myers et al. 2015; Hard et al. 2015; NWFSC 2015). The relatively poor status of natural populations in the basin continues under current conditions.

For example, regarding listed fish populations, for ESA recovery planning purposes under the SSPS recovery plan (SSPS 2005), the equilibrium abundance target roughly reflecting the historic abundance potential for the Skykomish Chinook population is 17,000 fish, with a

planning range for abundance of 17,000 to 51,000 spawners (Ruckelshaus et al. 2002; SSPS 2005). Between 1997 and 2001, the Skykomish population averaged 1,853 natural-origin fish that returned to the river to spawn. The equilibrium abundance target for the other Chinook salmon population in the basin – Snoqualmie - is also 17,000 fish, and the planning range for abundance is 17,000 to 33,000 spawners (Ruckelshaus et al. 2002; SSPS 2005). The Snoqualmie Chinook population averaged 1,746 natural-origin fish during the 1997 through 2001. Both populations remain at these low abundance levels through the present. At current levels, the two populations are at approximately four percent of their estimated historical numbers. These escapement estimates do not include hatchery-origin Chinook salmon or other non-native natural-origin fish that return to natural spawning areas in the Skykomish basin, or stray into Snoqualmie River areas. When hatchery-origin fish are included, the abundances increase to 3,853 fish for the Skykomish population and 2,034 naturally-spawning Chinook in the Snoqualmie basin for the same period.

Steelhead counts in the Snohomish River basin have declined since the 1980s. The recent five-year (2005-2009) geometric mean escapement for Snohomish River basin natural-origin winter-run steelhead is 4,573 fish (range 500 to 41,865 fish) (Ford et al. 2011). This compares to an historical population based on harvests recorded for Snohomish County in the late 1800s and early 1900s that were indicative of runs over 100,000 winter-run fish (Myers et al. 2015). Based on a basin area size of 2,185 $km^2$, the Puget Sound Steelhead Technical Recovery Team estimated that the intrinsic productivity of Snohomish River basin suggests a run size of approximately 21,389 to 42,779 winter-run steelhead (Myers et al. 2015). The natural-origin winter-run steelhead population in the watershed has a decreasing recent year (1997-2005) abundance trend (0.961) (Ford et al. 2011), and below the population replacement level. The estimated probability that this steelhead population would decline to 10 percent of its current estimated abundance (i.e., to 445 fish) is moderately high—about 50 percent within 100 years.

Census data regarding the total number of bull trout in the Snohomish River basin is unavailable, though USFWS estimates that only one migratory population has greater than 100 individuals, and the total population may range from 500 to 1,000 fish, based on current habitat capacity (USFWS 2004). Data collected at the Sunset Falls Fishway for the South Fork Skykomish River bull trout component in the Basin indicates a recent year (2000-2011) annual average bull trout adult return of 80 fish (WDFW 2013a). The recovered abundance level for bull trout in the Snohomish River watershed has been set at 500 adult spawners, based on current habitat capacity (USFWS 2004). Haring (2002) reported that the Snohomish River watershed remains one of the primary producers of bull trout in the Puget Sound region, and (citing WDFW and WWTT 2004) the species is considered healthy in status.

Under baseline conditions, the salmon hatchery programs may potentially affect natural-origin salmon and steelhead populations and their habitat in the Snohomish River basin through genetic risks, competition, predation, fish disease transfer, and facility effects. Population status masking effects are unlikely to occur, as all fish released through the programs are marked, and would continue to be marked, to identify their hatchery origin. Incidental fishing effects associated with harvest of salmon produced through the program were reviewed through separate consultations by NMFS and determined to have no substantial adverse effects on listed natural fish populations (NMFS 2016). The hatchery programs may benefit natural-origin salmon and

steelhead population viability in the action area by: preserving and increasing abundance and spatial structure; retaining genetic diversity; increasing productivity of a natural-origin population if natural-origin fish abundance is low enough that they are having difficulty finding mates, or when supplementation fish are reintroduced into more productive habitats; and through marine-derived nutrient cycling. Each of these potential hatchery-related effects are briefly described in Table 7. Any effects - positive, neutral, or negative - depend on the design of hatchery programs, the condition of the habitat, and the current status of the species, among other factors.

NMFS' Draft Environmental Impact Statement on Two Joint State and Tribal Resource Management Plans for Puget Sound Salmon and Steelhead Hatchery Programs (DEIS - NMFS 2014) analyzes and discloses Snohomish River basin salmon hatchery effects under baseline conditions on salmon in the action area, with a focus on ESA-listed Chinook salmon and steelhead (NMFS 2014). Detailed evaluations of the risks and benefits of the six Snohomish River basin salmon programs identified in Table 7 are included in the DEIS.

As described in the DEIS (NMFS 2014), under baseline conditions, salmon produced by the hatchery salmon programs could affect the genetic diversity and fitness of natural Chinook, coho, and fall chum salmon in the action area if the hatchery fish stray into natural fish spawning areas. Although the current understanding of the genetic effects of hatchery fish spawning with their natural-origin counterparts is evolving, it appears that hatchery rearing can have a substantial genetic effect on fitness. The occurrence and magnitude of effects are dependent on species, broodstock source, degree of natural influence by the local population, the number of generations and length of time per generation the fish are exposed to the artificial rearing environment, and the strength of selection in that environment for maladaptive traits. After release, factors bearing on fitness include relative effective population size and number of effective migrants per generation, and the degree of deleterious gene flow between hatchery- and natural-origin fish that could potentially lead to long-term reductions in reproductive success or fitness loss. However, the data are insufficient to determine the magnitude and duration of genetic diversity effects and fitness loss in any particular situation. Recently, studies of hatchery supplementation have also documented demographic benefits to natural production from hatchery fish spawning in the wild (Anderson et al. 2012; Berejikian et al. 2008; Hess et al. 2012). On balance, the benefits of artificial propagation for reducing extinction risk and for rebuilding severely depressed fish populations may outweigh the possibility of short-term fitness loss.

Hatchery-related genetic risks to the Skykomish Chinook salmon population assigned in the NMFS DEIS for the Wallace River Hatchery Chinook salmon program are low, because the "All H Analyzer (AHA)" model-derived "Proportionate Natural Influence" (PNI) estimate for the program of 0.77 (derived from demographic, rather than genetic data) is greater than the 0.67 level recommended by the HSRG as the standard to indicate an appropriately operated integrated hatchery salmon program associated with a "primary" population (NMFS 2014, citing ICF International 2010). The estimated average annual proportion of the total number of naturally spawning Chinook salmon in the Skykomish River watershed originating from Wallace River Hatchery (pHOS) is 12 percent. In addition, a low risk was assigned for the Wallace River

Table 7. General mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations

| Effect Category | Description of Effect |
|---|---|
| Genetic risks | Interbreeding with hatchery-origin fish can change the genetic character of the local salmon or steelhead populations.<br>Interbreeding with hatchery-origin fish may reduce the reproductive performance of the local salmon or steelhead populations. |
| Competition and predation | Hatchery-origin fish can increase competition for food and space.<br>Hatchery-origin fish can increase predation on natural-origin salmon and steelhead. |
| Facility effects | Hatchery facilities can reduce water quantity or quality in adjacent streams through water withdrawal and discharge.<br>Weirs for broodstock collection or to control the number of hatchery-origin fish on the spawning grounds can have the following unintentional consequences:<br>Isolation of formerly connected populations<br>Limiting or slowing movement of migrating fish species, which may enable poaching or increase predation<br>Alteration of stream flow<br>Alteration of streambed and riparian habitat<br>Alteration of the distribution of spawning within a population<br>Increased mortality or stress due to capture and handling<br>Impingement of downstream migrating fish<br>Forced downstream spawning by fish that do not pass through the weir<br>Increased straying due to either trapping adults that were not intending to spawn above the weir, or displacing adults into other tributaries |
| Masking | Hatchery-origin fish can increase the difficulty in determining the status of the natural-origin component of a salmon or steelhead population. |
| Incidental fishing effects | Fisheries targeting hatchery-origin fish have incidental impacts on natural-origin fish. |
| Disease transfer | Concentrating salmon and steelhead for rearing in a hatchery facility can lead to an increased risk of amplifying the incidence of infectious fish disease pathogens. When hatchery-origin fish are released from the hatchery facilities, they may increase the disease risk to natural-origin salmon and steelhead. |

| Effect Category | Description of Effect |
|---|---|
| Population Viability benefits | Abundance: Preservation of, and possible increases in, the abundance of a natural-origin fish population resulting from implementation of a hatchery program.<br>Spatial Structure: Preservation or expansion of the spatial structure of a natural-origin fish population resulting from implementation of a hatchery program.<br>Genetic diversity: Retention of within-population genetic diversity of a natural-origin fish population resulting from implementation of a hatchery program.<br>Productivity: Hatchery programs could increase the productivity of a natural-origin population if naturally spawning hatchery-origin fish match natural-origin fish in reproductive fitness and when the natural-origin population's abundance is low enough to limit natural-origin productivity (i.e., they are having difficulty finding mates) or spawning in degraded habitat), or when hatchery fish are reintroduced into more productive habitat. |
| Nutrient cycling | Returning hatchery-origin adults can increase the quantity of marine-derived nutrients in freshwater systems. |

Hatchery Chinook salmon program because there is a high adherence to best management practices (BMPs) for broodstock collection and mating (NMFS 2014). Genetic risks for the Tulalip Tribes' Bernie Kai-Kai Gobin Salmon Hatchery integrated Chinook salmon program were also determined to be low in the DEIS because the PNI for the program of 0.77 (again, derived from demographic, rather than genetic data) is above the 0.67 HSRG-recommended level, and the program would incorporate native, natural-origin Wallace River (Skykomish stock) fish into the hatchery broodstock (NMFS 2014).

In recent years (2006-2014), natural-origin Chinook salmon have been observed through spawning ground surveys to be a sizeable fraction of the total spawning abundance, averaging 74.5 percent (Tulalip 2012; Tulalip Tribes, unpublished data 2016). The average hatchery-origin fraction of the naturally spawning Skykomish Chinook salmon population over this period was 27.8 percent. However, about 58 percent of the total number of hatchery-origin Chinook salmon observed on natural spawning grounds in the Skykomish River watershed were in the Wallace River, where hatchery Chinook salmon produced by Wallace River Hatchery homed to their release site. Under the current baseline, the estimated pHOS for the Skykomish River watershed excluding the Wallace River therefore remains 12 percent. The current PNI objectives for the Wallace River Hatchery Chinook salmon program, based on demographic (carcass count) rather than gene flow data to indicate the effective number of hatchery-origin spawners in natural spawning areas, are 0.50 on the short term and 0.7 over the longer term (WDFW 2013a). Based on demographic data-based estimates of the proportion of hatchery-origin fish spawning naturally, and considering natural-origin Chinook salmon broodstock incorporation levels that attenuate observed pHOS levels, the average PNI for the program from 2006 through 2013 was

0.57 for the total Skykomish population, and remains at 0.70 for the population excluding the Wallace River.

With regards to the other Chinook salmon population in the action area, no hatchery programs propagate Snoqualmie Chinook salmon. Hatchery-induced selection risks would therefore not be posed by any hatchery program under the alternatives, and there are no PNI results from the AHA Model for the Snoqualmie Chinook salmon population. However, Chinook salmon adults originating from the Wallace River Hatchery and Bernie Kai-Kai Gobin Salmon Hatchery programs may stray into natural-origin Chinook salmon spawning areas in the Snoqualmie River watershed in substantial numbers (Rawson et al. 2001). Rawson et al (2001) reported results from sampling of Snohomish River watershed natural-origin Chinook salmon escapement in 1999 indicating that 14 percent of 119 (pHOS = 12 percent) adult fish sampled in the Snoqualmie River and 26 percent of 98 (pHOS = 27 percent) fish sampled in Tokul Creek (a Snoqualmie River tributary) were otolith-marked hatchery-origin fall-run Chinook salmon. The hatchery-origin fraction of the naturally spawning Snoqualmie Chinook salmon population has largely remained consistent over the last 17 years. A moderate increase was observed in recent years (20.4 percent from 2005-2014) relative to the 1997-2001 average of 15.6 percent (Tulalip 2012; Tulalip Tribes, unpublished data 2016). This increase can be attributed to lower numbers of natural-origin spawners in recent years, as the actual number of hatchery-origin spawners declined by 1.7 percent for the period 2006-2014 relative to the 1997-2001 period. The recent year (2005 - 2013) average proportion of Tulalip Hatchery-origin fish observed in natural spawning areas within the Snoqualmie River watershed was 4.4 percent of the total naturally spawning population. Although genetic introgression levels resulting from hatchery Chinook salmon straying are unknown, available stray rate information based on survey counts of adults indicates the overall genetic risk level posed by the two Chinook salmon hatchery programs is likely moderate (medium) for the Snoqualmie Chinook salmon population (NMFS 2014).

The hatchery programs for coho salmon in the action area may pose genetic risks from straying and interbreeding with natural-origin coho salmon. Although data are unavailable with regards to the proportion of hatchery fish spawning naturally, coho salmon produced through the Wallace River Hatchery and Eagle Creek Hatchery may affect natural coho salmon in the Snohomish River watershed at levels similar to those described above for Chinook salmon. Because natural-origin coho salmon are incorporated as broodstock at Wallace River Hatchery, and considering lower juvenile coho salmon release levels relative to Chinook salmon release levels at the hatchery, it is likely that the estimated PNI for the coho salmon program is similar to the Wallace River Hatchery Chinook salmon program (0.77). Further, the estimated pHOS for the coho program at Wallace River Hatchery is likely to be similarly low, at or below the 12 percent estimated based on demographic data for the Chinook salmon program at the hatchery. Because of their release locations, and high harvest rates applied in Tulalip Bay fisheries, coho and fall chum salmon released through the Tulalip Bay programs, and coho salmon released through the Everett Bay Net Pen program, are unlikely to stray at substantial rates into areas in the Snohomish River watershed where natural populations of the species spawn. Genetic effects on natural coho and fall chum salmon associated with these programs are likely negligible under current conditions. Because of species differences, no genetic effects are likely for other salmon species (steelhead, pink salmon and sockeye salmon) not under propagation through the hatchery salmon programs reviewed in this EA.

Hatchery salmon production occurring under the current baseline in the action area has the potential to affect natural-origin fish through competition. Risks are low for the Wallace River Hatchery programs (including Eagle Creek Hatchery) because of the relatively short duration the hatchery fish interact with natural fish as the hatchery smolts emigrate seaward, release timing for hatchery subyearling Chinook salmon that separates the fish from their earlier migrating natural counterparts, and differences in diet preferences between larger hatchery yearling Chinook and coho salmon and smaller natural-origin fish, including chum and pink salmon. The relatively large size of the hatchery yearlings released through these programs, and the release locations in the upper watershed are risk factors regarding potential competition with similarly sized natural-origin steelhead smolts emigrating at the same time, downstream of the hatchery release sites (NMFS 2014). There may be a niche separation between Chinook salmon and steelhead due to food preference and river out-migration area differences that limit competition risks for these hatchery release types. Also, while the release of the hatchery fish as yearling smolts that out-migrate relatively rapidly seaward may attenuate competition effects. However, considering the Chinook salmon yearling release magnitude and location, the competition risk posed by the Wallace River Hatchery Chinook and coho salmon and Eagle Creek Hatchery coho yearlings to natural-origin steelhead is high (NMFS 2014). Competition risks for Chinook and coho salmon released from the Tulalip Hatchery programs are negligible because the hatchery fish are released into tributaries to Tulalip Bay that lack natural salmon and steelhead populations. Competition effects from the Tulalip tribal hatchery fall chum salmon program and the Everett Bay Net Pen Coho Salmon hatchery program are also negligible. Because of their small size at release, and due to differences in migration behavior and diet preferences, fall chum salmon fry produced by the Tulalip program pose negligible risks of competition to natural fish species. The relatively small number of coho salmon smolts produced by the Everett Bay Net Pen program are released directly into seawater, where the fish disperse into pelagic waters. The program has negligible competition effects on any fish species. Practices are applied in all of the current salmon hatchery programs (i.e., fish size, location, and timing of releases; release of smolts only) that are designed to limit opportunities for co-occurrence and interaction between hatchery-origin fish and migrating natural-origin fish, reducing the potential for adverse effects from predation.

Hatchery salmon production in the Snohomish River basin may also affect natural fish populations through predation. From the DEIS (NMFS 2014), a moderate risk of predation is assigned for releases of Wallace River Hatchery Chinook salmon subyearlings and yearlings because the relative individual size of both the subyearlings and the yearlings are large compared to the natural-origin Chinook salmon that the hatchery-origin fish may encounter after release in the watershed. Similar effects are likely for predation on natural chum and pink salmon fry.

Under current conditions, there is a low risk of predation from Wallace River Hatchery and Eagle Creek Hatchery coho salmon, because the natural-origin Skykomish Chinook salmon population is relatively large (averaging 1.15 million juvenile out-migrants per year compared to the combined number of hatchery coho salmon released (204,000 fish)), lessening the potential that a substantial proportion of the natural Chinook salmon are consumed. These effects on coho salmon are likely similar for natural chum and pink salmon. Predation risks for Chinook and coho salmon released from the Tulalip Hatchery programs are negligible because the hatchery

fish are released into tributaries to Tulalip Bay that lack natural salmon and steelhead populations. Chinook and coho salmon yearlings released from the Tulalip and Wallace River hatchery programs could prey on juvenile natural fish in nearshore marine areas where they co-occur, and before the hatchery fish disperse seaward to an unknown extent. Predation effects from the Tulalip tribal hatchery fall chum salmon program and the Everett Bay Net Pen Coho Salmon hatchery program are also negligible. Because of their small size at release, and zooplankton rather than fish diet preferences, fall chum salmon fry produced by the Tulalip program pose negligible risks of predation to natural fish species. Coho salmon smolts produced by the Everett Bay Net Pen program are released directly into seawater, and have no freshwater ecological effects on any fish species. Practices are applied in all of the current salmon hatchery programs (i.e., fish size, location, and timing of releases; release of smolts only) that are designed to limit opportunities for co-occurrence and interaction between hatchery-origin fish and migrating natural-origin fish, reducing the potential for adverse effects from predation.

Regarding fish disease and fish disease pathogen transfer risks, compliance with applicable protocols for fish health as applied under the baseline for all of the hatchery salmon programs effectively minimize this risk so that any effects are negligible.

Under current conditions, facilities operated by the Wallace River Hatchery program could adversely affect migrating and rearing natural salmon in the Wallace River as a result of hatchery facilities (weirs) used to collect broodstock, and through hatchery operation effects on water quality and water withdrawal. The NMFS DEIS assigned a moderate (medium) risk of adverse effects from hatchery facilities and operation on Skykomish Chinook salmon and (because the facility is removed from the Snoqualmie River), a negligible risk to Snoqualmie Chinook salmon. Weirs used at the hatchery are operated seasonally, and natural salmon not needed for spawning are passed upstream to spawn naturally. The freshwater streams where the Tulalip and Eagle Creek Hatchery programs operate do not harbor natural fish populations, so any facility effects on natural fish are undetectable. The Everett Bay Net Pen program is located in marine waters and relies on tidal flow for fish rearing. Facility effects on natural fish populations are undetectable at that location.

Turning to potential population viability benefits, the NMFS DEIS assigned low to negligible benefits to natural Chinook salmon associated with operation of the WDFW and Tulalip tribal hatchery programs, respectively, for the species (NMFS 2014). The proposed salmon hatchery programs operate for integrated harvest purposes, using native or localized adult fish as broodstock. Chinook salmon produced by the two programs propagating that species are not genetically diverged from the donor native Skykomish River Chinook salmon population. Natural spawning by adult fish that stray into the Skykomish River could benefit the viability status of the Skykomish River Chinook salmon natural population. The current Wallace River Hatchery Chinook salmon program may accelerate recovery of the salmon species or populations under propagation to a low extent by increasing abundance faster than may occur naturally. The hatchery program may also create genetic reserves for the associated natural populations to reduce the risk that unique traits are lost due to poor natural productivity conditions or catastrophes. The Wallace River Hatchery program, simply by virtue of creating more fish, can increase effective breeding population sizes to low extents. Because there is no natural Chinook salmon population in Tulalip Creek, the Bernie Kai-Kai Gobin Hatchery Chinook salmon

program would provide negligible benefits to any Chinook salmon population in the action area. Similar viability benefit could be imparted by the programs in the Skykomish River watershed propagating coho salmon (Wallace River Hatchery and Eagle Creek Hatchery), as the fish reared through the programs are derived from coho salmon native to the watershed. River basin. Viability benefits associated with the Tulalip and Everett Bay programs are likely negligible, because adult fish produced through the programs do not return and stray at substantial levels into areas where natural coho salmon production occurs. Fall chum salmon produced by the Tulalip Tribes are not native to the action area, and impart no viability benefits to native natural chum salmon if the hatchery fish stray into the Snohomish River watershed where natural chum salmon spawning occurs.

NMFS has identified one salmon ESU (Puget Sound Chinook Salmon) and one steelhead DPS (Puget Sound Steelhead) in the analysis area that require protection under the ESA and that may be affected by current salmon hatchery programs under baseline conditions (70 FR 37160, June 28, 2005; 72 FR 26722, May 11, 2007). Salmon production under current hatchery operations may also affect three additional non-listed anadromous salmon species in the analysis area (fall chum salmon, pink salmon, and coho salmon). The degree to which the current salmon hatchery programs interact with each of these salmon species under baseline conditions is described below.

### 3.3.1 Puget Sound Chinook Salmon (ESA-listed)

The Snohomish River watershed harbors two Chinook salmon populations that are among the 22 independent populations of Chinook salmon delineated by NMFS as part of the Puget Sound Chinook salmon ESU (Ruckelshaus et al. 2006). The two populations – Skykomish and Snoqualmie – are grouped with eight other independent populations in the Whidbey biogeographical region for Puget Sound Chinook salmon ESU recovery planning purposes (SSPS 2005; NMFS 2007). Under NMFS recovery and delisting criteria for the listed ESU, two or more populations within the biogeographical region need to be recovered to a low extinction risk status for the ESU to be considered recovered and delisted (NMFS 2007). Hatchery-origin Chinook salmon produced through the Tulalip Hatchery program (Tulalip 2012) and the Wallace River Hatchery program (WDFW 2013a) are included with the natural-origin component of the Skykomish Chinook salmon population as part of the ESA-listed ESU (70 FR 37160, June 28, 2005). The Snoqualmie population has no associated hatchery-origin component. The Skykomish population includes summer-timed fish spawning in the Snohomish River mainstem, the mainstem of the Skykomish, Pilchuck, Wallace, and Sultan rivers; Woods, Elwell, Olney, Proctor, and Bridal Veil creeks; and the North and South Forks of the Skykomish River. Since the 1950s, the spawning distribution of the Skykomish Chinook salmon population appears to have shifted upstream. Since that time, a much larger proportion of fish spawn higher in the drainage, between Sultan and the North and South Forks of the Skykomish River, than in previous decades (Snohomish Basin Salmonid Recovery Technical Committee [SBSRTC] 1999). Adult fish return to the Skykomish River watershed beginning in May and extending through July. Age at return data collected for return years 1996 through 2011 indicate that adults predominately return as four-year-old fish (60 percent), although two (2 percent), three (15 percent), and five year olds (23 percent) can make up substantial proportions of total returns in some years (Hall and Holmgren 2014). Spawning in the watershed occurs primarily in September. Scale analysis shows that a large proportion of the returning, natural origin adult

Chinook population exhibits a river type (yearling) life history. From 1996 through 2011, yearling Chinook salmon contributed to an annual average of 24 percent of the natural-origin returning adults in both the Skykomish and Snoqualmie populations (Mike Crewson [Tulalip Tribes] and Pete Verhey [WDFW], unpublished escapement data, 2014). The remainder of the fish exhibit an ocean-type life history trajectory, with juveniles emigrating seaward in March through June as fry, fingerlings, or sub-yearling smolts after just a few months of rearing in the watershed. Kubo et al. (2013) reported that from 2000 through 2012, natural origin subyearling Chinook salmon generally exhibited bimodal peaks, with the first peak in late-March through April and the second from late-May to early-June. Juvenile outmigrant trapping from 2001 through 2011 indicated that 1 to 10 percent of emigrating natural-origin juvenile Skykomish Chinook salmon captured at the rotary trap were yearlings (6 percent annual average) and 90 to 99 percent were subyearlings (Kubo et al. 2013). The proportions of Chinook salmon in the Skykomish population emigrating as yearlings may be higher than reported, as the capability of the rotary screw trap to catch larger fish is lower than for smaller fish (fry), especially when the river is clear and flows are low.

The Snoqualmie population is considered a fall-run stock, spawning in the Snoqualmie River and its larger tributaries, including the Tolt and Raging Rivers, and Tokul Creek. Adult fish enter the river in late summer and early fall, and spawning occurs from mid-September through October. Spawning can extend through November on the Snoqualmie River in some years (PSIT and WDFW 2010a). Age class at adult return data collected for return years 1996 through 2011 indicate that adults predominately return as four-year-old fish (60 percent), although two (2 percent), three (17 percent), and five year olds (21 percent) can make up substantial proportions of total returns in some years (Hall and Holmgren 2014). Snoqualmie Chinook salmon are considered an ocean-type fall-run stock, as the majority of juvenile fish emigrate seaward as subyearlings, although a relatively large proportion of smolts collected through smolt trapping are yearling migrants in some years. In 1993 and 1994, 25 percent to 30 percent of the total number of returning Snoqualmie Chinook adult salmon sampled originated from yearling emigrants. More recent data collected from 2001 through 2011 indicated that 2 to 46 percent of emigrating natural origin juvenile Skykomish Chinook salmon were yearlings (26 percent annual average) and 54 to 98 percent were subyearlings (Kubo et al. 2013). These fluctuations in the proportion of yearlings observed emigrating seaward may be an artifact of increased efficiency of the rotary screw trap in capturing larger fish in some years relative to others, perhaps due to varying river conditions. Natural origin subyearling Chinook salmon juveniles emigrate seaward over an extended period (February through June), with bimodal peaks, one in early-March and the other occurring from May through early-June. Recent juvenile trapping and adult scale analysis data indicate that approximately 26 percent of the juvenile production is composed of yearlings and 22 percent of the adult returns were yearlings for the Snoqualmie population, whereas yearlings made up 6 percent of the juvenile emigrants and 24 percent of the adult returns for the Skykomish population.

Abundance of Snohomish River basin Chinook salmon is a fraction of historical levels (SSPS 2005) (Figure 3 and Figure 4). As noted above, the upper limits for equilibrium abundance

levels[3] for the Skykomish and Snoqualmie populations are 51,000 and 33,000 fish, respectively (84,000 fish total) (Ruckelshaus et al. 2002). Between 1997 and 2014, the average total annual natural Chinook salmon escapement for the Skykomish and Snoqualmie populations were 3,676 and 1,795 fish, respectively (data from PSIT and WDFW 2010a; Tulalip 2012; Tulalip Tribes, unpublished data 2014). Between 1997 and 2014, the average total annual natural-origin Chinook escapements for the Skykomish and Snoqualmie populations for the years for which data were available were 2,145 and 1,353 fish, respectively (data from PSIT and WDFW 2010a; Tulalip 2012; Tulalip Tribes, unpublished data 2014). Therefore, current total natural-origin Chinook salmon abundances for the two populations are 4.2 percent and 4.1 percent of total respective historical equilibrium abundances for the Skykomish and Snoqualmie populations, or 4.2 percent of the 84,000 fish combined (total) upper level of equilibrium abundance for the basin.

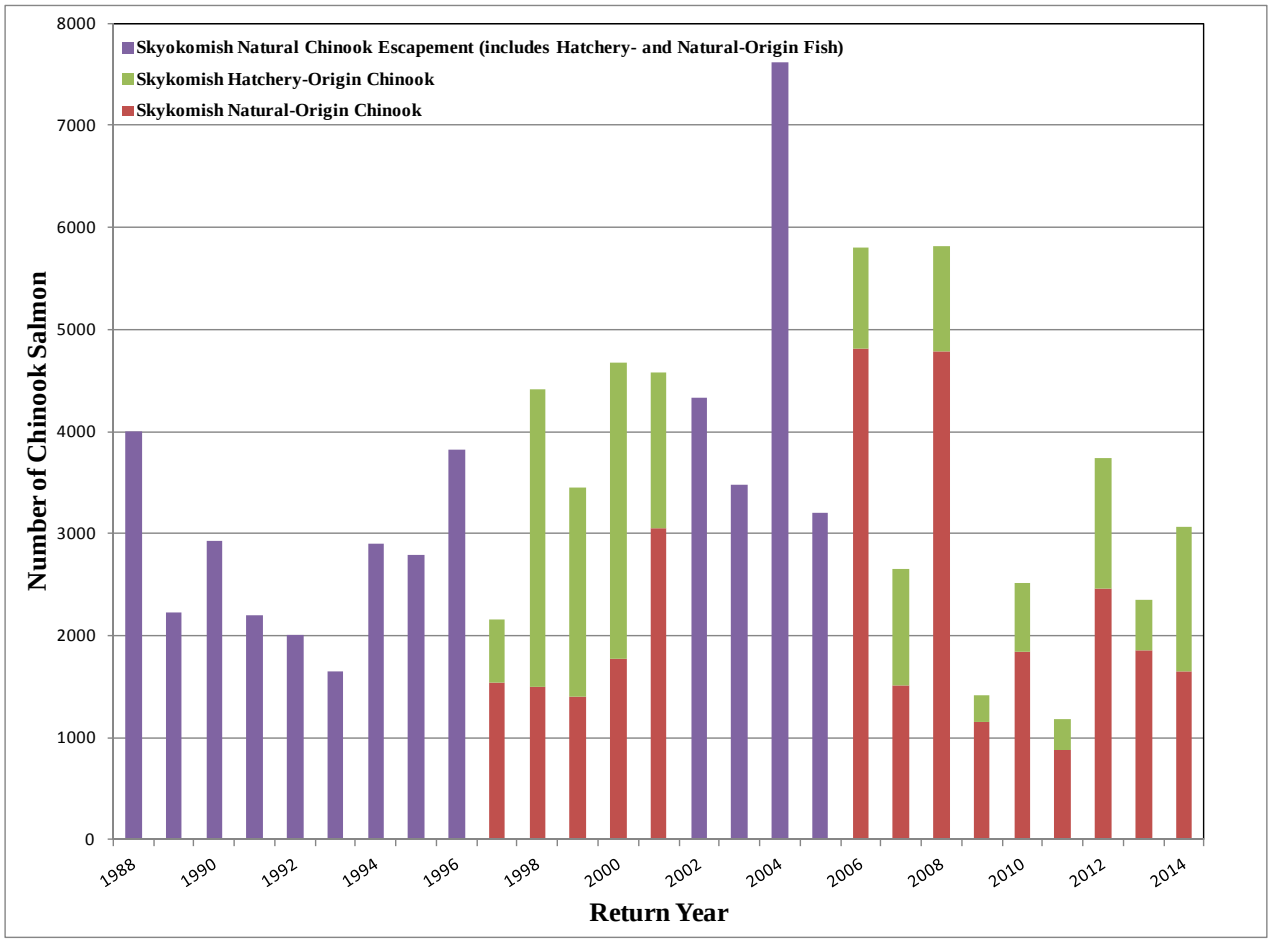


Figure 3. Estimated annual natural Chinook salmon escapement abundances in the Skykomish River for 1988 through 2014. Natural- and hatchery-origin breakouts are included for years where data are available. Source Tulalip 2012; Mike Crewson and Pete Verhey, Tulalip Tribes and WDFW unpublished escapement data 2016.

[3] "Equilibrium abundance" is the estimated upper abundance of naturally spawning salmon that would have maximized use of available historical habitat at replacement levels (i.e., productivity $\geq$ 1.0) (NMFS 2011). The minimum number for each population is 17,000 fish.

Skykomish hatchery-origin Chinook salmon returning to natural spawning areas are not included as part of natural-origin fish spawning escapement estimates. Naturally produced Chinook salmon make up a sizeable fraction of the spawning abundance, averaging 72.2 percent for the basin in recent years (2006-2014), compared with an average of 50 percent from 1997 to 2001 (Tulalip 2012; Tulalip Tribes, unpublished data 2014). The average hatchery-origin fraction of the naturally spawning Skykomish Chinook salmon population in the most recent eight years (2006-2014; 27.8 percent) has decreased by nearly half from the level 15 years ago, when the five-year (1997-2001) average was 50 percent. Approximately 58 percent of the total number of hatchery-origin Chinook salmon observed on natural spawning grounds in the Skykomish River watershed were in the Wallace River (1997-2014 for years with available data).

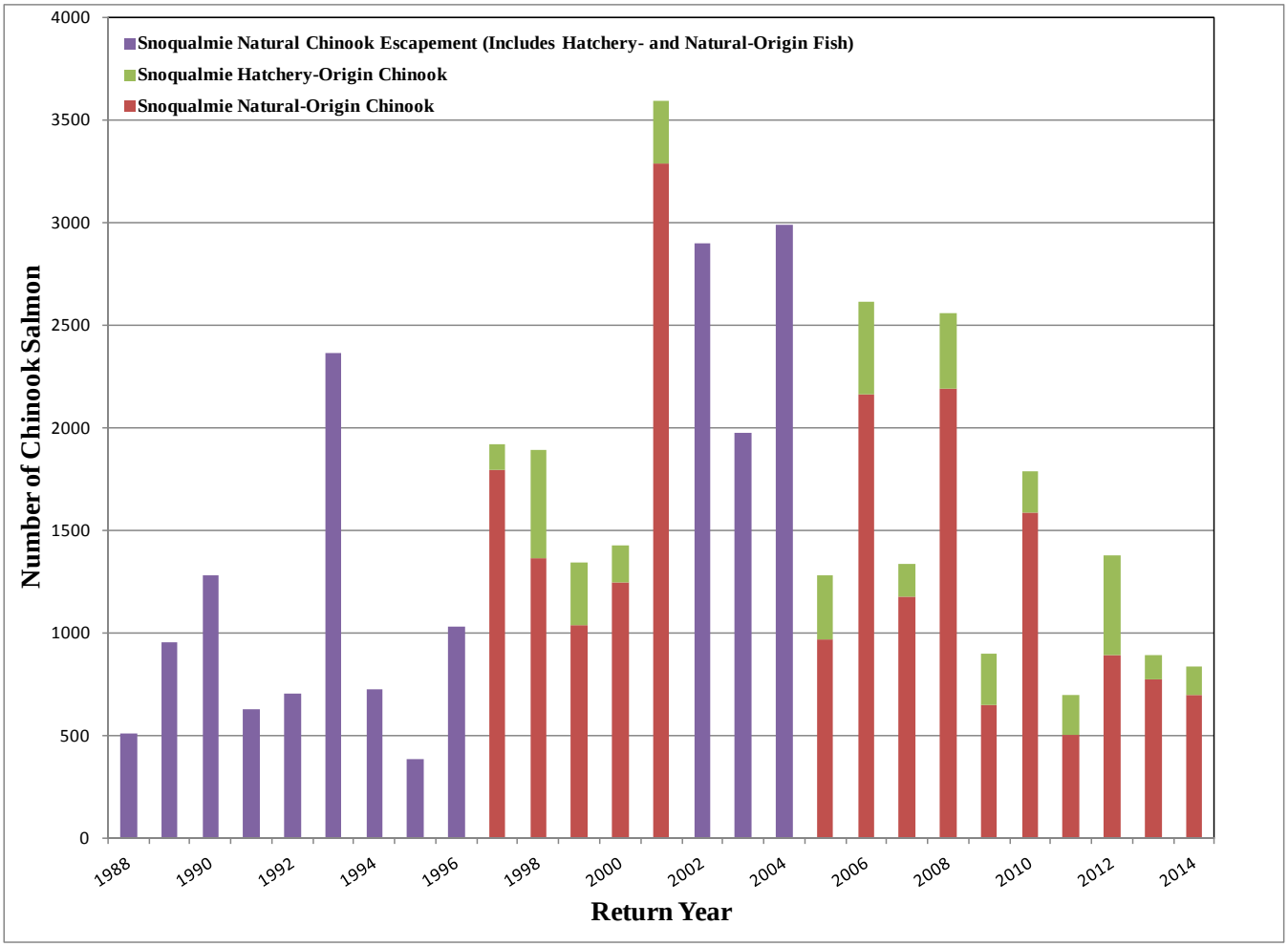


Figure 4. Estimated annual natural Chinook salmon escapement abundances in the Snoqualmie River for 1988 through 2014. Natural- and hatchery-origin breakouts are included for years where data are available. Source Tulalip 2012; Mike Crewson and Pete Verhey, Tulalip Tribes and WDFW unpublished escapement data 2016.

In the Snoqualmie River, the hatchery-origin fraction of all naturally spawning Snoqualmie Chinook salmon has largely remained consistent over the last 17 years. A moderate increase was observed in recent years (20.4 percent from 2005-2014) relative to the 1997-2001 average of 15.6 percent (Tulalip 2012; Tulalip Tribes, unpublished data 2014). This increase can be

attributed to declines in natural origin spawners in recent years; as the actual number of hatchery-origin spawners declined by 1.7 percent for the period 2006-2014 relative to the 1997-2001 period. The proportion of Tulalip Hatchery-origin fish on the natural spawning grounds has declined markedly in recent years. During the period from 1997-2001, the co-managers estimated that 80.1 percent of the hatchery-origin Chinook on the natural spawning grounds in the Snoqualmie River were from the Tulalip Hatchery, but from 2005 through 2013 only 4.4 percent of the hatchery-origin Chinook were from the Tulalip Hatchery (Tulalip Tribes, unpublished data 2014).

Spatial structure for the Skykomish and Snoqualmie populations has been adversely affected through habitat loss and degradation in the basin. Bank protection and diking of the river and major tributaries, have disconnected the river channels from their floodplains, leading to loss of accessible river areas and habitat complexity for rearing and migrating Chinook salmon. Lack of adequate in-channel large woody debris relative to historical conditions has decreased the amount of rearing and refuge areas for juvenile Chinook salmon. Chinook salmon habitat has been further reduced by the loss of wetlands through draining and land conversion. Road construction, commercial and residential construction, and bank hardening for flood control have also impaired Chinook salmon habitat use and access and population spatial structure. Artificial barriers scattered through the basin, including dams, tide gates, water diversions, culverts, and pumping stations) prevent juvenile Chinook salmon from reaching rearing habitat to the further detriment of population spatial structure.

Genetic and life history diversity of the Snohomish River basin Chinook salmon populations is believed to have been substantially reduced by anthropogenic activities over the last century, and is further threatened by on-going developmental actions in the watershed (SSPS 2005). Lost and degraded estuarine habitat has impaired the fry migrant components of the Skykomish and Snoqualmie populations, which need a properly functioning, braided lower river and brackish water environment to grow to a viable smolt size. Fry migrants represent a particularly important component of the life history diversity for both Chinook populations in the Snohomish basin. Additionally, as a summer-run population, the Skykomish population is particularly important for maintaining life history diversity among populations. Evidence suggests that the Puget Sound Chinook Salmon ESU has lost 15 spawning aggregations that were either demographically independent historical populations or major components of the life history diversity of the remaining 22 extant independent historical populations identified (Ruckelshaus et al. 2006). Nine of the 15 putatively extinct spawning aggregations were thought to be spring or summer-run type Chinook salmon. The disproportionate loss of early-run life history diversity, as portrayed by the extant Skykomish population, represents a particularly important loss of the evolutionary legacy of the historical ESU. The substantially reduced abundance of the Skykomish summer-run population relative to historical levels represents a risk to remaining ESU diversity. The extent to which hatchery practices have affected diversity of the two native Chinook salmon populations in the basin is unknown. Hatchery-related risks to diversity resulting from interbreeding between hatchery and natural salmon include reduction in the genetic character of the natural Chinook salmon populations.

Recent productivity estimates for the Skykomish and Snoqualmie populations derived by the Tulalip Tribes, as measured by recruit per spawner and spawner to spawner rates, are shown in

Table 8. The extent to which hatchery practices have affected productivity of the two native Chinook salmon populations in the basin is unknown. Hatchery-related risks to natural Chinook population productivity resulting from interbreeding between hatchery and natural salmon include reduced reproductive fitness.

Table 8. Recent productivity estimates for Skykomish and Snoqualmie Chinook salmon populations (source: Rawson and Crewson 2014).

| Brood Year (BY) | Skykomish Population Recruits per Natural Spawner (based on observed annual average age distribution) | Skykomish Population Recruits per Natural Spawner (based on observed annual age distribution) | Snoqualmie Population Recruits per Natural Spawner (based on observed annual average age distribution) | Snoqualmie Population Recruits per Natural Spawner (based on observed annual age distribution) |
|---|---|---|---|---|
| 1995 | 0.79 | 0.54 | 3.09 | 2.09 |
| 1996 | 0.67 | 0.63 | 2.02 | 2.06 |
| 1997 | 1.71 | 2.33 | 1.59 | 2.24 |
| Missing Data | | | | |
| 2000 | 1.76 | 2.09 | 2.49 | 2.80 |
| 2001 | 1.39 | 0.83 | 0.67 | 0.42 |
| 2002 | 1.57 | 1.38 | 1.04 | 1.27 |
| 2003 | 1.29 | 0.70 | 1.16 | 0.66 |
| 2004 | 0.81 | 1.11 | 0.93 | 1.17 |
| 2005 | 0.79 | 0.94 | 1.11 | 1.32 |
| 2006 | 0.41 | 0.28 | 0.61 | 0.53 |
| **1995-1997 Average** | **1.05** | **1.17** | **2.23** | **2.13** |
| **2000-2006 Average** | **1.15** | **1.05** | **1.14** | **1.17** |

During the summer and fall months, hatchery-origin Chinook salmon produced through the WDFW and Tulalip Tribal programs are subject to directed harvest in terminal area Tulalip net fisheries in marine waters, and recreational fisheries in marine waters, the Snohomish River, and the Skykomish River. The Tulalip Terminal Area Fishery (Commercial Area 8D, or for recreational fisheries, the Tulalip Bay "bubble" area) is the primary terminal marine area where hatchery-origin Chinook salmon produced through the Tulalip program are harvested, with an annual average of 5,749 fish harvested in tribal net fisheries (1988-2011) and 1,145 fish harvested in recreational fisheries (1994-2010) (Tulalip 2012). There is currently no fishery (tribal, commercial or recreational) that targets natural origin Skykomish or Snoqualmie Chinook salmon. However, although impacts are limited to certain time, gear, and area fisheries, natural origin Chinook salmon are harvested or impacted incidentally in fisheries directed at hatchery origin Chinook and coho salmon. Harvest of basin-origin natural and hatchery-origin Chinook salmon occurs in mixed stock marine area fisheries in U.S. and Canadian waters and in extreme terminal area recreational selective fisheries in the Skykomish River. Exploitation rates on

Skykomish and Snoqualmie natural-origin populations were nearly 80 percent for brood years 1980 through 1985, contributing to the observed decline in numbers of fish returning to the spawning grounds (PSIT and WDFW 2010a). However, total exploitation rates on natural-origin Chinook salmon produced in the basin have been substantially reduced to a recent year (2008-2012) average of 25 percent (NMFS 2016).

Fishery impact modeling by the co-managers shows a declining trend in annual fishing year exploitation rate from 1983-2000, and fairly stable rates since 2000 (PSIT and WDFW 2010a). Declining from an annual average of 70 percent in the 1980s, exploitation rates from 2003 through 2010 on natural-origin Chinook salmon from the Snohomish River basin have ranged from 21 to 34 percent; averaging 28 percent (PSIT and WDFW 2013). These impacts occur incidentally in terminal area fisheries targeting hatchery-origin Chinook and coho salmon, and in pre-terminal area mixed-stock fisheries, with harvests in the latter fishing areas accounting for the majority of total annual Skykomish Chinook salmon mortalities (Larrie LaVoy, NMFS, personal communication, CTC data November 10, 2014). The goal of harvest management is to maintain fishing rates low enough so that natural-origin populations will grow, assuming that concurrent habitat restoration and protection occurs consistent with population recovery. The current overall maximum exploitation rate is 24 percent (NMFS 2015).

Planned fisheries that affect listed Snohomish River basin Chinook salmon have been evaluated and conditionally approved annually by NMFS. NMFS's most recent authorization for salmon fisheries including those in the action area (NMFS 2016) analyzed a 2016 Puget Sound harvest plan assembled by the tribal co-managers (Grayum 2016; Bowhay 2016). The co-manager plan was found to be in compliance with ESA protective requirements for listed salmon and steelhead. This most recent authorization of a co-manager harvest plan remained relatively similar to those issued over the past several years, and is expected to continue to do so.

### 3.3.2 Puget Sound Steelhead (ESA-listed)

The Puget Sound Steelhead Technical Recovery Team (PSTRT) delineated five steelhead demographically independent populations (DIPs) that are native to the Snohomish River basin and part of the listed Puget Sound steelhead DPS (72 FR 26722, May 11, 2007): Snohomish/Skykomish winter-run; Pilchuck winter-run; Snoqualmie winter-run; Tolt summer-run; and North Fork Skykomish summer-run (Myers et al. 2014). Under DPS viability criteria developed by the PSTRT (Hard et al. 2014), at least one winter-run and one summer-run population in the basin will be identified as a key population needing to be restored to a low extinction risk status for recovery and delisting of the DPS. There are no hatchery-origin steelhead produced in basin hatcheries that are included as part of the listed DPS.

Winter-run steelhead in the Snohomish River basin enter freshwater as adults between mid-October and May (Myers et al. 2015). Spawning occurs from mid-March through mid-June, with peak spawning in April. Most winter-run steelhead return to spawn as four-year-old fish (57 percent), with five year-olds comprising 42 percent of total returns (Myers et al. 2015, citing WDFW 1994b). Major spawning areas used by the Pilchuck River DIP include the mainstem Pilchuck River to RM 15.3 and Worthy, Dubuque, and Little Pilchuck creeks. Spawning areas used by the Snohomish/Skykomish DIP include: the Snohomish and Skykomish rivers and the South Fork Skykomish up to Sunset Falls (RM51.5), the Wallace River to RM 5.8, the Sultan

River to RM 15, and Proctor, Elwell/Young's, East Fork Woods, West Fork of Woods, Olney, Lewis and Salmon creeks. Major spawning areas used by the Snoqualmie River DIP include the Snoqualmie River from the confluence with the Skykomish River to Snoqualmie Falls (RM 40.5), the mainstem, North Fork, and South Fork Tolt rivers, Raging River, and in Tokul, Cherry, Harris, Griffin, Patterson, Canyon, and Deep creeks. Juvenile out-migrant trapping data indicate that natural origin Snohomish River basin steelhead juveniles emigrate seaward in April and May as smolts predominantly as two-year old fish (84 percent) during their second spring in freshwater (Myers et al. 2015, citing WDFW 1994b). Three-year-old smolts are a lesser seaward emigration component for the species (15 percent of the total smolt migration).

Adult summer steelhead return to the watershed between late-May and mid-October, and predominately as four-year-olds (Myers et al. 2015, this and following). Summer-run steelhead in the Tolt River spawn from January through May, with two peak spawning periods; one in February and the other in mid-April. Most spawning by summer steelhead in the basin takes place in the South Fork Skykomish and tributaries above Sunset Falls, particularly in the Beckler River. Genetic data indicate that steelhead returning to the South Fork Skykomish River are of non-native Skamania stock lineage, and the population in the tributary is therefore not included as part of the Puget Sound steelhead DPS. Skamania-origin hatchery summer-run steelhead produced by WDFW's Reiter Ponds program spawn from late December through April. The spawn timing of Skamania lineage hatchery stock is believed to overlap with naturally spawning native summer-run steelhead in the region, but the overlap may be diminished because of current broodstock collection procedures that have retained the earliest returning fish for spawning (Myers et al. 2015). However, recent genetic analyses conducted by WDFW indicate that introgression by Skamania-linage steelhead is substantial in at least two steelhead populations in the watershed (K. Warheit, WDFW, pers. comm., February 2014). Summer-run steelhead are thought to exhibit the same predominantly 2-year-old smolt emigration life history strategy as natural origin winter-run steelhead, leaving the basin for marine waters in April and May, with peak migration in early to mid-May.

Historically, the Snohomish River basin was one of the primary producers of steelhead in Puget Sound (Myers et al. 2015). Abundance estimates for the species are lacking for the pre-developmental period, but steelhead harvest levels in basin fisheries in the late-1800s and early-1900s indicate that the numbers of steelhead were quite high. Harvests recorded for Snohomish County during this period were indicative of runs over 100,000 fish (Myers et al. 2015, citing WDFG). Escapement surveys by the Washington Department of Fish and Game in 1929 found "large aggregations" of steelhead in the Pilchuck River, Sultan River, Skykomish, and Tolt rivers, and medium aggregations in the North Fork and South Fork Skykomish, Wallace, Snoqualmie, and Raging rivers (Myers et al. 2015, citing WDFG 1932).

Since 1995, natural-origin Puget Sound steelhead abundance has shown a widespread declining trend over much of the DPS (NWFSC 2015). Winter-run population data for the three winter-run steelhead DIPs in the Snohomish River basin suggest that the most recent population decline started in the late-1980s; the decline in escapement began around 2000 (Figure 5). Escapement between 1981 and 1999 (where data are available) ranged from a low of 2,954 (1981) to a high of 8,588 fish (1992); averaging 6,518 fish; PSIT and WDFW 2010b; WDFW spawning ground database).

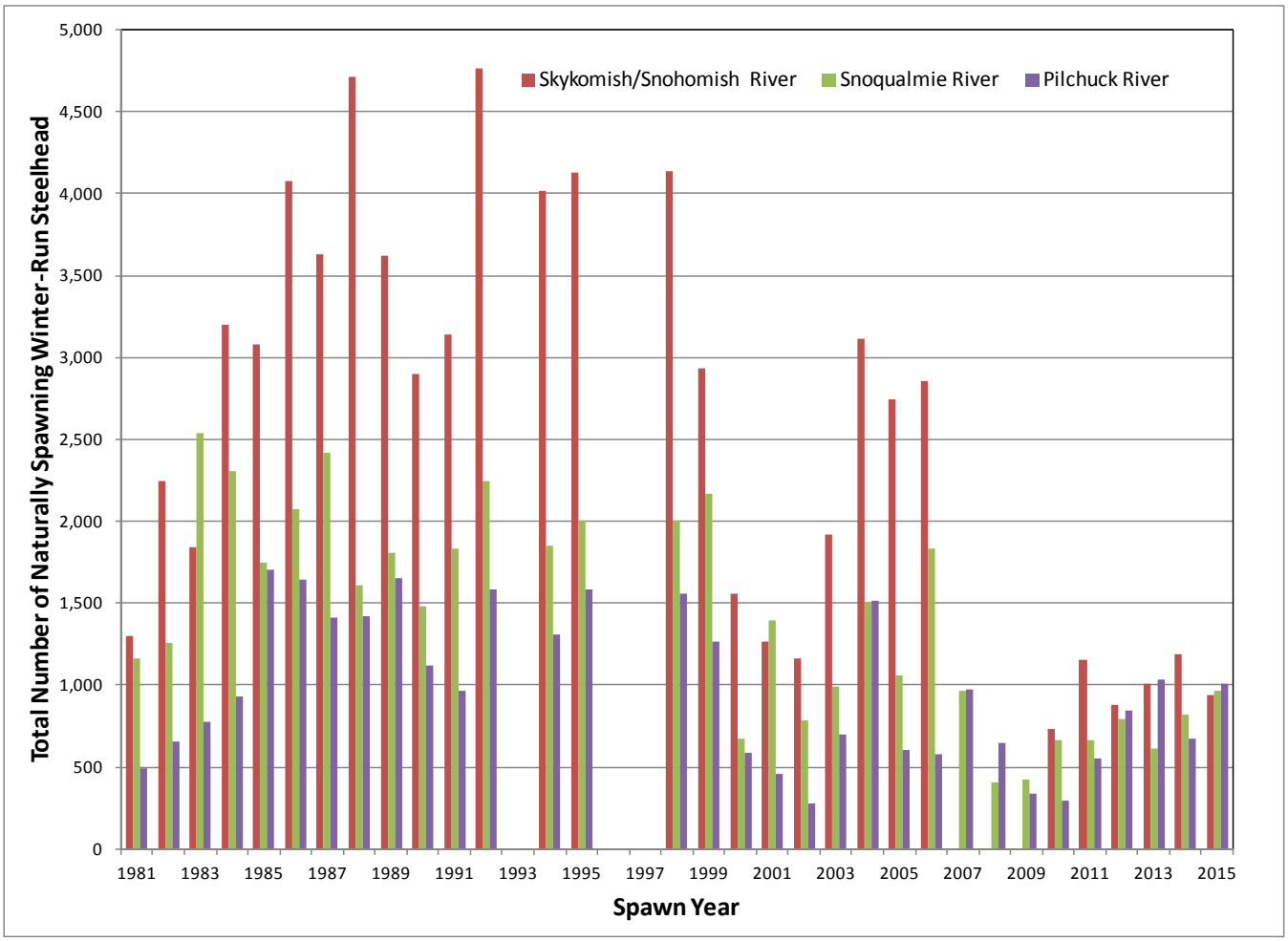


Figure 5. Total estimated number of naturally spawning winter-run steelhead for the Skykomish, Snoqualmie, and Pilchuck rivers for return years 1981-2015. Source: WDFW Score Database.

Intrinsic potential production estimates based on basin size indicate the Snohomish River basin could support a total winter-run steelhead abundance for the three DIPs of approximately 43,322 fish (assumed smolt to adult survival (SAS) of 10 percent; Myers et al. 2015). The 5-year geometric mean abundance for the Snohomish/Skykomish population was 3,084 natural-spawners from 2005 through 2009 and only 930 from 2010 through 2014 (from Table 59 *in* NWFSC 2015). Hard et al. (2015) estimated that the probability that the population would decline to a QET of 73 steelhead was low (about 40 percent within 100 years) based on a mean population growth rate of -0.005 ($\lambda$=0.995). The 5-year geometric mean abundance for the Pilchuck population was 597 natural-origin spawners from 2005 through 2009 and 614 from 2010 through 2014; indicating an overall increase of +3 percent (from Table 59 *in* NWFSC 2015). Hard et al. (2015) estimated that the probability that the population would decline to a QET of 34 steelhead was low (about 40 percent within 100 years) based on a mean population growth rate of -0.006 ($\lambda$=0.994). The 5-year geometric mean abundance for the Snoqualmie population was 1,249 natural-spawners from 2005 through 2009 and only 680 from 2010 through 2014; indicating an overall decline of -46 percent (from Table 59 *in* NWFSC 2015). Hard et al. (2015) estimated that the probability that the population would decline to a QET of 73 steelhead

was high (nearly 70 percent within 100 years) based on a mean population growth rate of -0.027 ($\lambda$=0.973).

The combined intrinsic potential for the two summer-run steelhead DIPs in the basin is 984 fish (assumes a 10 percent SAS; Myers et al. 2015). The IP capacity ranges for each summer-run steelhead DIP are 321 to 641 adults in the Tolt River DIP and 663 to 1,325 adults in the North Fork Skykomish River (Myers et al. 2015). For Tolt River summer-run steelhead (the only summer-run population in the basin for which redd count data are available), escapements have declined since the late 1990s) (Figure 6). The recent year (2000-2015) average Tolt River summer-run steelhead escapement is 105 fish (WDFW Score Database).

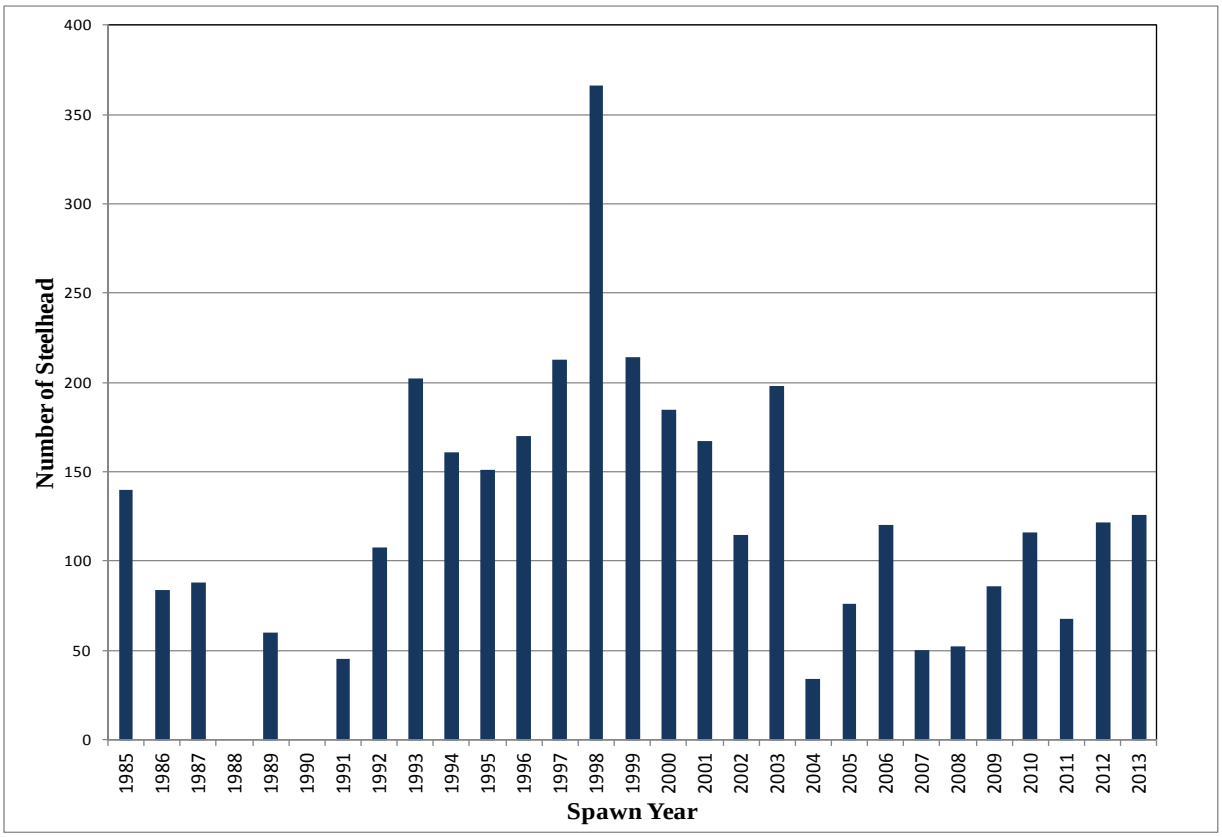


Figure 6. Estimated total natural spawning escapement for the Tolt River summer-run steelhead population for years for which data are available (Source: WDFW 2013a; WDFW spawning ground database). Escapement based on redd counts in the S.F. Tolt River from RM 3.3 to 7.8 multiplied by 0.81 (to account for multiple redds constructed by some females) and then 2 to represent the spawning pair.

The TRT viable abundance goals for the two summer populations are 250 natural-origin fish for the Tolt River population and 331 for the North Fork Skykomish River natural population (Hard et al. 2015). The 5-year geometric mean abundance for the Tolt population was 73 natural-origin spawners from 2005 through 2009 and 105 from 2010 through 2014; indicating an overall increase of +44 percent (from Table 59 *in* NWFSC 2015). Hard et al. (2015) estimated that the

probability that the population would decline to a QET of 25 steelhead was high (about 80 percent within 100 years) based on a mean population growth rate of -0.013 ($\lambda$=0.987).

Human developmental activities in the Snohomish River basin have adversely affected steelhead population spatial structure. Scott and Gill (2006) reported that the spatial distribution of both summer- and winter-run steelhead in the basin had been reduced from the historical distribution.

Data are not available to evaluate changes in the life history diversity of steelhead in the Snohomish River basin. However, it is likely that the degradation and loss of habitat in the watershed, hatchery practices, and past harvest practices that disproportionately affected the earliest returning fish, have reduced the diversity of the species relative to historical levels. Genetic diversity for the native winter-run populations may have been adversely affected by releases of non-native Chambers Creek steelhead from basin hatcheries, in watershed areas where spawn timings for natural and hatchery origin fish over-lapped. Hatchery introduction of summer-run steelhead of Skamania-origin into the South Fork Skykomish River coincident with the initiation of a trap-and-haul operation at Sunset Falls in 1958 has affected the diversity of summer-run steelhead in the watershed. The introduction of non-native summer-run steelhead has resulted in a population with genetic characteristics that differ from the native North Fork Skykomish population (Kassler et al. 2007). This introduced population, and continued releases of Skamania lineage steelhead through the WDFW Reiter Ponds program, impact native summer-run populations.

In a review of eight years of escapement data (1997 – 2004), Scott and Gill (2006) reported population growth rates for the Snohomish-Skykomish, Pilchuck, and Snoqualmie winter-run steelhead populations of +0.02, +0.04, and -0.03, respectively. Based on these productivity estimates, the three populations were viewed by the authors as having a low relative risk. Ford et al. (2011) reported an exponential trend in natural spawner abundance (lambda) for the Snohomish winter-run population from 1995 through 2009 of 0.961 (range 0.878–1.050). Using index area escapement estimates for the same period for the Tolt summer-run steelhead population, Scott and Gill (2008) derived an estimated growth rate of -0.05, and reported that the population was at unknown risk. The estimated 1995-2009 mean trend in natural population abundance for the Tolt population is 0.961 (Ford et al. 2011).

Tribal commercial, subsistence, and ceremonial steelhead fisheries are conducted in marine area 8A, including the Snohomish River downstream of the I-5 Bridge, and in Area 8D (Tulalip Bay). The Tulalip Tribes currently do not fish in other areas of the Snohomish River system during the hatchery-origin and natural-origin adult steelhead migration periods. Non-tribal commercial fishing is closed to steelhead in all marine and freshwater areas, although there is some incidental harvest mortality. The recreational fishery directed at hatchery-origin early winter-run steelhead is currently open from November 1 to January 31 (or February 15 in a few locations) in certain freshwater areas in the watershed. Average annual tribal steelhead harvest has ranged from 10,394 fish (1986/87; 6 percent harvest of wild fish) to zero fish (2003); averaging 1,340 fish (12 percent harvest of wild fish). Average annual recreational steelhead harvests have ranged from 12,621 (1987/88; 20 percent harvest of wild fish) to 2,172 (1987/88; 5 percent harvest of wild fish); averaging 6,755 (14.5 percent harvest of wild fish) (Appendix A in PSIT and WDFW 2010).

Pursuant to court orders, the tribes have not opened fisheries directed at hatchery-produced summer steelhead, but rather choose to pursue their allocation of summer steelhead in the winter steelhead fishery. Hatchery summer steelhead-directed recreational fisheries occur on hatchery-origin adult returns. Angling regulations for winter and summer-run steelhead are structured to allow harvest of trout and only adipose fin-clipped steelhead. Since the 2000-2001 management season, terminal area harvest rates estimated from tribal and non-tribal landed catch and escapement of Snohomish River basin natural-origin winter-run steelhead ranged from 0.4 to 8.0 percent (NMFS 2016; WDFW and PSIT 2016). Fisheries exploitation rates for winter-run steelhead in the Snohomish River basin terminal area are based on a stepped approach, taking into account annual run sizes: if escapement is forecast not to exceed 3,250, the terminal exploitation rate will not exceed five percent; if escapement is forecast to fall between 3,250 and 6,500, the terminal exploitation rate will not exceed 10 percent; and, if escapement is forecast to exceed 6,500, harvest will not exceed the lesser of 50 percent of the excess plus 650 or a 10 percent terminal area exploitation rate. The terminal area exploitation rate for Snohomish natural-origin summer steelhead will not exceed 10 percent. Fisheries will be managed to achieve the hatchery escapement goal for Snohomish programs.

Planned fisheries that affect listed Snohomish River basin steelhead have been evaluated and conditionally approved annually by NMFS. NMFS's most recent authorization for salmon fisheries including those in the action area (NMFS 2016) analyzed a 2016 Puget Sound harvest plan assembled by the tribal co-managers (PSTT 2016). The co-manager plan was found to be in compliance with ESA protective requirements for listed salmon and steelhead. This most recent authorization of a co-manager harvest plan remained relatively similar to those issued over the past several years, and is expected to continue to do so.

### 3.3.3 Puget Sound Fall Chum Salmon (Non-listed)

The fall chum salmon stocks in the Snohomish River basin are part of the Puget Sound/Strait of Georgia Chum Salmon ESU (Johnson et al. 1997). The ESU includes all naturally spawned populations of chum salmon from Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca up to and including the Elwha River, with the exception of summer-run chum salmon from Hood Canal and the Strait of Juan de Fuca. After reviewing the status of chum salmon populations in the region, NMFS determined that ESA listing of the ESU was not warranted on August 10, 1998 (63 FR 11774).

There are three fall chum salmon stocks in the Snohomish River basin that are considered native, natural-origin stocks: Skykomish; Snoqualmie; and Wallace river watershed chum salmon (WDFW and WTIT 1994; Haring 2002). The hatchery fall chum salmon stock propagated through the Tulalip Tribes' program are not native to the Snohomish River basin, and are of transferred stock origin from Hood Canal and Deep South Sound (Tulalip 2013b). The native Skykomish and Wallace fall chum stocks are considered healthy in status, and the Snoqualmie stock is of unknown status (WDFW and WTIT 1994). Adult freshwater entry timing for Snohomish River basin fall chum salmon occurs primarily from October through December, with a peak entry of early to mid-November (Haring 2002). Spawning occurs during November through December, with the peak in early to mid-December. Juvenile chum emigrate seaward soon after emerging from the gravel as unfed fry from mid-March through early May, with peak

migration in April (Nelson and Kelder 2005). The historical (pre-European settlement period) abundance of fall chum salmon in the basin is unknown. The 2006 return of 278,0000 fish - the largest natural-origin Snohomish River basin fall chum return to Puget Sound observed over the past 44 years (1968-2012) - can be assumed to represent potential historical run size (data from A. Dufault, WDFW unpublished data, May 14, 2014). The most recent eleven-year (2002-2012) run size estimate for Snohomish River basin fall chum averaged 30.079 fish. Fall chum salmon population abundance, spatial structure, productivity, and genetic diversity have likely been adversely affected in a similar manner and for the same reasons to varying degrees as described above for listed Chinook salmon and steelhead in the basin. Habitat loss and degradation have been, and continue to be, the primary threats to fall chum salmon survival and productivity during the species freshwater life history phases. However, because chum salmon spend little time in freshwater relative to other anadromous salmon species (minimal rearing prior to seaward emigration), the types and degree to which specific freshwater habitat factors affect the species may differ from those limiting (for e.g.) Chinook salmon and steelhead, which rely on freshwater for longer periods and may use different habitats. Chum salmon early marine survival, as affected by varying natural productivity conditions in the estuary and ocean, is the primary factor determining the success or failure of each brood year in returning adult chum salmon back to the rivers to spawn (Salo 1991).

Tulalip tribal and WDFW commercial fisheries for fall chum salmon occur seasonally in marine areas in Possession Sound, Port Susan, and Port Gardner Bay adjacent to the mouth of the Snohomish River, contingent on the availability of fish surplus to spawning escapement needs. These fisheries harvest natural-origin Snohomish River basin fall chum salmon, and hatchery-origin fall chum salmon produced through the hatchery program on Battle Creek. The Tulalip Tribes also conduct commercial, ceremonial, and subsistence fisheries in Tulalip Bay specifically directed at the harvest of Tulalip Hatchery-origin fall chum salmon. Between 1988 and 2002, annual fall chum salmon harvests of Snohomish River basin natural and hatchery-origin fall chum salmon by the Tulalip Tribes averaged 73,680 fish, and ranged from 4,583 fish to 175,766 fish (Tulalip 2013c).

### 3.3.4 Puget Sound Pink Salmon (Non-listed)

The odd- and even-year pink salmon aggregations in the Snohomish River basin are included as part of the Washington Odd- and Puget Sound Even-Year Pink Salmon ESUs, respectively (Hard et al. 1996). NMFS determined that ESA listing for the two ESUs and their component populations, including the Snohomish populations, was not warranted (60 FR 192, October 4, 1995).

The basin has two native pink salmon stocks: Snohomish odd-year; and Snohomish even-year. There is no hatchery production of the species in the basin. Both native stocks are considered healthy in status (WDFW and WTIT 1994). Most spawning for odd-year pink salmon takes place in the mainstem Snohomish, Skykomish, and Snoqualmie Rivers, and in larger tributaries such as the Wallace, Sultan, Pilchuck, Beckler, and Tolt Rivers (WDFW and WTIT 2004). Spawning also occurs in Woods, Elwell, McCoy, Olney, Proctor, Deer, Lewis, Bridal Veil, and Cherry Creeks. Odd-year pink salmon spawning generally occurs from late September through October in odd-numbered years. Even-year pink salmon spawning occurs in the mainstem Snohomish and lower Skykomish Rivers and possibly in the Snoqualmie River. Even-year pink

salmon spawning occurs in September. Like chum salmon, juvenile pink salmon emigrate seaward after little or no residency or feeding in freshwater. Odd-year pink salmon fry emigration peaks in early May, and extends from mid-March through the end of May. Even year pink salmon emigrate earlier, with a peak seaward migration timing in early March (Nelson and Kelder 2005).

Based on available adult return abundance data, it is likely that pink salmon were historically, and are presently, the most numerous anadromous salmonid species in the Snohomish River basin. Although pre-development era data are lacking, average run size data available since the late 1950s indicate that the odd-year pink salmon population is healthy and abundant. From 1959 through 2011, the average Snohomish River basin adult return to Puget Sound for odd-year pink salmon has averaged 433,489 fish, and ranged from 76,285 fish to 2,403,012 fish (WDFW run reconstruction data, 2013). The run size for the most recent six return years (2001 through 2011) averaged 1,261,354 fish. The Puget Sound run size forecast for odd-year pink salmon returns to the basin in 2013 was 852,998 fish (A. Dufault, WDFW, pers. comm. February, 2013). The viability status of the even-year pink salmon population relative to its historical status is unknown. Even-year pink salmon returning to the basin are far less abundant, with adult returns for years for which data are available (1986-2000) averaging 3,921fish (range 1,016 to 12,900 fish). Although the same freshwater habitat-related limiting factors and threats identified above for other salmon species apply to varying degrees, odd-year pink salmon returns throughout Puget Sound and in the Snohomish basin have thrived in recent years, with annual spawning escapements at or approaching historical abundance levels. However, severe marine mortality was observed for all Puget Sound pink salmon stocks returning in 2015, including the Snohomish River basin stock. Like chum salmon, early marine survival, as affected by varying natural productivity conditions in the estuary and ocean, is the primary factor determining the success or failure of each brood year in returning adult pink salmon back to the rivers to spawn (Heard 1991).

Tulalip Tribal and WDFW commercial fisheries for odd-year pink salmon may occur in marine areas in Possession Sound, Port Susan, and Port Gardner Bay adjacent to the mouth of the Snohomish River, contingent on the availability of fish surplus to natural spawning escapement needs. Recreational fisheries for pink salmon also occur in the same marine fishing areas and in the Snohomish, Skykomish and Snoqualmie rivers. These fisheries are directed at the harvest of natural origin odd-year Snohomish River basin pink salmon. Even-year pink salmon are not subjected to directed harvest in any fisheries, but may be harvested incidentally in Chinook salmon fisheries in the analysis area. Between 1981 and 2009, annual commercial net fishery odd-year pink salmon harvests in the Stillaguamish-Snohomish region (mainly marine waters in the vicinity of Everett) by all groups averaged 135,123 fish, and ranged from 19,193 fish to 706,958 fish (PFMC Table B-43, 2012).

### 3.3.5 Puget Sound Coho Salmon (Non-listed)

The coho salmon populations in the Snohomish River basin are part of the Puget Sound/Strait of Georgia coho salmon ESU (Weitcamp et al 1995). ESA listing of the ESU was determined by NMFS to be not warranted (75 FR 38776, July 6, 2010), but the ESU remains on the Federal Candidate Species list.

The fishery resource managers delineated four native coho salmon stocks for the Snohomish River basin – Snohomish; Skykomish; South Fork Skykomish; and Snoqualmie, and all four were considered healthy in status in the 1990s (WDFW and WTIT 1994). Spawning occurs in basin waters from late October through mid-January, extending into early February in some years. Spawning locations include Snohomish tributaries, especially in Quilceda Creek, Pilchuck River, and French Creek; accessible waters of the South Fork Skykomish above Sunset Falls; throughout the mainstem Snoqualmie River and tributaries downstream from Snoqualmie Falls; and for the Skykomish population, throughout the Skykomish River basin. Juvenile coho salmon emigrate seaward as yearling smolts from late April through early June, with peak migration in the first two weeks of May. Native Skykomish stock-lineage coho salmon are propagated in the Wallace River Hatchery and Tulalip Hatchery programs.

The historical abundance of natural-origin coho salmon produced in the Snohomish River basin before European contact is unknown. Presently, coho salmon are abundant in the Snohomish River basin relative to the status of the species in other Puget Sound regions, and the basin is considered a stronghold for the species in the ESU. The long term (1981 through 2010) average annual Puget Sound run size for natural-origin Snohomish River basin coho salmon is 135,342 fish (range 44,603 fish to 294,379 fish) (PFMC Appendix Table B-42 data). The 46 year (1965-2011) high natural-origin coho salmon abundance level for the Snohomish River basin is 268,313 fish (J. Haymes, WDFW, unpublished data, January 7, 2013). Spawning escapement in Snohomish tributaries for this period averaged 102,395 fish, compared to the goal natural escapement range of 31,000 to 50,000 fish. The natural-origin coho salmon run size for the most recent five years (2006 through 2010) averaged 111,439 fish, and spawning escapement for the same period averaged 75,485 fish. To varying degrees, the same habitat-related threats identified above for Chinook salmon and steelhead adversely also affect coho salmon population viability. Although human developmental actions are threatening lower river tributaries important for natural-origin coho salmon production, the populations in the basin remain relatively healthy and abundant.

Tulalip Tribal commercial, ceremonial, and subsistence fisheries for Snohomish River basin coho salmon occur seasonally in marine areas in Possession Sound, Port Susan, and Port Gardner Bay adjacent to the mouth of the Snohomish River, contingent on the availability of natural-origin fish surplus to spawning escapement needs destined for the Stillaguamish and Snohomish River basins. These fisheries harvest natural-origin Snohomish River basin coho salmon, and hatchery-origin coho salmon produced through the tribes' hatchery program on Tulalip Creek and through the Wallace River Hatchery program. Recreational fisheries targeting Snohomish River basin coho salmon occur in these same areas, and in basin tributaries. The Tulalip Tribes also conduct commercial, ceremonial, and subsistence fisheries in Tulalip Bay specifically directed at the harvest of hatchery-origin coho salmon produced through the Tulalip Hatchery program. Recreational fisheries harvesting hatchery-origin coho salmon also occur in Tulalip Bay. Between 1981 and 2010, commercial net fisheries (mainly Tulalip tribal) harvests of Snohomish River basin natural and hatchery-origin coho salmon in the analysis area averaged 27,213 natural-origin fish and 32,278 hatchery-origin fish (PFMC Table B-42, 2012). Total Snohomish River basin-origin commercial fishery coho salmon harvests for the period averaged 59,490 fish and ranged from 1,729 fish to 178,268 fish.

### 3.3.6 Sockeye Salmon

There is no known persistent sockeye salmon population in the Snohomish River basin. However, low numbers of riverine spawning sockeye salmon are observed in the watershed each year (Gustafson et al. 1997; Snohomish 2005). It is unknown whether these fish are a self-sustaining riverine stock, or if they represent strays from adjacent watersheds where self-sustaining sockeye populations are present (e.g., Baker River, Lake Washington, or Fraser River). In its status review of west coast sockeye salmon, NMFS did not delineate any discrete sockeye salmon population in the basin (Gustafson et al. 2007).

The status of riverine spawning sockeye salmon in the Snohomish River basin is unknown.

There are no tribal or WDFW fisheries promulgated to harvest riverine sockeye salmon, but they may potentially be taken in other sockeye fisheries or incidentally in Chinook and coho salmon-directed fisheries.

## 3.4 Other Fish Species

Many fish species in the Snohomish River basin and adjacent nearshore marine areas have a relationship with salmon and steelhead as prey, predators, or competitors (Table 9). The following species may eat salmon and steelhead eggs and fry: Pacific lamprey, Western brook lamprey, river lamprey, coast range sculpin, prickly sculpin, rainbow trout, kokanee, bull trout, cutthroat trout, brook trout, smallmouth bass, minnows, suckers, Pacific staghorn sculpin, rockfish, starry flounder, and spiny dogfish. All fish species in the Snohomish River basin may be prey for salmon and steelhead at some life stage. Additionally, all fish species in the Snohomish River basin compete with salmon and steelhead for food and space.

In addition to Chinook salmon and steelhead, bull trout in the Snohomish River basin are also listed as a threatened fish species under the ESA. The basin harbors four discrete populations that are included as part of the “Snohomish/Skykomish core area” for the listed Puget Sound/Washington Coastal bull trout DPS: North Fork Skykomish River; Salmon Creek; South Fork Skykomish River; and Troublesome Creek (USFWS 2004). The analysis area is not considered as one of the geographical areas occupied by the ESA-listed southern DPS of Pacific eulachon (76 FR 65324, October 20, 2011), and the species will not be discussed further in this document.

The Snohomish River basin includes habitat designated as critical for bull trout (75 FR 63898, October 18, 2010). Bull trout critical habitat includes primary constituent elements considered essential for the conservation of bull trout, and may require special management considerations or protection. Such elements include adequate migration, spawning, and rearing habitat, including maintained connectivity, sufficient water quality and quantity, low levels of piscivorous (i.e., fish eating) or competing species, and an abundant food base.

Pacific lamprey and Western brook lamprey are Federal “species of concern” and are Washington State “monitored species” (Table 9). In marine areas, several species of rockfish are listed as threatened under the ESA. Pacific herring (a forage fish for salmon and steelhead) is a Federal species of concern and a State candidate species. All of these species have a range that

includes the Snohomish River basin or nearby marine areas where they may be affected by the current hatchery programs under baseline conditions. However, none of these species is located exclusively in the Snohomish River basin or nearby marine waters, and in most cases, these areas are a very small percentage of their total range.

Table 9. Range and status of other fish species that may interact with Snohomish River basin salmon and steelhead.

| Species | Range in Snohomish River Basin | Federal/State Listing Status | Type of Interaction with Salmon |
|---|---|---|---|
| Freshwater - | | | |
| Pacific Lamprey, Western Brook Lamprey, and River Lamprey | Pacific and River Lamprey: basin reaches accessible to anadromous fish. Western Brook Lamprey: entire basin above and below barriers to anadromous fish migration. | Pacific and Western Brook Lamprey: Federal Species of Concern; Washington State Monitored Species. River: Federal Species of Concern, State Candidate Species | Predator of salmon eggs and fry<br>Potential prey item for adult salmon<br>May compete with salmon for food and space<br>May benefit from additional marine-derived nutrients provided by hatchery-origin fish |
| Coast Range and Prickly Sculpin | Entire basin above and below barriers to migration. Prickly sculpin habitat extends into tidally influenced areas | None | Predator of salmon eggs and fry<br>Potential prey item for adult salmon<br>May compete with salmon for food and space<br>May benefit from additional marine-derived nutrients provided by hatchery-origin fish |
| Three-spine stickleback | Basin reaches downstream of impassable barriers; estuarine and nearshore marine areas | None | May compete with juvenile salmon for food and space<br>Potential prey item for salmon<br>May benefit from additional marine-derived nutrients provided by hatchery-origin fish |
| Mountain Whitefish | Entire basin above and below barriers to migration. | None | Predator of salmon eggs and fry<br>Potential prey item for adult salmon |

| Species | Range in Snohomish River Basin | Federal/State Listing Status | Type of Interaction with Salmon |
|---|---|---|---|
| | | | May compete with salmon for food and space<br>May benefit from additional marine-derived nutrients provided by hatchery-origin fish |
| Rainbow Trout (resident form) | Entire basin below, and potentially above barriers to anadromous fish migration. | None – the resident form of O. mykiss is not included as part of the listed Puget Sound steelhead DPS | Predator of salmon eggs and fry<br>Potential prey item for salmon<br>May compete with salmon for food and space<br>May benefit from additional marine- derived nutrients provided by hatchery-origin fish |
| Kokanee | Lake Roesiger (in the Woods Creek watershed) and in Lake Stevens (in the Stevens Creek watershed). | None | Predator of salmon eggs and fry<br>Potential prey item for salmon<br>May compete with salmon for food and space |
| Bull Trout | Basin reaches downstream of impassable barriers, and South Fork Skykomish above Sunset Falls; also, estuarine and nearshore marine areas | Listed as threatened under the Federal ESA | Predator of salmon eggs and fry<br>Potential prey item for salmon<br>May compete with salmon for food and space<br>May benefit from additional marine- derived nutrients provided by hatchery-origin fish |
| Cutthroat Trout | Basin reaches upstream (resident form) and downstream (resident and sea-run forms) of impassable barriers; also, estuarine and nearshore marine areas (sea-run form) | None | Predator of salmon eggs and fry<br>Potential prey item for salmon<br>May compete with salmon for food and space<br>May benefit from additional marine- derived nutrients provided by hatchery-origin fish |
| Eastern Brook Trout | Griffin Creek, and areas downstream (may not have | None | Potential predator of salmon eggs and fry |

| Species | Range in Snohomish River Basin | Federal/State Listing Status | Type of Interaction with Salmon |
|---|---|---|---|
| | persisted after initial hatchery plants) | | Potential prey item for salmon<br>May compete with salmon for food and space |
| Smallmouth Bass | Basin lakes, ponds, and sloughs | None | Potential predator of juvenile salmon |
| Minnows (sp.), including Northern Pikeminnow | Entire basin below, and potentially above barriers to anadromous fish migration. | None | Potential predators of salmon eggs and juveniles<br>Potential prey items for salmon<br>May compete with salmon for food and space |
| Suckers (sp.) | Entire basin below, and potentially above barriers to anadromous fish migration. | None | Potential predator of salmon eggs and fry<br>Potential prey item for salmon<br>May compete with salmon for food and space |
| Marine Areas - | | | |
| Pacific Staghorn Sculpin | Lower Snohomish River brackish and estuarine areas; adjacent nearshore marine areas | None | Predator of salmon fry and smolts<br>Potential prey item for adult salmon<br>May compete with salmon for food and space |
| Rockfish | Rocky reef habitats in certain areas of Puget Sound including North Puget Sound and the San Juan Islands areas | Several species are federally listed as threatened and/or have State Candidate listing status 4 | Predators of juvenile salmon<br>Juvenile rockfish are prey for juvenile and adult salmon<br>May compete with salmon for food |
| Forage Fish | Most marine waters within Puget Sound | Pacific herring is a Federal species of concern and a State candidate species | Prey for juvenile and adult salmon<br>May compete with salmon for food |
| Shiner Perch | Most marine waters within Puget Sound | None | Prey for juvenile and adult salmon |

[4] Georgia Basin bocaccio DPS (*Sebastes paucispinis*) - Federally listed as endangered and state candidate species; Georgia Basin yelloweye rockfish DPS (*S. ruberrimus*) - Federally listed as threatened and state candidate species; Georgia Basin canary rockfish DPS (*S. pinniger*). Federally listed as threatened and state candidate species; Black, brown, China, copper, green-striped, quillback, red-stripe, tiger, and widow rockfish are state candidate species.

| Species | Range in Snohomish River Basin | Federal/State Listing Status | Type of Interaction with Salmon |
|---|---|---|---|
| | | | May compete with salmon for food |
| Starry Flounder | Brackish, nearshore, and marine waters within Puget Sound | None | Predator of juvenile salmon<br>Juvenile flounders are prey for juvenile and adult salmon<br>May compete with salmon for food |
| Spiny Dogfish | Most marine waters within Puget Sound | None | Predator of juvenile salmon<br>May compete with salmon for food |

Sources: USFWS 2012; Snohomish County 2007; 2012; SRBSCP Appendix C-1 2005; Gustafson et al. 2010; Wydoski and Whitney 1979.

## 3.5 Wildlife

In general, hatchery operations in the Snohomish River basin have potentially affected local wildlife species by changing the total abundance of salmon in aquatic and marine environments. Salmon produced by the current Snohomish River basin hatchery programs are a food source for various wildlife species and changes in salmon abundance can affect these species through predator/prey interactions. Many wildlife species also feed on salmon carcasses in the Snohomish River basin and subsequently bring marine derived nutrients from the salmon into the terrestrial ecosystem (i.e., nutrient cycling). Increases or decreases in the abundance of juvenile and adult salmon in the basin associated with hatchery operations may therefore affect the viability of wildlife species that depend on salmon as a food source. In addition, the hatcheries could affect wildlife through transfer of toxic contaminants from hatchery-origin fish to wildlife (Boxall et al. 2004; Pouliquen et al. 2003), the operation of weirs (which could block or entrap wildlife, or conversely, make salmon easier to catch through their corralling effect), or by current predator control programs (which may harass or kill wildlife preying on juvenile salmon at hatchery facilities).

The Snohomish River basin area supports a variety of birds, large and small mammals, amphibians, and invertebrates that may eat or be eaten by salmon (Table 10). Although southern resident killer whales, harbor seals, sea lions, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins are not found in freshwater tributaries in the Snohomish River basin (harbor seals and sea lions may range into upper estuarine areas), they do intercept adult salmon returning to the basin when feeding in adjacent marine waters. Harbor seals may also be important predators of Snohomish River basin-origin salmon and steelhead smolts transiting the Salish Sea in seaward areas (Moore et al. 2010; Moore et al. 2015). Harbor seals and sea lions have been observed in nearshore areas preying on salmon produced by the proposed hatchery programs. An estimated 50 seals and sea lions annually move into Tulalip Bay beginning with the return of hatchery-origin Chinook salmon in June, remaining in the bay through January, which is the end of the annual chum salmon run. The Tulalip Tribes estimate that these pinnipeds consume about half of the fish encountered in continuously-manned nets in Tulalip Bay tribal salmon fisheries (Mike Crewson, Tulalip Tribes, personal communication, September

24, 2014). No other marine mammals are likely to prey on Snohomish River basin-origin salmon in the analysis area

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Table 10. Status and habitat associations of wildlife in the analysis area with direct or indirect relationships with hatchery-origin salmon and steelhead.

| Species | Status | Habitat [1] | | | Relationship with Salmon and Steelhead | | | |
|---|---|---|---|---|---|---|---|---|
| | | Fresh-water | Estuary | Marine | Predator | Competitor | Prey | Scavenger |
| Bald eagle | State threatened species | X | X | X | X | | | X |
| Northern spotted owl | Federal threatened species | X | | | X | | | |
| Marbled Murrelet | Federal threatened species | | X | X | X | | | |
| Northern goshawk | Federal species of concern | | X | | X | | | |
| Pacific Fisher | Federal candidate species | X | | | X | | | |
| Peregrine falcon | Federal species of concern | X | X | | | | | |
| Gulls and cormorants | None | X | X | X | X | X | | X |
| Great blue heron | State Monitored Species | X | X | | X | X | | |
| Duck (species) | None | X | X | X | X | | | |
| Beaver | None | X | | | | X | | |
| Cougar | None | X | | | X | | | |
| Black bear | None | X | X | | X | | | |
| River otter | None | X | X | | X | | | X |
| Mink and weasels | None | X | X | | X | | | X |
| Bats | Varies by species 2 | X | | | | X | | |

| Species | Status | Habitat [1] | | | Relationship with Salmon and Steelhead | | | |
|---|---|---|---|---|---|---|---|---|
| | | Fresh-water | Estuary | Marine | Predator | Competitor | Prey | Scavenger |
| Amphibians (e.g., salamanders & frogs) | Varies by species 3 | X | | | X | X | X | |
| Aquatic/terrestrial/ riparian zone invertebrates (e.g., insects and snails) | Varies by species 4 | X | X | | | | X | X |
| Southern Resident Killer Whale | Federal Endangered Species | | | X | X | | | |
| Harbor seal | Protected under MMPA 5 | | X | X | X | X | | |
| Steller sea lion | Protected under MMPA; Western DPS ESA-listed endangered | | X | X | X | X | | |
| California sea lion | Protected under MMPA | | X | X | X | X | | |
| Northern sea otter | Protected under MMPA; Federal species of concern | | X | X | X | X | | |
| Harbor porpoise (Inland Washington and Oregon-Washington Coastal | Protected under MMPA; State | | | X | X | X | | |
| Dall's porpoise (California /Oregon/Washington stock) | Protected under MMPA | | | X | X | X | | |

| Species | Status | Habitat [1] | | | Relationship with Salmon and Steelhead | | | |
|---|---|---|---|---|---|---|---|---|
| | | Fresh-water | Estuary | Marine | Predator | Competitor | Prey | Scavenger |
| Pacific white-sided dolphin (California /Oregon/Washington stock) | Protected under MMPA. | | | X | X | X | | |
| Marine invertebrates (e.g., zooplankton; crab) | None | | X | X | | | X | X |

Sources: Listed and Proposed Endangered and Threatened Species and Critical Habitat; Candidate Species; And Species of Concern in Snohomish County. As Prepared by The U.S. Fish and Wildlife Service Washington Fish and Wildlife Office. (Revised March 15, 2012; Washington State Species of Concern Lists: http://wdfw.wa.gov/conservation/endangered/lists/search.php?searchby=simple&search=black+bear&orderby=AnimalType percent2CCommonName

State threatened and monitored species are so designated under the Washington State Endangered, Threatened, and Sensitive Species Act (Subsection 1.6.9).

Notes:

[1] Includes those habitats most relevant for evaluating interactions with salmon and steelhead; does not include all habitats used by each species.

[2] Applicable listed species include Long-eared myotis (Myotis evotis) (Federal sensitive species); Long-legged myotis (Myotis volans) (Federal sensitive species); and Pacific Townsend's big-eared bat (Corynorhinus townsendii townsendii) (state and Federal candidate species).

[3] Applicable listed species include federally listed sensitive species (Cascades frog (Rana cascadae) (State Monitored); Olympic torrent salamander (Rhyacotriton olympicus); Tailed frog (Ascaphus truei) (State Monitored); Van Dyke's salamander (Plethodon vandykei); and Western toad (Bufo boreas).

[4] Applicable listed species include federally listed snails (Bliss Rapids snail, Taylorconcha serpenticola, (federally threatened), Banbury Springs lanx, Lanx sp., (federally endangered), Snake River physa snail, Physa natricina, (federally endangered), Utah valvata, Valvata utahensis, (federally endangered).

[5] Marine Mammal Protection Act. Enacted by Congress in 1972, the MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.

Salmon eat invertebrates and amphibians, which may include insects and frogs. Salmon predators include several species of birds, cougars, black bear, river otter, mink, weasels, and some amphibians. Some bird species, including bald eagles (protected under the Bald and Golden Eagle Protection Act (Subsection 1.6.2, 16 U.S.C. 668-668c)) and cormorants, scavenge on salmon and steelhead carcasses, as do minks, weasels, and several invertebrate species. Other wildlife species compete with salmon and steelhead for food or habitat (e.g., gulls). Fish are not the only component of the diets of these species, though salmonids may represent a somewhat larger proportion of the diet during the relatively short periods of the year that juvenile salmon emigrate from, and adults return to the analysis area.

Within the analysis area, there are several wildlife species listed under the ESA. The marbled murrelet is listed as endangered and the northern spotted owl is listed as threatened – both of these are found in Snohomish County, Washington (USFWS 2012), the county encompassing the

majority of the analyses area. Other ESA-listed wildlife species in Snohomish County are the Canada lynx, gray wolf, and grizzly bear. Federal candidate wildlife species within the action area are the fisher, North American wolverine, Oregon spotted frog, and yellow-billed cuckoo. The bald eagle, Beller's ground beetle, Cascades frog, long-eared myotis, long-legged myotis, northern goshawk, olive-sided flycatcher, Pacific Townsend's big-eared bat, peregrine falcon, tailed frog, and western toad are present in the action area and are designated by the U.S. Fish and Wildlife Service as "species of concern." Harbor seals, sea lions, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins are present in Puget Sound, and nearshore marine areas immediately adjacent to where Snohomish region hatchery-origin adult fish return. Southern resident and Bigg's killer whales are also observed in marine waters of Puget Sound proximate to the analyses area. Steller sea lions are listed under the ESA as threatened. Steller sea lions, with California sea lions, harbor seals, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins, are additionally protected under the federal Marine Mammal Protection Act (MMPA) (16 U.S.C. 1361 - Subsection 1.6.3, Marine Mammal Protection Act). The southern resident killer whale is also listed under the federal ESA as endangered.

Although southern resident killer whales, harbor seals, sea lions, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins are not found in freshwater tributaries in the Snohomish River basin (harbor seals and sea lions may range into upper estuarine areas), they do intercept adult salmon returning to the basin when feeding in adjacent marine waters. Harbor seals may also be important predators of Snohomish River basin-origin salmon and steelhead smolts transiting the Salish Sea in seaward areas (Moore et al. 2010; Moore et al. 2015). Harbor seals and sea lions have been observed in nearshore areas preying on salmon produced by the proposed hatchery programs. An estimated 50 seals and sea lions annually move into Tulalip Bay beginning with the return of hatchery-origin Chinook salmon in June, remaining in the bay through January, which is the end of the annual chum salmon run. The Tulalip Tribes estimate that these pinnipeds consume about half of the fish encountered in continuously-manned nets in Tulalip Bay tribal salmon fisheries (Mike Crewson, Tulalip Tribes, personal communication, September 24, 2014). No other marine mammals are likely to prey on Snohomish River basin-origin salmon in the analysis area.

Based on currently available data, the southern resident killer whale diet in inside Puget Sound marine waters during the summer months consists mainly of salmon, with Chinook salmon being the preferred species, making up approximately 80 percent of all salmon species consumed (Hanson et al. 2010, Ford et al. 2016). The density of Chinook salmon in the summer as they migrate into Puget Sound, predominately fish originating from and returning to the Fraser River, is far higher than the density in the rest of the year when Chinook salmon are spread over a much larger area in the Pacific Ocean (Hilborn et al. 2012). Summer-run Chinook salmon from the proposed hatchery actions return to the Salish Sea between May and July and while their summer return timing makes adult Chinook salmon from the proposed hatchery action available to southern resident killer whales, their contribution is unsubstantial relative to overall Chinook abundance in the Salish Sea (PFMC 2011; CTC 2015). Chinook salmon abundance in areas frequented by the whales during the summer months is dominated by much more abundant fish originating from and returning to the Fraser River (Hilborn et al. 2012).

However, the summer period, when Chinook salmon return to the Snohomish River basin, is not likely to be the most critical period when Chinook salmon abundance affects southern resident killer whale population health. The expert scientific panel convened by NMFS found that it is unlikely that the summer period would be the most critical period where Chinook salmon abundance affected SRKW vital rates (Hilborn et al. 2012). Additionally, although there is evidence for strong reliance on Chinook salmon in the killer whale diet in the summer, southern resident killer whales have been shown to switch to alternative, more abundant chum salmon when Chinook salmon of suitable size and quality are not readily available in the fall (Hilborn et al. 2012). For these reasons, and because Snohomish River basin salmon, including Chinook salmon, co-occur in inside marine waters with many other hatchery-origin and natural origin salmon populations originating from other Puget Sound watersheds, the Fraser River, Columbia River, and Washington Coast, under current conditions, fish produced through the current salmon hatchery programs are not a substantial component of the killer whale diet.[5]

None of the facilities supporting Snohomish River basin hatchery programs under baseline conditions relies on hazing wildlife to prevent them from eating fish being raised in the hatchery facilities. Instead, the hatchery facilities use nets over their raceways and rearing ponds to exclude predators, and this practice is not expected to have adversely affect any wildlife species (Tulalip 2012; WDFW 2013a; 2013b; 2013c; Tulalip 2013a; 2013b). Similarly, pinniped exclusion vertical bar structures framing the mouths of Tulalip and Battle Creeks are used to exclude harbor seals and sea lions congregating to prey on returning hatchery-origin Chinook, coho and chum salmon (Tulalip 2013b).

## 3.6 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 regions where the hatchery facilities operate. Hatchery facilities generate economic activity (personal income and jobs) by providing employment opportunities and through local procurement of goods and services for hatchery operations.

Current annual operation of the Snohomish River basin salmon hatchery programs contributes approximately $900,000 (through the procurement of local goods and services) and 9 full-time, and up to 22 temporary jobs to the regional economy (Tulalip 2012; WDFW 2013a; 2013b; 2013c; Tulalip 2013a; 2013b). The Tulalip Tribes operate the Tulalip Hatchery, the Tulalip Creek upper and lower Ponds, and the Battle Creek Pond program, employing five full-time hatchery employees, two permanent intermittent employees, and from one to twenty temporary workers during spawning, egg shocking and picking, fish transfers, and tagging operations

[5] The number of adult fish produced by Snohomish River basin hatchery programs represents an unsubstantial proportion of the total abundance of each salmon species present in Puget Sound and Pacific Coastal marine areas. For example, a recent ten year (2000-2009) average of 16,906 Chinook salmon originating from Snohomish-Stillaguamish natural areas and hatcheries returned each year to Puget Sound (PFMC 2011). The 2000-2009 average total run size for Chinook salmon in Puget Sound was 247,917 fish, and the estimated total annual ocean abundance of Chinook salmon from all regions in Washington State and British Columbia Pacific Ocean coastal waters averages approximately 1,000,000 fish (L. LaVoy, NMFS, pers. comm., January 6, 2012).

(Tulalip 2012; 2013a; 2013b). WDFW operates Wallace River Hatchery, using four full-time employees to perform operation and maintenance duties (WDFW 2013a; 2013b). The Everett Bay Net-Pen coho salmon program is supported by WDFW staff from Wallace River Hatchery, and is operated by several volunteer workers from the Everett/ Puget Sound Anglers organization (WDFW 2013c).

Fisheries contribute to local economies through the purchase of supplies such as fishing gear, camping equipment, consumables, and fuel at local businesses. All of these expenditures help to support local businesses, but it is unknown how dependent these businesses are on fishing-related expenditures. Anglers also contribute to the economy through payments for fishing outfitter, guide, and charter fees.

Fisheries directed at salmon currently produced by the Snohomish River basin hatchery programs only occur in limited places and times in terminal fishing areas (Tulalip Bay and the Skykomish and Snohomish Rivers). However, under the baseline, hatchery program-origin salmon are also harvested incidentally with fish originating from other regions in U.S. and Canadian marine area commercial and recreational fisheries. Fisheries to which Snohomish River basin salmon contribute extend from the San Juan Islands and Admiralty Inlet northward, including the west and east coasts of Vancouver Island and southeast Alaska (CTC 2015; WDFW 2013a). Chinook salmon originating from the basin benefit Washington State fisheries regulated by WDFW and the Puget Sound Tribes, and help meet Pacific Salmon Treaty harvest sharing agreements with Canada. Salmon present in those areas originate from watersheds throughout the Pacific Northwest and southeast Alaska regions, with the total abundance of Chinook salmon alone numbering about 1.0 million fish in an average year, of which fish originating from the action area are a small proportion (PFMC 2011; CTC 2015).

Although coho and chum salmon originating from the Snohomish River basin represent the primary source of salmon harvests in nearby marine waters, contributions of basin-origin salmon are less important for mixed stock marine area fisheries outside of the analysis area. Fisheries in Puget Sound and Strait of Juan de Fuca do benefit from salmon production from the programs. Snohomish River basin salmon incidentally intercepted in fisheries further offshore in Washington Coast, Southeast Alaska, and British Columbia harvest areas represent an unsubstantial proportion of the total number of fish harvested in those areas. Salmon originating specifically from Snohomish River basin hatchery programs do not contribute substantially to fisheries in other marine areas of the Pacific Northwest. Although harvest contributions of Snohomish River basin-origin salmon in other marine area fisheries may be important in some years and for some fisheries (e.g., WDFW regulated recreational fisheries in Puget Sound), the vast majority of salmon produced by the hatchery programs are harvested in nearshore marine and freshwater area fisheries occurring within Snohomish County.

Commercial and recreational fishing activities in Washington State contribute substantial economic benefits at the state level through employment, sales, income, and value added impacts) and expenditures on fishing trips and durable equipment at the regional level. In 2011, approximately 67,000 jobs in Washington were associated with the commercial finfish and shellfish industry (harvesters, processors, wholesalers and retailers), with $8.0 billion in ex-vessel, value-added and import sales (this and following from NOAA 2013). Total commercial

fisheries landings revenue that year was $331 million for 211 million pounds of fish and shellfish landed. A portion of total annual seafood industry employment and revenue accrued from commercial salmon fisheries and sales. The recent 10 year (2002-2011) average total landings revenue for commercial salmon fisheries in Washington State was $22.8 million (in 2011, $42.4 million). For this period, Washington commercial salmon fisheries landed an estimated 26.3 million pounds of fish at an average value per pound of $0.88. In 2011, an estimated 4,900 jobs in Washington were generated by recreational fishing activities, including activities directed at salmon. These employment impact estimates were generated by expenditures on recreational fishing trips taken by anglers (private or rental boat, for-hire boat, or shore-based trips) or expenditures on durable equipment. In Washington, most of the employment impacts in 2011 (72 percent) were generated by expenditures on durable equipment, with value added impacts that year of $275 million. In addition to employment impacts, the contribution of recreational fishing activities to Washington's economy can be measured in terms of sales impacts and the contribution of these activities to gross domestic product (value added impacts). In 2011, recreational fisheries-associated sales impacts in Washington were $514 million. These statewide economic impacts are concentrated in the primary places where fishing actually occurs, and communities in proximity to those places are disproportionately affected. Therefore, these fishery-related economic impacts (e.g., jobs, income, sales from stores, employment) are not shared evenly across the state. For example, within the action area, impacts associated with hatchery salmon production originating from the Tulalip Bay hatcheries would be largely confined to tribal fishing families.

Data on the number of jobs in Washington currently supported through commercial and recreational fisheries harvests of Snohomish region hatchery salmon, and fishing-related expenditures directed at Snohomish region -origin salmon only, are not available. However, the annual amount of money (ex-vessel value) directly generated to fishers by Tulalip Tribal and WDFW commercial net fisheries for Chinook and/or coho salmon in basin marine waters can be estimated based on available data. Assuming annual recent year average total net fishery harvests of 5,749 hatchery-origin Chinook salmon and 32,278 hatchery-origin coho salmon (Subsection 3.3.1 – Puget Sound Chinook Salmon and Subsection 3.3.5 – Puget Sound Coho Salmon), average individual fish weights of 15 pounds and 8 pounds, respectively, and the average value per pound of $0.88[6] cited above, the average annual ex-vessel value of the commercial net fishery harvest in Snohomish River basin marine areas is $318,301. To encompass expanded impacts to the local economy inclusive of and beyond just ex-vessel value, NMFS (2014) provided estimates of the subregional economic impacts per pound of commercially landed salmon in the North Puget Sound region that includes the action area. Applying marine area tribal and non-tribal commercial fishery economic impact values from NMFS (2014) of $2.38 for Chinook salmon and $1.85 per pound for coho salmon to the above average annual harvest levels and average individual fish weights, the average annual economic

[6] This average value per pound estimate is an average for all salmon species. Chinook and coho salmon are a higher valued species compared with chum and pink salmon, with ex-vessel prices averaging $2.35 per pound for Chinook salmon and $1.52 per pound for coho salmon (NMFS 2014), and approaching $6 per pound for Chinook salmon and $3 per coho salmon in some years (M. Crewson, pers. comm. January 26, 2016). The commercial catch values provided for these species are therefore likely to be minimums.

impact for the commercial net fishery harvest in Snohomish River basin marine areas is $682,954.

The recent year average annual recreational fisheries harvest of mostly hatchery-origin Chinook salmon in the Tulalip "bubble area" fishery over the same 5-year period evaluated for commercial fisheries impacts was 1,145 fish (Subsection 3.3.1 – Puget Sound Chinook Salmon). The value of these recreational fishery-caught Chinook salmon to the local economy (i.e., through fishery-related expenditures) is unknown, but important to sectors of the community.

Under baseline conditions, commercial and recreational salmon fisheries in Snohomish River basin areas are of high value to the Tulalip Tribes and to the local region. This is especially true for tribal fishers dependent on hatchery-origin salmon returns to Tulalip Bay, where Tulalip tribal members who are most dependent on salmon for income and sustenance are able to fish using methods requiring minimal costs. However, the relative contribution of fisheries within the action area, and other fisheries supported by the Snohomish River basin salmon hatchery programs in the analyses to the total Washington State economy is likely unsubstantial. Total fishing-related expenditures in the entire state of Washington accounted for less than 0.2 percent ($534 million) of the total state revenue in 2006, and salmon angling only accounted for a portion of that total (USCB 2012).

## 3.7 Cultural Resources

Impacts on cultural resources typically occur when an action disrupts or destroys cultural artifacts, disrupts cultural use of natural resources, or would disrupt cultural practices. Salmon produced through the current Snohomish region hatchery programs directly affect cultural resources and practices of the Tulalip Tribes. Salmon represent an important cultural resource to the Tulalip Tribes, and are a core symbol of tribal identity, individual identity, and the ability of Native American cultures to endure (NMFS 2005; Stay 2012). The survival and well-being of salmon is seen as inextricably linked to the survival and well-being of Native American people and the cultures of the tribes (NMFS 2005). The hatchery programs also have the potential to negatively affect cultural resources if there is construction or expansion at the hatchery facilities that disrupts or destroys cultural artifacts or if the hatchery programs affect the ability of Native American tribes to use salmon and steelhead in their cultural practices.

The Tulalip Tribes' "usual and accustomed" fishing area, as defined by the federal court, includes the entire Snohomish River basin and marine waters extending from the Canadian border to mid-Puget Sound, including Possession Sound, Port Susan, and Port Gardner Bay. The use of hatcheries to foster returns of salmon to the tribes' important on-reservation fishing area in Tulalip Bay, and to the Snohomish River basin's ecosystems and food webs, has a deep, resonating value and purpose for the Tulalip Tribes (this and following from Tulalip 2012). The cultural value of returning salmon to the tribe, and of fish harvested for use by Tribal members to continue ancient traditional ceremonies, religious events, or funerals, is immeasurable. From the Tulalip Tribes' perspective, no value can be placed on the salmon resource, and the fish are as much an iconic part of the Tulalip People's culture as any other thing imaginable. The relationship between the Tulalip Tribes and salmon extends back thousands of years. Tribal rights for the harvest of salmon for food, cultural, and ceremonial uses are enhanced by the Snohomish River basin hatchery programs, directly providing salmon to meet the Tribes' treaty-

affirmed fishing rights. The availability of hatchery-origin fish greatly strengthens the Tribes' culture as well as the Tribes' self-sufficiency and competence in natural resource management. In addition, recreational and economic benefits to the Indian and non-Indian communities may accrue through increased fishing opportunities, augmentation of fisheries-related jobs, revenue generated by local service industries as a result of increased tourism, and through the sale of fish and fishing equipment. By providing increased abundance and fishing opportunities, the hatchery programs help maintain public support for salmon recovery efforts as well. Since the advent of the Tulalip Tribes' Chinook salmon hatchery program in the early 1980's, the Tribes' salmon fisheries have shifted from mixed stock marine areas, to the lower Port Susan and Tulalip Bay terminal fishing area, where the Tribes have the opportunity to conduct directed Chinook, coho, and fall chum salmon harvest on hatchery-origin adults. Tulalip Tribes' fisheries have shifted to target hatchery-origin salmon concentrated in the Tulalip Bay extreme terminal area where adult fish return to their point of origin. This area, largely devoid of commingled wild stocks, has greatly contributed to regional salmon recovery efforts by reducing fishery impacts on culturally important, ESA-listed, natural-origin Chinook salmon populations and other natural-origin species and stocks of concern. It would not be possible to employ time-area fishery management strategies similar to those implemented in Tulalip Bay to avoid impacts on natural-origin adult salmon, including those populations destined for the Snohomish and Stillaguamish River basins, in large, more-seaward marine fishing areas where salmon stocks are greatly intermingled.

## 3.8 Human Health and Safety

Hatchery facilities may use a variety of chemicals to maintain a clean environment for the production of disease-free fish. Common chemical classes include disinfectants, therapeutics (e.g., antibiotics), anesthetics, pesticides/herbicides, and feed additives. The production of these chemicals for the protection of public health and the environment is governed by the Environmental Protection Agency (through the Federal Insecticide, Fungicide, and Rodenticide Act) and Food and Drug Administration (through the Federal Food, Drug, and Cosmetic Act). Use of chemical products in the workplace is not considered a threat to human health when label warnings and directions are followed as established by EPA or FDA. Chemicals used in hatcheries are typically disposed of according to label requirements or discharged as effluents to receiving waters according to established water-quality guidelines developed through Federal or state regulations. However, some chemicals (e.g., antibiotics) do not have established water-quality criteria. A more in-depth description of specific chemicals used at hatchery facilities and their potential effects can be found in Subsection 3.2, Fish Habitat, and in the Draft EIS for Puget Sound hatcheries (NMFS 2014).

A number of parasites, viruses, and bacteria are potentially harmful to human health and may be transmitted from fish species (NMFS 2014). Many of these are transmitted primarily through seafood consumption (i.e., improperly or under-cooked fish). Although it is extremely rare, hatchery facility workers may also be exposed to diseases while handling fish, through direct contact with fish, or by accidental needle-stick injuries during vaccination of fish (Section 3.7.6, Relevant Disease Vectors and Transmission).

Seafood consumption by humans is generally promoted due to the nutritional value of fish products. For example, fish contain elevated levels of omega-3 fatty acids, which are considered

beneficial to the cardiovascular system (Mayo Clinic 2010). However, concerns have been raised that farm-raised and hatchery-origin fish may contain contaminants that may pose a health risk to consumers (WHO 1999; Hites et al. 2004; Jacobs et al. 2002a; Jacobs et al. 2002b; Easton et al. 2002). Sources of contaminants in the fish may include chemicals or therapeutics, contamination of the nutritional supplements or feeds, and/or contamination of the environment where the fish are reared or released (Jacobs et al. 2002a; Jacobs et al. 2002b; Easton et al. 2002; Hites et al. 2004; Carlson and Hites 2005; Johnson et al. 2007; Johnson et al. 2009; Maule et al. 2007; Kelly et al. 2008). As a result of their propagation in the hatchery environment, hatchery-origin fish may contain chemicals of concern. However, the risk from consuming contaminants in hatchery-origin fish that are directly attributable to hatchery propagation is unsubstantial. When considered in the context of contaminant levels in the Salish Sea, hatchery salmon are much more likely to accumulate contaminants of concern during their estuarine and ocean life history phases (O'Neill and West 2009).

Several watersheds in Puget Sound (including the lower Snohomish River basin) and portions of Puget Sound proper have 303(d) listed contaminants that may be at levels of concern to human health where the contaminants are concentrated. Time spent within the vicinity of these contaminated areas with Puget Sound appears to be an important factor in contaminant loading for Chinook salmon. Natural-origin and hatchery-origin Chinook salmon originating from the Snohomish River basin and other Puget Sound regions occur at various times year-round in Puget Sound estuaries as juveniles, and to a greater extent, in Puget Sound marine waters as immature sub-adult and adult resident "blackmouth" salmon. In general, as a highly piscivorous species, Chinook salmon appear to have the highest PCB loads of all salmon species returning to Puget Sound watersheds (O'Neill et al. 2006; O'Neill and West 2009). Uptake of organic contaminants directly from water to fish is considered to be a minor accumulation pathway, and the major source of contamination in salmon is probably their diet (Johnson et al. 2007). The average PCB content of Puget Sound Chinook salmon was found in one study to be 53 parts per billion (ppb), compared to levels of 10-20 ppb in Chinook salmon from Alaska, British Columbia, and the Washington and Oregon coasts (O'Neill et al. 2006). Coho salmon from Puget Sound had average values of 31 ppb. Herring in Puget Sound have high levels of PCBs as well, and herring are the preferred prey of Chinook salmon. The FDA PCB tolerance level in food products is 2 ppm, and the average PCB concentration found by researchers in Puget Sound Chinook salmon was about 2.7 percent of the FDA limit. The amount of PCBs that could contribute to the diet of the *average* American from salmon is unsubstantial in the context of overall PCB intake from all food sources (e.g., beef, chicken, pork) (Hardy 2005). However, based on the total amount of toxins observed in Puget Sound Chinook salmon (including PCBs), the Washington State Department of Health (DOH) in their Human Health issued a Fish Consumption Health Advisory in 2006 to limit consumption to no more than one serving per week (Selecky et al. 2006). Data published by the Tulalip and Squaxin Island Tribes (Toy et al. 1996) and WDOE (WDOE 2013) indicates the average salmon consumption rates on which the DOH Advisory was based are substantial underestimates for Puget Sound tribal communities, where salmon composes a high proportion of the diet. Contaminant risks to human health resulting from salmon consumption may therefore be substantially higher for tribal communities than for the average American.

## 3.9 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.

Executive Order 12898 (59 FR 7629) states that Federal agencies shall identify and address, as appropriate "…disproportionately high and adverse human health or environmental effects of [their] 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, certainly 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, Alaskan Native, Native Hawaiian or other Pacific Islander, and Hispanic[7].
- 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 EA, 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, per capita income, and percentage below poverty level are meaningfully greater than the percentage of minority, per capita income, and percentage below poverty level in Washington State.

The majority of the Snohomish River basin, and all hatcheries currently supporting the basin's salmon hatchery programs, are located in Snohomish County. Although contributions of

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

Snohomish River basin-origin salmon in other areas, in particular, Puget Sound and Strait of Juan de Fuca marine area fisheries, may be important in some years, the vast majority of salmon produced by the hatchery programs are harvested in nearshore marine and freshwater areas encompassed within Snohomish County (Subsection 3.6, Socioeconomics). Therefore, for the purposes of this analysis, it is assumed that Snohomish County is the only county that would be meaningfully affected by Snohomish River basin salmon hatchery programs. Considering poverty level, Snohomish County is not an environmental justice community of concern because 9.3 percent of the population is below the poverty level, compared to 12.5 percent for the state as a whole (Table 11). However, because the percent Asian population in the county is meaningfully greater than the state-wide average, Snohomish County can be considered an environmental justice community.

Table 11. Percentage minority, per capita income, and percentage below poverty level in Snohomish County and Washington State.

| Indicator | Snohomish County | Washington State |
|---|---|---|
| Black (percent in 2011) | 2.8 | 3.8 |
| American Indian (percent in 2011) | 1.6 | 1.8 |
| Asian (percent in 2011) | 9.2 | 7.5 |
| Pacific Islanders (percent in 2011) | 0.5 | 0.7 |
| Hispanic or Latino origin (percent in 2011) | 9.2 | 11.6 |
| Per capita income (2007- 2011) | $31,276 | $30,481 |
| Below poverty level (percent in 2007-2011) | 9.3 | 12.5 |

Source: http://quickfacts.census.gov/qfd/states/53/53061.html;

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).

The Tulalip Tribes’ 22,000-acre reservation (Tulalip Indian Reservation) is located north of Everett and the Snohomish River and west of Marysville, Washington, in Snohomish County. The Tulalip Indian Reservation was reserved for the use and benefit of Indian tribes and bands

signatory to the Treaty of Point Elliott of January 22, 1855 (Subsection 1.6.5, Treaties of Point Elliot, Medicine Creek, and Point No Point; this and following from: http://www.tulaliptribes-nsn.gov/Home/WhoWeAre/AboutUs.aspx). Under the Treaty, the tribes collectively agreed to cede their ancestral lands and relocate their homes onto the Reservation. Its boundaries were established by the 1855 Treaty and by Executive Order of President U.S. Grant dated December 23, 1873. The reservation was created to provide a permanent home for the Snohomish, Snoqualmie, Skagit, Suiattle, Samish and Stillaguamish Tribes and allied bands living in the region. After living alongside one another on the reservation for seventy-nine years, the tribes formed a single governmental structure under the auspices of the Indian Reorganization Act of 1934 as the Tulalip Tribes. The Tulalip Constitution and Bylaws were approved January 24, 1936, and a charter ratified October 3, 1936. The governing body is the seven-member Tulalip Board of Directors. The Tribes' current population is about 4,576, with 2,551 members residing on-reservation (R. Topaum, Tulalip Tribes Enrollment Officer, pers. comm. with M. Crewson, Tulalip Tribes, January 26, 2016). A 2000 census estimated a total of 9,246 persons residing within the boundaries of the Tulalip Indian Reservation. As described in Subsection 3.7, Cultural Resources, the Snohomish River basin hatchery programs provide cultural, nutritional, economic, and social benefits to the tribes. In addition, the Tulalip Tribes manage and participate in marine area salmon and shellfish fisheries in Tulalip Bay, Possession Sound, Port Gardner Bay, Port Susan, and other areas in the U&A fishing area that extends from the Canadian border to mid-Puget Sound. The Tulalip Tribes' usual and accustomed fishing areas extend west and north to the Canadian border, including the San Juan Islands, where the Tulalip Tribes fish with other tribes for salmon, halibut, and shellfish.

Although American Indians in Snohomish County are below the state-wide average proportion of the minority group, for the above reasons, tribal people within the action area - specifically, the Tulalip Tribes - may be disproportionately affected through the proposed Federal actions: development and implementation of ESA determinations for the Snohomish River basin salmon hatcheries. Environmental justice impacts to the Tulalip Tribes may be considered disproportional to the general population in the action area for several reasons. Within the confines of the Tulalip Indian Reservation fully encompassed by Snohomish River basin action area, the Tulalip Tribes represent a low-income minority group, whose area affected by the proposed NMFS salmon hatchery determination actions exceeds 50 percent. Within the reservation component of the affected area, the percentage of tribal people area (about 28 percent) is meaningfully greater than the American Indian population percentage in the general population within the entire action area (1.6 percent). Also, within the reservation, the percentage of American Indians, and percentage of tribal families below the poverty level (23.5 percent - USCB 2000), are meaningfully greater than in Washington State (1.8 percent and 12.5 percent, respectively). The Tulalip Tribes' Treaty-reserved resources, lands, sites of special cultural, religious, and archaeological importance, and other areas reserved for hunting, fishing, and gathering (the Tribes' usual and accustomed fishing area) as well as the ability to access fish for harvest, may be affected ecologically and culturally by the proposed NMFS action and alternatives. Environmental justice impacts to the Tulalip Tribes may extend to human health, economic, and social impacts, which are interrelated to impacts of the NMFS action on the natural or physical environment. Further, within the action area, the primary consumers of hatchery salmon production considered as part of the Federal action are the poorest tribal fishers, for which salmon produced by the Tulalip Bay hatchery programs were originally designed to

benefit. For these reasons, NMFS is striving to ensure fair treatment, equal protection, and meaningful involvement of the Tulalip Tribes in the development and completion of the agency's ESA determination processes for the salmon hatchery actions.

# 4 ENVIRONMENTAL CONSEQUENCES

## 4.1 Introduction

The four alternatives being evaluated in this EA are described in Chapter 2, Alternatives Including The Proposed Action. The baseline conditions for the eight resources (fish habitat, salmon and steelhead, other fish, wildlife, socioeconomics, environmental justice, cultural resources, and human health and safety) that may be affected by the Proposed Action and alternatives are described in Chapter 3, Affected Environment. This chapter provides an analysis of the direct and indirect environmental effects associated with the alternatives on these nine resources. This chapter analyzes the effects of the Proposed Action and alternatives in the context of these changing environmental conditions. Cumulative effects are presented in Chapter 5, Cumulative Impacts.

The effects of Alternative 1 are described in terms of how current conditions are likely to appear into the future under continued implementation of the programs (Chapter 3, Affected Environment). The effects of the other alternatives are described relative to Alternative 1 (No Action), which reflects current conditions. 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.

### 4.1.1 Critical Habitat

Critical habitat for ESA-listed species in the Snohomish River basin includes many of the identified primary constituent elements (PCEs - see Subsection 3.2). As described in Subsection 3.2, the specific aspects of critical habitat that may be affected by the Proposed Action include: adequate water quantity and quality; excessive predation; and, migration corridors free of obstruction. Hatchery-related water quantity and water quantity effects under the Proposed Action and alternatives are analyzed in Subsection 4.2, Fish Habitat. Potential impacts of hatchery-related predation and barriers to fish migration to critical habitat are analyzed in this Environmental Assessment in the broader discussion of impacts on fish population viability (Subsection 4.3, Salmon and Steelhead and Subsection 4.4, Other Fish Species).

## 4.2 Fish Habitat

Within the "Fish Habitat" resource (Subsection 3.2), the only baseline conditions bearing on the PCEs identified in Subsection 3.1.1 that may have detectable effects through implementation of

the EA alternatives are water quantity and water quality. For other elements of fish habitat, for the Proposed Action and all alternatives, there will be no changes in effects levels relative to the baseline. Hatchery-related effects on water quantity and water quality are analyzed in this subsection. The effects on PCEs from hatchery fish predation and hatchery facilities ("excessive predation"; "migration corridors free of obstruction", respectively) are analyzed in Subsection 3.3, Salmon and Steelhead, and Subsection 3.4, Other Fish Species, where effects on fish population viability are the focus.

Taking into account other human activities in the action area affecting water quantity and water quality aspects of fish habitat, any potentially detectable hatchery-related effects would be confined to certain sites within the action area that are in close proximity to the hatchery locations. Effects on these two components of fish habitat associated with the proposed salmon hatchery operations and the alternatives are summarized here (see Table 12, and analyzed below.

Table 12. Summary of effects on water quantity and water quality components of Fish Habitat.

| Resource | Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Water Quantity** | Undetectable | Same as Alt 1 | Negligible effect | Negligible effect |
| **Water Quality** | Low effect | Same as Alt 1 | Low effect | Low effect |

### 4.2.1 Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule

**Water Quantity**

Under Alternative 1 (No-Action), over the short and long terms, the Snohomish River basin salmon hatchery programs would have the same juvenile salmon production levels as under baseline conditions (Table 3). For the freshwater programs, the same quantities of groundwater and surface water would be used as under baseline conditions for broodstock holding, egg incubation, and juvenile rearing (Table 13). Because the same amount of water would be used, relative to baseline conditions, there would be no change in the amount of surface water flowing between each of the hatchery facilities' water intake and discharge structures. Likewise, there would be no change in the amount of water in any aquifer and no change in compliance with water permits or water rights at any of the hatchery facilities relative to baseline conditions (Subsection 3.2.1 , Water Quantity). As noted in Table 5, percentage surface water withdrawal estimates provided assume hatchery use of available surface water up to the maximum permitted water withdrawal levels. Actual surface water percentages withdrawn for use in the hatcheries, as applied to minimum and mean surface water flows, are much lower.

Fish biomass in the hatcheries, and required water withdrawal amounts, would reach maximum permitted levels only in the late winter and spring months just prior to fish release dates, when flows in river and tributary sources reach the annual maximums listed in Table 5 (Subsection 3.2.1 , Water Quantity). Fish biomass and water requirements for fish rearing at the hatcheries are lowest in the late summer and fall months, when annual minimum flows in surface water sources occur. For these reasons, withdrawal of surface water at maximum permitted levels for fish rearing at Wallace River Hatchery – which would occur only during the late winter and

spring high flow period - are not expected to have a measurable effect on the hydrology or water availability for fish migration or rearing in the Wallace and Skykomish rivers. For Tulalip Table Hatchery, the Tulalip Ponds, and Battle Creek Pond, there are no natural ESA-listed or anadromous fish populations in these areas that would be affected by water withdrawals, regardless of the timing of those withdrawals. The Everett Bay Net-pen program relies on passive tidal flow to supply marine water for rearing fish. No freshwater is withdrawn or used by the program, and there are no detectable effects on marine water quantity, as tidal flows pass through the net-pen with no effects on net flow in the net-pen area. Under Alternative 1, there would therefore be no detectable effect on river hydrology or availability of water relative to the baseline.

Table 13. Water use by hatchery facility and alternative.

| | Surface / Groundwater Use by Hatchery Facility (Maximum cfs) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Baseline Conditions | | Alternative 1 | | Alternative 2 | | Alternative 3 | | Alternative 4 | |
| *Hatchery Facility* | Surface | Ground | Surface | Ground | Surface | Ground | Surface | Ground | Surface | Ground |
| Wallace River Hatchery | 54 | 0 | 54 | 0 | 54 | 0 | 0 | 0 | 27 | 0 |
| Eagle Creek Hatchery | 0.8 | 0 | 0.8 | 0 | 0.8 | 0 | 0 | 0 | 0.4 | 0 |
| Tulalip Hatchery (Bernie Kai-Kai Gobin Hatchery) | 16 | 1.6 | 16 | 1.6 | 16 | 1.6 | 0 | 0 | 8 | 0.8 |
| Tulalip Creek Ponds | 41 | 0 | 41 | 0 | 41 | 0 | 0 | 0 | 41 | 0 |
| Battle Creek Pond | 15 | 0 | 15 | 0 | 15 | 0 | 0 | 0 | 15 | 0 |
| Everett Bay Net-Pen | N/A | 0 | N/A | 0 | N/A | 0 | 0 | 0 | 0 | 0 |

**Water Quality**

Under Alternative 1 (No Action), the Snohomish River basin salmon hatchery programs would have the same production levels as under baseline conditions over the short and long terms (Table 3). There would therefore be no expected change in the discharge of ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, antibiotics, fungicides, disinfectants, steroid hormones, polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites, pathogens, anesthetics, pesticides, and herbicides into the Snohomish River, Tulalip Creek, Battle Creek, or Puget Sound from the hatchery programs (Subsection 3.2.2, Water Quality). Consequently, there would be no change in compliance with NPDES permits where required relative to the baseline. While the hatchery facilities operate in compliance with NPDES permits, there could still be low effects on the environment from the substances typically found in hatchery effluent. However, the amounts of these substances are not expected to result in substantial effects on the stream environment because of the settling pond at Wallace River Hatchery designed to ameliorate the effects of the effluent. Because of the short duration of seasonal use at the sites, and resultant low poundage of fish production, Tulalip Hatchery, the Tulalip Creek Ponds and Battle Creek Pond programs do not produce enough effluent to cause detectable adverse effects. No changes would be expected to “category 5” 303(d) listings for the Wallace, Skykomish, and Snohomish Rivers, because hatchery production levels and ongoing contributions of substances from other sources (e.g., from activities such as human development, agricultural practices, and forest practices) would be the same as under baseline conditions. There would continue to be no known mitigation actions

being implemented within the analysis area that would remove these impaired water bodies from the 303(d) list in the foreseeable future. For these reasons, any change in effects on water quality under Alternative 1 would be undetectable relative to the baseline.

### 4.2.2 Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule

**Water Quantity**

Under Alternative 2, the Snohomish River basin salmon hatchery programs would have the same production levels as under Alternative 1 over the short and long terms (Table 3), so the same amount of groundwater and surface water would be used as under Alternative 1 for broodstock holding, egg incubation, and juvenile rearing (Table 12). Because the same amount of water would be used, there would be no change in the amount of surface water flowing between each of the hatchery facilities' water intake and discharge structures. Likewise, there would be no change in the amount of water in any aquifer and no change in compliance with water permits or water rights at any of the hatchery facilities relative to Alternative 1. As described in Subsection 4.2.1, fish biomass in the hatcheries, and therefore required water withdrawal amounts, would reach maximum permitted levels only in the late winter and spring months just prior to fish release dates, when flows in river and tributary sources reach the annual maximums listed in Table 5 (Subsection 3.2.1, Water Quantity). Fish biomass and water requirements for fish rearing at the hatcheries are lowest in the late summer and fall months, when annual minimum flows in surface water sources occur. For these reasons, under Alternative 2, withdrawal of surface water at maximum permitted levels for fish rearing Wallace River Hatchery – which would occur only during the late winter and spring high flow period - are not expected to have a measurable effect on the hydrology or water availability for fish migration or rearing in the Wallace and Skykomish rivers. For the Eagle Creek Hatchery, Tulalip Hatchery, Tulalip Ponds, and Battle Creek Pond programs, there are no natural ESA-listed or anadromous fish populations in the associated streams that would be affected by water withdrawals, regardless of the timing of those withdrawals. There would therefore be no detectable effect on river hydrology or availability of water pertaining to effects on natural origin fish. The Everett Bay Net-pen program relies on passive tidal flow to supply marine water for rearing fish. No freshwater is withdrawn or used by the program, and there are no detectable effects on marine water quantity, as tidal flows pass through the net-pen with no effects on net flow in the net-pen area. For the above reasons, effects on water quantity under Alternative 2 would be the same as under Alternative 1.

**Water Quality**

Under Alternative 2, the Snohomish River basin salmon hatchery programs would have the same production levels as under Alternative 1 over the short and long terms, so there would be no expected change in water quality relative to Alternative 1 as a result of changes in the discharge of ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, antibiotics, fungicides, disinfectants, steroid hormones, pathogens, and anesthetics, pesticides, and herbicides into the Snohomish River, Tulalip Creek, Battle Creek, or Puget Sound from the hatchery programs (Subsection 3.2.2, Water Quality). Consequently, compliance with NPDES permits or tribal wastewater plans, and contribution of hatcheries to water quality in any 303(d) listed segments of the analysis area would persist at similar levels relative to Alternative 1. Effects of the hatchery facility effluent on the environment would remain low as a result of water

treatment included at the two largest facilities. For the above reasons, effects on water quality under Alternative 2 would be the same as under Alternative 1.

### 4.2.3 Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin

**Water Quantity**

Under Alternative 3, the Snohomish River basin salmon hatchery programs would be terminated. Consequently, water use would be reduced under Alternative 3 relative to Alternative 1, because there would no longer be in any hatchery facilities in operation that would withdraw water for fish rearing. As under Alternative 1, considering that hatchery water use would be reduced or become negligible, the hatchery facilities would continue to comply with water withdrawal permits and water under Alternative 3. Under Alternative 3, seasonal flows in river or stream reaches from the points of hatchery water withdrawal to the points of discharge may be increased, but to a negligible extent, relative to Alternative 1, considering that water use is non-consumptive; all water would continue to be returned to the rivers or streams near the points of withdrawal. Further, hatchery fish growth and rearing schedules necessitate withdrawal of water up to permitted maximum levels only during the spring months, when natural seasonal flows are highest. For these reasons, although effects on water quantity under Alternative 3 would be reduced relative to Alternative 1, any effects are negligible. An analysis of the site-specific effects under this alternative of the Snohomish River basin hatchery programs is provided below.

*Wallace River Hatchery*

Wallace River Hatchery uses surface water only for salmon production. All surface water diverted from the Wallace River and May Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the Wallace River between the hatchery water intake structures and the hatchery discharge location, and lower May Creek downstream from the hatchery water intake structure.

Under Alternative 3, salmon production at Wallace River Hatchery would be terminated. As a result, up to 54 cfs of water would not be diverted from the Wallace River and May Creek for hatchery use (Table 12). As described in Subsection 4.2.1, fish biomass in the hatchery, and the associated water withdrawal amounts, would reach maximum permitted levels only in the late winter and spring months just prior to fish release dates, when flows in river and tributary sources would substantially exceed the annual average flow listed in Table 5 (Subsection 3.2.1, Water Quantity). Fish biomass and water withdrawals for fish rearing at the hatchery is lowest in the late summer and fall months, when annual minimum flows in surface water sources occur. Undetectable effects on hydrology and water availability for fish migration or rearing in the Wallace and Skykomish rivers are therefore expected under Alternative 1. For these reasons, cessation of surface water withdrawals under Alternative 3 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing.

*Eagle Creek Hatchery*
This hatchery program uses surface water for coho salmon production. All surface water diverted from the unnamed spring supplying the program is returned to the spring near the point of withdrawal. The segments of the spring impacted by hatchery water withdrawal facility would be the 170 feet between the hatchery water intake structure and the discharge location below the lowest rearing pond.

Under Alternative 3, coho salmon production at Eagle Creek Hatchery would be terminated (Table 3). As a result, up to 0.8 cfs of water would not be diverted from the unnamed spring, seasonally affecting the quantity of surface water in the 150 feet of the stream between the water intake and the lowest discharge point. As described in Subsection 4.2.1, surface water withdrawals to support fish biomass in the hatchery would reach the maximum permitted level only in the late winter and spring months just prior to fish release dates, when flows in spring would the annual maximum level and withdrawals would represent a small percentage of the overall flow. Fish biomass and water withdrawals for fish rearing at the hatchery are lowest in the late summer and fall months, when the annual minimum flow in the unnamed spring occurs. The spring lacks any natural ESA-listed or anadromous fish populations that could be affected by water withdrawal. For these reasons, cessation of surface water withdrawals under Alternative 3 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in the spring.

*Tulalip Hatchery (Bernie Kai-Kai Gobin Salmon Hatchery)*
Tulalip Hatchery primarily uses surface water, supplemented with groundwater, for salmon production). All surface water diverted from the East and West Forks of Tulalip Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the East and West Forks of Tulalip Creek between the hatchery water intake structures and the hatchery discharge location at river mile 2.1 of Tulalip Creek. The groundwater used to supplement surface water is drawn from wells on tribal Trust lands.

Under Alternative 3, salmon production at Tulalip Hatchery would be terminated. As a result, up to 16 cfs of water would not be diverted from the East and West Forks of Tulalip Creek (Table 5), seasonally affecting the quantity of surface water in the short stream reaches between the water intakes and discharge structures. As described in Subsection 4.2.1, surface water withdrawals to support fish biomass in the hatchery would reach the maximum permitted level of 16 cfs only in the late winter and spring months just prior to fish release dates, when flows in Tulalip Creek reach the annual maximum of 106 cfs listed in Table 5. Fish biomass and water withdrawals for fish rearing at the hatchery are lowest in the late summer and fall months, when the annual minimum flow in Tulalip Creek occurs. Tulalip Creek lacks any natural ESA-listed or anadromous fish populations that could be affected by water withdrawal. For these reasons, including the non-consumptive nature of water use, cessation of surface water withdrawals under Alternative 3 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Tulalip Creek.

In addition to reduction in the amount of surface water needed for fish rearing, under Alternative 3, up to 1.6 cfs of groundwater would not be withdrawn for use by Tulalip Hatchery. Termination of the hatchery programs and water withdrawals would equate to a negligible effect

on the amount of groundwater available for other users of the aquifer. Therefore, Alternative 3 would have a negligible effect on groundwater relative to Alternative 1.

*Tulalip Creek Ponds*
The Tulalip Creek Ponds use surface water only for salmon rearing. Surface water impounded from Tulalip Creek (minus evaporation) remains in the creek channel, and is released downstream after passage through the ponds. Surface water segments impacted by this rearing facility would be the impounded section of Tulalip Creek, although water is not actually removed from the stream, to the outflow of the ponds, which drains directly into Tulalip Bay.

Under Alternative 3, salmon rearing at Tulalip Creek Ponds would be terminated. Termination of the program would likely result in returning the flow of Tulalip Creek to its natural state, but would not have any effect on water quantity in Tulalip Creek, because when the hatchery is in operation, no water is removed from the creek channel. The water is simply passed through the rearing fish pond. With program termination, the same quantity of available water would be released downstream. In addition, Tulalip Creek lacks any natural ESA-listed or anadromous fish populations that could be affected by surface water use for fish rearing. For these reasons, termination of the Tulalip Creek Ponds program under Alternative 3 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Tulalip Creek.

*Battle Creek Pond*
Battle Creek Pond uses surface water only for salmon rearing. Surface water impounded from Battle Creek (minus evaporation) is returned to Tulalip Bay. Surface water segments impacted by this rearing facility would be the impounded section of Battle Creek, the outflow of the pond drains into Battle Creek at river mile 0.1.

Under Alternative 3, salmon rearing at Battle Creek Pond would be terminated. Termination of the program would likely result in returning the flow of Battle Creek to its natural state, but would not have any effect on water quantity in Battle Creek for the same reasons described above for the Tulalip Creek Ponds. In addition, Battle Creek lacks any natural ESA-listed or anadromous fish populations that could be affected by water impoundment and use for fish rearing. For these reasons, termination of the Battle Creek Pond program under Alternative 3 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Battle Creek.

*Everett Bay Net-Pen*
The Everett Bay Net-Pen program uses seawater, passively supplied through tidal flow. No water is removed from the environment to operate this program.

Under Alternative 3, salmon rearing in the Everett Bay Net-Pen program would be terminated. Because no water is withdrawn from the environment to operate this program, the amount of water in any aquifer and compliance with water permits or water rights would persist at similar levels relative to conditions under Alternative 1. Under Alternative 3, there would be no substantial difference from Alternative 1 regarding the potential for impacts on fish or wildlife as

a result of water quantity effects. Consequently, Alternative 3 would have the same, undetectable impacts on water quantity as Alternative 1.

**Water Quality**

Under Alternative 3, the Snohomish River basin salmon hatchery programs would be terminated and, therefore, effects on water quality may differ relative to Alternative 1. There would be a reduction in the discharge of ammonia, macronutrients (e.g., nitrogen, phosphorus), biological oxygen demand, pH, suspended solids levels, infectious fish pathogens, and possibly, antibiotics, fungicides, disinfectants, pathogens, and anesthetics, pesticides, and herbicides into the Wallace River, the unnamed spring used by Eagle Creek Hatchery, Tulalip Creek, Battle Creek, or Puget Sound that would be associated with the implementation of the Snohomish River basin salmon hatchery programs (Subsection 3.2.2, Water Quality). The effects of a reduction in the discharge of these substances from the Wallace River and Tulalip Creek hatcheries would be low because any hatchery effluents are passed through pollution abatement ponds or offline settling tanks to settle out uneaten food and waste. This waste is periodically removed, and only clarified water from the surface of the settling ponds is discharged into receiving waters (Subsection 3.2.2, Water Quality). The effects of a reduction in the discharge of these substances from Tulalip and Battle Creek ponds would also be low because they have been shown to act as settling ponds to remove suspended sediments, including silt and uneaten food and fish waste, which is then either periodically removed and hauled to an upland repository or the top clarified water is discharged into receiving waters. Terminating salmon production and rearing at Eagle Creek Hatchery, Tulalip Hatchery, Tulalip Creek Ponds, Battle Creek Pond, and the Everett Bay Net-Pens would completely reduce discharge of some of these substances from those locations relative to Alternative 1. Because changes may be detectable in the immediate vicinity of these facilities but ameliorated for the reasons stated above, Alternative 3 may provide a low, biologically beneficial, localized effect on water quality relative to Alternative 1.

Alternative 3 would not be expected to change any of the 303(d) lists relative to Alternative 1 because the contribution of substances from these programs is very small relative to the contribution of substances described under baseline conditions (e.g., from activities such as human development, agricultural practices, and forest practices) (Subsection 3.2.2, Water Quality). Because water quality would be expected to improve under Alternative 3 relative to Alternative 1, there would be no change in compliance with water quality standards associated with NPDES permits for Wallace River Hatchery, Tulalip Hatchery, and Tulalip Creek Ponds relative to Alternative 1. NPDES permits for the Tulalip Hatchery, and Tulalip Creek Ponds would no longer be required because the programs would be terminated. However, Wallace River Hatchery uses most of its capacity to raise Chinook and coho salmon, and termination of the programs under Alternative 3 would cause total fish production for the facility to fall below levels for which a NPDES permit is required. The NPDES permit would no longer be necessary or applicable.

For the above reasons, effects on water quality under Alternative 3 would be reduced to a low extent relative to conditions under Alternative 1.

### 4.2.4 Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin

**Water Quantity**

Under Alternative 4, the hatchery programs would be operated at decreased (one-half) production levels relative to Alternative 1. Less water would be required to rear salmon with a reduction in the number of fish under propagation, but the effects of short and long-term water use would be negligible under Alternative 4 relative to Alternative 1. As under Alternative 1, the programs would remain in compliance with water permits or water rights at the hatchery facilities. The fact that less water would be used relative to Alternative 1 would have no substantial, relative effect on surface water and groundwater quantities in the action area. An analysis of the site-specific effects of the hatchery programs under Alternative 4 is provided below.

*Wallace River Hatchery*

Wallace River Hatchery uses surface water only for salmon production. All surface water diverted from the Wallace River and May Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the Wallace River between the hatchery water intake structures and the hatchery discharge location, and lower May Creek downstream from the hatchery water intake structure.

Under Alternative 4, salmon production at Wallace River Hatchery would be reduced by one-half. As a result, it is assumed that surface water needs for fish rearing would be reduced by one-half relative to Alternative 1 from 54 cfs to 27 cfs (Table 12). Up to 27 cfs less water would be diverted from the Wallace River for fish rearing under Alternative 4 relative to Alternative 1. As described in Subsection 4.2.1, fish biomass in the hatchery, and therefore required water withdrawal amounts, would reach maximum permitted levels only in the late winter and spring months just prior to fish release dates, when flows in river and tributary sources would greatly exceed the annual average flow listed in Table 5 (Subsection 3.2.1, Water Quantity). Fish biomass and water requirements for fish rearing at the hatcheries are lowest in the late summer and fall months, when annual minimum flows in surface water sources occur. Undetectable effects on hydrology and water availability for fish migration or rearing in the Wallace and Skykomish rivers are therefore expected under Alternative 1. For these reasons, including the non-consumptive nature of water use, reduction in surface water withdrawals by one-half under Alternative 4 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing.

*Eagle Creek Hatchery*

The Eagle Creek Hatchery program uses surface water for coho salmon production. All surface water diverted from the unnamed spring supplying the program is returned to the spring near the point of withdrawal. The segments of the spring impacted by hatchery water withdrawal facility would be the 170 feet between the hatchery water intake structure and the discharge location below the lowest rearing pond.

Under Alternative 3, coho salmon production at Eagle Creek Hatchery would be reduced by one-half (Table 3). As a result, it is assumed that surface water needs for fish rearing would be reduced by one-half relative to Alternative 1 from 0.8 cfs to 0.4 cfs (Table 12). Up to 0.4 cfs less

water would be diverted from the unnamed spring for fish rearing under Alternative 4 relative to Alternative 1. As described in Subsection 4.2.1, surface water withdrawals to support fish biomass in the hatchery would reach the maximum permitted level only in the late winter and spring months just prior to fish release dates, when flows in spring would the annual maximum level. Fish biomass and water withdrawals for fish rearing at the hatchery are lowest in the late summer and fall months, when the annual minimum flow in the unnamed spring occurs. The spring lacks any natural ESA-listed or anadromous fish populations that could be affected by water withdrawal. For these reasons, reduction in surface water withdrawal under Alternative 4 will have the same undetectable effect as Alternative 1 on hydrology and water availability for potential fish migration or rearing in the spring.

*Tulalip Hatchery (Bernie Kai-Kai Gobin Salmon Hatchery)*
Tulalip Hatchery primarily uses surface water, supplemented with groundwater, for salmon production. All surface water diverted from the East and West Forks of Tulalip Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the East and West Forks of Tulalip Creek between the hatchery water intake structures and the hatchery discharge location at river mile 2.1 of Tulalip Creek. The groundwater used to supplement surface water is drawn from wells on tribal Trust lands.

Under Alternative 4, salmon production at Tulalip Hatchery would be reduced by one-half relative to Alternative 1 - from 16 cfs to 8 cfs. As a result, up to 8 cfs less water would be diverted from the East and West Forks of Tulalip Creek, affecting the quantity of surface water in the areas between the water intakes and discharge structures (Table 12). As described in Subsection 4.2.1, fish biomass in the hatchery, and therefore the required surface water withdrawal amount, would reach the maximum permitted level only in the late winter and spring months just prior to fish release dates, when flows in Tulalip Creek reach the annual maximum listed in Table 5. Fish biomass and water requirements for fish rearing at the hatchery are lowest in the late summer and fall months, when the annual minimum flow in Tulalip Creek occurs. In addition, Tulalip Creek lacks any natural ESA-listed or anadromous fish populations that could be affected by water withdrawal. For these reasons, reduction of surface water withdrawal by one-half under Alternative 4 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Tulalip Creek.
In addition to surface water, under Alternative 4, up to 0.8 cfs less groundwater would be withdrawn for use by Tulalip Hatchery, likely a negligible on the amount of water available for other users of the aquifer. Therefore, Alternative 4 would have a negligible effect on groundwater relative to Alternative 1.

*Tulalip Creek Ponds*
The Tulalip Creek Ponds use surface water only for salmon rearing. Surface water impounded from Tulalip Creek (minus evaporation) remains in the creek channel, and is released downstream after passage through the ponds. Surface water segments impacted by this rearing facility would be the impounded section of Tulalip Creek, although water is not actually removed from the stream, to the outflow of the ponds, which drains directly into Tulalip Bay.

Under Alternative 4, salmon rearing at Tulalip Creek Ponds would be reduced by one-half relative to Alternative 1. Reduction of the program would not have any effect on water quantity

in Tulalip Creek, because when the hatchery is in operation, no water is removed from the creek channel. The water is simply passed through the rearing fish pond. With program reduction, the same quantity of available water would be released downstream, but there would be a reduced need to impound the water prior to its release. In addition, Tulalip Creek lacks any natural ESA-listed or anadromous fish populations that could be affected by water impoundment and use for fish rearing. For these reasons, reduction of the Tulalip Creek Ponds program by one-half under Alternative 4 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Tulalip Creek.

*Battle Creek Pond*
Battle Creek Pond uses surface water only for salmon rearing. Surface water impounded from Battle Creek (minus evaporation) remains in the creek channel, and is released downstream after passage through the pond. Surface water segments impacted by this rearing facility would be the impounded section of Battle Creek, the outflow of the pond drains into Battle Creek at river mile 0.1.

Under Alternative 4, salmon rearing at Battle Creek Pond would be reduced by one-half relative to Alternative 1. Reduction of the program by one-half would not likely result in returning the flow of Battle Creek to its natural state, and would not have any effect on water quantity in Battle Creek for the same reason described above for the Tulalip Creek Ponds. In addition, Battle Creek lacks natural ESA-listed or anadromous fish populations that could be affected by water impoundment and use for fish rearing. For these reasons, reduction of the Battle Creek Pond program under Alternative 4 will have the same undetectable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Battle Creek.

*Everett Bay Net-Pen*
The Everett Bay Net-Pen program uses seawater, passively supplied through tidal flow. No water is removed from the environment to operate this program.

Under Alternative 4, salmon rearing in the Everett Bay Net-Pen program would be reduced by one-half relative to Alternative 1. Because no water is withdrawn from the environment to operate this program, the amount of water in any aquifer and compliance with water permits or water rights would persist at similar levels relative to conditions under Alternative 1. Under Alternative 4, there would be no substantial difference from Alternative 1 regarding the potential for impacts on fish or wildlife as a result of water quantity effects. Consequently, Alternative 4 would have the same, undetectable impacts on water quantity as Alternative 1.

**Water Quality**
Under Alternative 4, the Snohomish River basin salmon hatchery programs would be reduced by one half and, therefore, effects on water quality may differ relative to Alternative 1. There would be a low level of reduction in the discharge of ammonia, nutrients (e.g., nitrogen), biological oxygen demand, pH, suspended solids levels, and possibly antibiotics, fungicides, disinfectants, pathogens, anesthetics, pesticides, and herbicides into the Wallace River, Tulalip Creek, Battle Creek, or Puget Sound that would be associated with the implementation of the Snohomish River basin salmon hatchery programs (Subsection 3.2.2, Water Quality). The effects of a reduction in the discharge of these substances from the Wallace River and Tulalip

Creek hatcheries would be negligible to low because any hatchery effluents are passed through pollution abatement ponds and tanks to settle out uneaten food and waste. This waste is periodically removed, and only clarified water from the surface of the settling ponds is discharged into receiving waters (Subsection 3.2.2, Water Quality). The effects of a reduction in the discharge of these substances from the Eagle Creek, Tulalip Creek, and Battle Creek ponds would also be negligible to low because they have been shown to act as settling ponds to remove suspended sediments, including silt and uneaten food and fish waste, which is then either periodically removed and hauled to an upland repository or the top clarified water is discharged into receiving waters. Reducing salmon production and rearing by one-half at Tulalip Hatchery, Eagle Creek Hatchery, Tulalip Creek Ponds, Battle Creek Pond, and Everett Bay Net-Pens would reduce discharge of these substances from those locations to a negligible to low extent relative to Alternative 1. Because changes may be detectable in the immediate vicinity of these facilities, Alternative 4 may provide a low, biologically beneficial, localized effect on water quality relative to Alternative 1.

Alternative 4 would not be expected to change any of the 303(d) lists relative to Alternative 1 because the contribution of substances from these programs is very small relative to the contribution of substances described under baseline conditions (e.g., from activities such as human development, agricultural practices, and forest practices) (Subsection 3.2.2, Water Quality). Because water quality would be expected to improve under Alternative 4 relative to Alternative 1, there would be no change in compliance with NPDES permits for Wallace River Hatchery, Tulalip Hatchery, or Tulalip Creek Ponds relative to Alternative 1. However, because the Wallace River Hatchery, Tulalip Hatchery and Tulalip Creek Ponds use all of their capacities to raise Chinook, coho, and fall chum salmon, under Alternative 4, fish production for the facilities would fall below levels for which a NPDES permit is required, and the permits would no longer be necessary or applicable.

For the above reasons, effects on water quality under Alternative 4 would be reduced to a low extent relative to conditions under Alternative 1.

## 4.3 Salmon and Steelhead

Table 7 lists the general mechanisms through which hatchery programs affect, both positively and negatively, natural-origin salmon and steelhead populations in the Snohomish River basin. A summary of specific salmon hatchery-related effects occurring under baseline conditions in the action area - genetic diversity loss, competition and predation effects, fish disease transfer effects, facility effects, and population viability effects - is presented in Subsection 3.3. Effects of the alternatives on each salmon species are summarized in Table 14, and analyzed below.

Table 14. Summary of effects on Snohomish River basin salmon and steelhead.

| Species | Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|---|
| **Puget Sound Chinook salmon** | Undetectable effects | Same as Alt 1 | Low reduction in risks; Medium reduction in benefits | Negligible-Low reduction in risks; Medium reduction in benefits |
| **Puget Sound Steelhead 1/** | Undetectable effects | Same as Alt 1 | Negligible to Low reduction in risks and benefits | Negligible to Low reduction in risks and benefits |
| **Puget Sound Chum salmon** | Undetectable effects | Same as Alt 1 | Low reduction in risks; Medium reduction in benefits | Negligible-Low reduction in risks; Medium reduction in benefits |
| **Puget Sound Pink salmon 1/** | Undetectable effects | Same as Alt 1 | Negligible to Low reduction in risks and benefits | Negligible to Low reduction in risks and benefits |
| **Puget Sound Coho salmon** | Undetectable effects | Same as Alt 1 | Low reduction in risks; Medium reduction in benefits | Negligible-Low reduction in risks; Medium reduction in benefits |
| **Sockeye salmon 1/** | Undetectable effects | Same as Alt 1 | Undetectable effects | Undetectable effects |

1/ These species are not propagated as part of the Proposed Action, so the programs do not impart benefits to the natural-origin population components of the species.

### 4.3.1 Puget Sound Chinook Salmon (ESA-listed).

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the hatchery programs, including juvenile salmon release levels (Table 3), would be implemented the same as under baseline conditions, commensurate with habitat restoration, harvest management, and monitoring actions implemented to improve salmon survival and productivity. Therefore, there would be no change in hatchery-related risks and benefits to the Skykomish and Snoqualmie Chinook salmon populations associated with hatchery program implementation relative to baseline conditions (Section 3.3.1 - Salmon and Steelhead - Puget Sound Chinook Salmon). The salmon hatchery-related effects described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer, and facility effects, would not change relative to baseline conditions as they pertain to effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity. The projected PNI of 0.77 and the pHOS of 12 percent for the hatchery Chinook salmon programs under the baseline, derived based on demographic data, would not change under Alternative 1. There would be no change in the annual number of natural-origin Chinook salmon removed for use as hatchery broodstock relative to the baseline. Any Chinook salmon population viability and nutrient cycling benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, an estimated annual average of 22,740 hatchery-origin adult Skykomish stock Chinook salmon would be produced by the hatchery programs. These fish would be harvested in marine area fisheries, with remaining fish returning to Snohomish River basin marine and freshwater areas (Table 15). After removal of 2,900 hatchery-origin fish for use as hatchery broodstock, 19,840 surplus adult Skykomish Chinook salmon would be available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest within the action area. With respect to considerations regarding the extent to which the Wallace River Hatchery and Tulalip Hatchery Chinook salmon harvest augmentation programs mitigate for lost natural production of Skykomish Chinook salmon, total hatchery-origin adult fish production plus recent year average natural-origin Skykomish Chinook salmon returns under Alternative 1 would be 51.7 percent of the historical equilibrium spawner abundance level of 51,000 Chinook salmon produced under properly functioning habitat conditions in the Skykomish River watershed (Table 15).

Table 15. Total annual Skykomish Chinook adult salmon return by alternative compared with the upper limit of historical equilibrium abundance for the population (Section 3.3.1, Puget Sound Chinook Salmon).

| Alternative | Hatchery-Origin Adult Return [1] | Natural Origin Adult Return [2] | Total Adult Return | Historical Abundance | Total Return Percent of Historical Abundance |
|---|---|---|---|---|---|
| 1 | 22,740 | 3,602 | 26,342 | 51,000 | 51.7 |
| 2 | 22,740 | 3,602 | 26,342 | 51,000 | 51.7 |
| 3 | 0 | 3,602 | 3,602 | 51,000 | 7.1 |
| 4 | 11,370 | 3,602 | 14,972 | 51,000 | 29.4 |

[1] Adult return estimates from Table 4. Assuming smolt release levels in Table 3, and smolt to adult return rates of 0.46 percent for Chinook salmon subyearlings and 1.42 percent for yearlings (Tulalip 2012) and Wallace River Hatchery and Tulalip Hatchery programs under baseline conditions, Alternative 1, and Alternative 2 may produce 22,740 adults each year (total contribution to all fisheries and escapement). Termination under Alternative 3 would produce no hatchery-origin adults, and reduction of the juvenile Chinook salmon release programs by one-half under Alternative 4 would produce 11,370 adult hatchery-origin fish.

[2] Average annual total Puget Sound (Area 4B) Snohomish River basin (Skykomish and Snoqualmie Chinook populations combined) natural-origin Chinook salmon run size estimate for 2009-2013 from Puget Sound Chinook Run Reconstruction (WDFW unpublished data, June 4, 2014), adjusted to address only the component originating from the Skykomish (Skykomish Chinook comprised 61 percent of the 1997-2013 average total annual natural-origin Chinook escapement in the watershed (data from PSIT and WDFW 2010a; Tulalip 2012; Tulalip Tribes, unpublished data 2014). The Skykomish Chinook Puget Sound run size estimate was then expanded by an estimated preterminal (Ocean, Canadian and Alaskan) fishery mortality rate of 23.8 percent for Skykomish fingerling Chinook salmon (2004-2012 annual average from Larrie LaVoy, CTC data, personal communication, November 10, 2014) to derive a total natural-origin component run size estimate (total contribution to fisheries and escapement).

Under Alternative 1, there would be no change in this comparative level of adult fish production relative to the baseline condition.

The watershed recovery plan for the Snohomish River basin (SSPS 2005), as updated annually in the Three Year Work Plan, includes projects under implementation, or proposed for implementation, that would benefit or enhance processes and conditions critical for Chinook salmon population viability, while monitoring VSP parameters. Projects helping to remediate

habitat limiting factors to Chinook salmon would increase smolt to adult return rates for fish produced by the hatchery program. Under Alternative 1, habitat protection and restoration, and population viability monitoring actions implemented to safeguard and improve salmon survival and productivity in the watershed as part of the watershed recovery plan would remain the same as under baseline conditions, as the actions are not affected by or included as part of the Proposed Action.

Over the short term, under Alternative 1, as under baseline conditions, fisheries would continue to directly harvest hatchery-origin Chinook salmon in the Skykomish and Snohomish Rivers; hatchery-origin and natural-origin Chinook salmon in the Tulalip Terminal Area and in some areas of Puget Sound. Snohomish River basin Chinook salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Snohomish River basin Chinook salmon would also be harvested incidentally in Puget Sound and in-river fisheries targeting coho salmon.

Over the long term, continued operation of the Chinook salmon program, in conjunction with other watershed actions successfully implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) as updated annually in the Three Year Work Plan, would be expected to restore the natural-origin and total Chinook salmon populations in the Snohomish River basin to a healthy status approaching historical levels. The level of potential benefit to Skykomish Chinook salmon population viability under Alternative 1 as the program continues into the future would be increased above the baseline level. This expected increase assumes success in protection and restoration of salmon habitat through recovery plan implementation, and effects on natural fish productivity resulting from implementation of hatchery-related risk reduction measures through the proposed programs.

New fisheries with direct harvest impacts on restored Snohomish River basin Chinook salmon populations could potentially be initiated over the long term under Alternative 1. Harvest-related risks to natural-origin Chinook salmon in the Snohomish River basin and Puget Sound under Alternative 1 would be expected to be increased above baseline levels (directed harvest of Chinook salmon in these areas is currently very restrictive), with no differences in effects likely in mixed stock marine area fisheries where Snohomish River basin Chinook salmon would continue to be harvested incidentally.

For the above reasons, under Alternative 1, adverse hatchery-related effects on Chinook salmon and the species' habitat would be the same as under baseline conditions, and beneficial effects would also be the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the operation of the Snohomish River basin salmon hatchery programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on natural-origin Chinook salmon and their habitat as under Alternative 1. There would be more certainty than under Alternative 1 regarding specific hatchery program implementation measures, and hence the magnitude of any hatchery-related

effects, because the programs would be approved under and regulated by the ESA. However, any changes that might occur in hatchery program implementation because ESA authorization was lacking would be speculative, and negligible changes would be expected in the hatchery-related risks summarized in Subsection 3.3. Specifically, the risks associated with genetic diversity loss, competition and predation, fish disease transfer, and facility effects would persist at similar levels relative to Alternative 1, and effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity would remain the same.

Under Alternative 2, as under Alternative 1, an estimated annual average of 22,740 hatchery-origin adult Chinook salmon would contribute to total fisheries harvest, and escapement to Snohomish River basin marine and freshwater areas (Table 15). After removal of 2,900 hatchery-origin fish for use as hatchery broodstock, 19,840 surplus adult Skykomish Chinook salmon would be available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. With respect to considerations regarding the extent to which the Wallace River Hatchery and Tulalip Hatchery Chinook salmon harvest augmentation programs mitigate for lost natural production of Skykomish Chinook salmon, total hatchery-origin adult fish production plus recent year average natural-origin Skykomish Chinook salmon returns under Alternative 1 would be 51.7 percent of the historical equilibrium spawner abundance level of 51,000 Chinook salmon produced under properly functioning habitat conditions in the Skykomish River watershed (Table 15). Under Alternative 2, there would be no change in this comparative level of adult fish production relative to Alternative 1.

The watershed recovery plan for the Snohomish River basin (SSPS 2005), as updated annually in the Three Year Work Plan, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of anthropogenic limiting factors and threats on habitat processes and conditions critical for Chinook salmon population viability, while monitoring VSP parameters. Projects helping to remediate habitat limiting factors to Chinook salmon would be expected to increase smolt to adult return rates for fish produced by the program. Under Alternative 2, habitat protection and restoration, and population viability monitoring actions implemented to safeguard and improve salmon survival and productivity in the watershed as part of the watershed recovery plan would remain the same as under Alternative 1, as the actions are not affected by or included as part of the proposed hatchery programs.

Under Alternative 2, over the short term, the effects of fisheries on Snohomish River basin Chinook salmon would persist at similar levels relative to Alternative 1. Fisheries would continue to directly harvest hatchery-origin Chinook salmon in the Skykomish and Snohomish Rivers; hatchery-origin and natural-origin Chinook salmon in the Tulalip Terminal Area and in some areas of Puget Sound. Snohomish River basin Chinook salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Snohomish River basin Chinook salmon would also be harvested incidentally in Puget Sound and in-river fisheries targeting coho salmon.

Over the long term, continued operation of the Chinook salmon programs, in conjunction with other watershed actions successfully implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) as updated annually in the Three Year Work Plan, would be expected to restore the natural-origin and total Chinook salmon populations in the Snohomish River basin

to a healthy status approaching historical levels. The level of potential benefits to Chinook salmon population viability under Alternative 2 and Alternative 1 would be similar, because program operation and hatchery-origin adult return levels would be similar. Over the long term, risks associated with genetic diversity loss, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer would persist at similar levels relative to Alternative 1 (Section 3.3.1 - Salmon and Steelhead - Puget Sound Chinook Salmon), and effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity would remain the same. However, there would be relative benefits to Chinook salmon population viability attendant with the increasing likelihood that the hatchery programs and associated VSP monitoring and hatchery risk reduction measures will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. Benefit and risks levels for listed Chinook salmon under either alternative depend on the extent to which salmon habitat is protected or restored through recovery plan implementation, and observed effects on natural fish productivity resulting from implementation of hatchery-related risk reduction measures through the proposed programs.

New fisheries with direct harvest impacts on restored Snohomish River basin Chinook salmon populations could potentially be initiated over the long term under Alternative 2. Harvest-related risks to natural-origin Chinook salmon in the Snohomish River basin and Puget Sound under Alternative 2 would be expected to be similar to Alternative 1, with no differences in effects between the alternatives likely in mixed stock marine area fisheries where Snohomish River basin Chinook salmon would continue to be harvested incidentally.

For the above reasons, under Alternative 2, adverse hatchery-related effects on Chinook salmon and the species' habitat would be the same as under Alternative 1, and beneficial effects would also be the same as under Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate risks associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer from salmon hatchery programs in the watershed, because the hatchery programs would cease operation. Potential adverse effects attributable to the hatchery programs in the action area on Chinook salmon life history, abundance, diversity, spatial structure, and productivity under Alternative 3 would become negligible, and any effects would likely be reduced relative to Alternative 1. However, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in natural-origin Chinook salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Similarly, population viability and nutrient cycling benefits for Snohomish River basin Chinook salmon attributable to the proposed hatchery programs would be eliminated, and become negligible, after hatchery-origin fish stop returning to the watershed to spawn (Section 3.3.1 - Salmon and Steelhead - Puget Sound Chinook Salmon). However, because the native Skykomish Chinook salmon population propagated through the Snohomish River basin hatchery Chinook salmon programs is at a low abundance level relative to its historical level (51.7 percent

of the equilibrium spawner abundance level for the aggregate hatchery-natural population), and the condition of natural habitat is currently limiting survival and productivity of the population in the wild, Alternative 3 may increase the risk of extirpation to a low extent, and delay attainment of a viable abundance level to a low extent relative to Alternative 1. Salmon would have similar access to habitat in the Snohomish River basin under Alternatives 3 and 1, but the low abundance of the natural-origin component of the Skykomish population limits dispersal of the species throughout the watershed. The hatchery program fosters use of available productive habitat, particularly in the Skykomish River watershed by augmenting the number of returning adult fish. Termination of the hatchery Chinook salmon program under Alternative 3 would therefore decrease any spatial structure and productivity benefits for Snohomish River basin Chinook salmon populations to a low extent relative to Alternative 1. Hatchery-related risks to listed Chinook salmon associated with genetic diversity loss, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer would be reduced relative to Alternative 1 (Subsection 3.3, Salmon and Steelhead) because the programs producing hatchery salmon posing these risks would be terminated. In particular, any genetic diversity and fitness reduction effects resulting from natural spawning by hatchery Chinook salmon would be eliminated, and become undetectable. Under Alternative 3, the estimated (demographic) PNI for the Wallace River and Tulalip Hatchery programs affecting the Skykomish Chinook salmon population would be 1.0, relative to 0.77 under Alternative 1 (Subsection 3.3, Salmon and Steelhead). Estimated pHOS levels based on demographic and not genetic data for both programs in areas where Skokomish and Snoqualmie Chinook salmon spawn would be zero, reduced from 12 percent under Alternative 1. Any reduction under Alternative 3 in genetic effects that were a legacy of past natural spawning by hatchery Chinook salmon would be negligible, as PNI (and pHOS) levels under Alternative 1 (and hence, the baseline) would have been adequately protective of natural Chinook salmon population genetic diversity and fitness (Subsection 3.3, Salmon and Steelhead). Taking into account the relative degree to which other factors described in the baseline affect the status of salmon in the action area (Subsection 3.2, Fish Habitat), with program termination, on-going effects on Chinook salmon population viability, including genetic diversity and fitness, would be reduced to a negligible to low extent relative to Alternative 1.

Under Alternative 3, no hatchery-origin adult Chinook salmon produced within the action area would contribute to total fisheries harvest or escapement to Snohomish River basin marine and freshwater areas (Table 15). There would be no surplus adult Skykomish Chinook salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest, and only fish that are part of the natural-origin component of the Skykomish population and non-local stray hatchery fish would return to the basin. The total all natural-origin Skykomish Chinook salmon return to basin areas under Alternative 3 of 3,602 fish compares with historical equilibrium abundance level for the Skykomish population of 51,000 fish (Section 3.3.1 - Salmon and Steelhead - Puget Sound Chinook Salmon). With respect to considerations regarding the extent to which the Wallace River Hatchery and Tulalip Hatchery Chinook salmon harvest augmentation programs mitigate for lost natural production of Skykomish Chinook salmon, total hatchery-origin adult fish production plus recent year average natural-origin Skykomish Chinook salmon returns under Alternative 3 would be 7.1 percent of the historical equilibrium spawner abundance level of 51,000 Chinook salmon produced under properly functioning habitat conditions in the Skykomish River watershed (Table 15). Under Alternative

3, the level of adult Skykomish Chinook salmon production would be reduced to a medium to high extent relative to Alternative 1.

The watershed recovery plan for the Snohomish River basin (SSPS 2005), as updated annually in the Three Year Work Plan, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of anthropogenic limiting factors and threats on habitat processes and conditions critical for Chinook salmon population viability, while monitoring VSP parameters. Under Alternative 3, habitat protection and restoration actions implemented to safeguard and improve salmon survival and productivity in the watershed as part of the watershed recovery plan would remain the same as under Alternative 1, as the actions are not affected by or included as part of the hatchery actions. However, under Alternative 3, no hatchery-origin Chinook salmon that could benefit natural population viability commensurate with these recovery plan actions would be produced. Natural-origin Chinook salmon population viability would still benefit from recovery plan implementation, but at a slower rate with hatchery program termination. With hatchery program termination, population viability status monitoring implemented as part of HGMP actions would be discontinued, decreasing capability for identifying the recovery status of natural Chinook salmon populations to a high extent relative to Alternative 1.

Unlike Alternative 1, under Alternative 3, fisheries that directly harvest hatchery-origin Snohomish River basin Chinook salmon over the short term would be discontinued within the Snohomish River basin, as no hatchery facilities would be producing salmon in the area. Fisheries that directly or incidentally harvest hatchery-origin Chinook salmon in Puget Sound would likely be further restricted, due to reduced production of hatchery-origin Chinook salmon commensurate with termination of the Snohomish River basin harvest augmentation hatchery programs for the species. Natural-origin Snohomish River basin Chinook salmon would continue to be harvested incidentally in Puget Sound, and directed Snohomish River basin fisheries targeting coho salmon. However, coho fisheries that may incidentally harvest Chinook salmon in the Snohomish River basin would likely be restricted relative to fisheries allowed under Alternative 1, because the Wallace River Hatchery, Tulalip Creek Ponds, and Everett Bay Net-Pen programs which produce coho salmon would be terminated, reducing the adult coho returns currently supporting fisheries directed at natural-origin and hatchery-origin fish.

Alternative 3 could both increase and decrease harvest of natural-origin fish, relative to the scenario under Alternative 1. Because fishing plans are driven by predicted overall rates of harvest on natural populations, it might be expected that Alternative 3 would not change harvest as compared with Alternative 1. However, in some cases, fisheries would be closed in areas where hatchery fish are no longer available because the hatchery programs providing fish for harvest have been terminated. Associated incidental harvest of natural origin fish in such fishing areas would be eliminated. In other cases, certain ceremonial and subsistence fisheries, for which harvest needs are met through harvest of hatchery-origin fish would likely continue after hatchery closures. Static harvest needs for such fisheries would have to be met entirely through harvest of natural-origin fish, thereby increasing harvest of natural-origin fish. Under Alternative 1, terminal area fisheries with large concentrations of hatchery origin fish, such as Tulalip Bay and the Snohomish River watershed below the Wallace River, attract fishing effort, leaving areas where predominately natural-origin fish transit unfished. Under Alternative 3,

without hatchery production, these areas where natural origin fish predominate might see more effort, and thus more harvest impacts would be absorbed by natural origin fish.

Over the long term, in conjunction with other watershed actions successfully implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) as updated annually in the Three Year Work Plan, termination of the Chinook salmon programs would be expected to restore the natural-origin and total Chinook salmon populations in the Snohomish River basin to a healthy status approaching historical levels, but at a slower pace relative to Alternative 1. The level of potential benefits to Chinook salmon population viability conferred under Alternative 1 would be decreased to a medium extent under Alternative 3, because production of hatchery-origin Chinook salmon that could contribute to VSP parameters for the natural Skykomish Chinook population would cease. Over the long term, risks associated with genetic diversity loss, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer would be reduced to a low extent relative to Alternative 1 (Subsection 3.3, Salmon and Steelhead). However, considering other factors affecting the viability of natural Chinook salmon populations in the action area (Subsection 3.2, Fish Habitat), effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity would be reduced to a negligible extent relative to Alternative 1. Benefit and risks levels for listed Chinook salmon under either alternative depend on the extent to which salmon habitat is protected or restored through recovery plan implementation, and observed effects on natural fish productivity resulting from implementation of hatchery-related risk reduction measures, including program termination.

Over the longer term, fisheries with direct harvest impacts on restored Snohomish River basin Chinook salmon populations could potentially be initiated under Alternative 3, but at a slower pace than under Alternative 1, because hatchery production of Skykomish Chinook salmon that could contribute to increasing population viability would be terminated. Under Alternative 1, a portion of hatchery-origin Chinook salmon are coded-wire tagged, and recoveries of these fish are used as indicators of marine survival and harvest rates for natural production. The information collected from these tagged fish is part of the coast-wide coded-wire tag database, used by Pacific Salmon Commission technical committees in advising the Commission on implementation of the Pacific Salmon Treaty as well as in other important salmon research. Under Alternative 3, elimination of Chinook salmon hatchery production would eliminate important Skykomish Chinook salmon tag groups from the coast-wide database and would harm increased efforts to understand recent large-scale declines in marine survival for Salish Sea salmon, potentially related to climate change. This loss would affect the capability to manage fisheries for Chinook salmon coast-wide to a negligible to low extent relative to Alternative 1, but would affect the ability to manage Snohomish River basin Chinook salmon populations within the action area to a medium to high extent relative to Alternative 1. In summary, over the long term, harvest-related risks to natural-origin Chinook salmon in Snohomish River basin fisheries under Alternative 3 would be expected to be increased to a medium to high extent relative to Alternative 1, with negligible differences in effects between the alternatives likely in mixed stock marine area fisheries where Snohomish River basin Chinook salmon would continue to be harvested incidentally.

For the above reasons, under Alternative 3, adverse hatchery-related effects on Chinook salmon and the species' habitat would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a medium extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, juvenile salmon production through the Snohomish River basin salmon programs would be reduced by one-half relative to Alternative 1 (Table 3). Implementation of Alternative 4 would reduce hatchery-related risks identified in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects on Snohomish River basin Chinook salmon populations, because juvenile salmon release levels would be reduced by one-half relative to Alternative 1. Any genetic diversity and fitness reduction effects resulting from natural spawning by hatchery Chinook salmon would be reduced relative to Alternative 1. Similar to Alternative 1, under Alternative 4, the estimated (demographic) PNI for the Wallace River and Tulalip Hatchery programs affecting the Skykomish Chinook salmon population would remain at or above 0.67 because natural Chinook salmon would continue to be incorporated as hatchery broodstock, and hatchery adult Chinook salmon would be reduced by half relative to Alternative 1 (Subsection 3.3, Salmon and Steelhead). Because half as many hatchery Chinook salmon would be released under Alternative 4, pHOS levels estimated based on demographic and not genetic data for both programs in areas where Skokomish and Snoqualmie Chinook salmon spawn would be reduced by half to approximately 6 percent, relative to 12 percent under Alternative 1. Any reduction under Alternative 4 in genetic effects that were a legacy of past natural spawning by hatchery Chinook salmon would be negligible, as PNI (and pHOS) levels under Alternative 1 (and hence, the baseline) would have been adequately protective of natural Chinook population genetic diversity and fitness (Subsection 3.3, Salmon and Steelhead). Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures would remain the same, hatchery-related effects on Chinook salmon life history, population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1. However, reducing salmon hatchery production by one-half in the action area would not be expected to result in measurable increases in natural-origin Chinook salmon abundance because of the current degraded condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Nutrient cycling benefits for Snohomish River basin Chinook salmon resulting from implementation of Alternative 1 would be reduced to a low extent under Alternative 4 after hatchery-origin salmon return in reduced abundances to the Basin to spawn (Subsection 3.3, Salmon and Steelhead). However, because the Skykomish Chinook salmon population propagated through the hatchery Chinook salmon programs is at low abundance levels, and the condition of natural habitat is currently limiting survival and productivity of the population in the wild, Alternative 4 may increase to a low extent the risk of extirpation, and delay attainment of a viable abundance level to a low extent relative to Alternative 1. Under Alternative 4, salmon would have access to habitat in the watershed similar to Alternative 1, but the expected lower abundance of Skykomish Chinook salmon would limit dispersal of the species throughout the

watershed, in particular in the Wallace River. Reduction of the hatchery Chinook salmon program under Alternative 4 would therefore decrease the potential for dispersal and the potential for increased spatial structure for the Skykomish Chinook salmon population to a low extent relative to Alternative 1. Reducing by half the Chinook salmon hatchery programs would be expected to reduce genetic diversity and fitness loss risks to the natural-origin population relative to Alternative 1. Considering other factors affecting the viability of natural Chinook salmon populations in the action area, including diversity (Subsection 3.2, Fish Habitat), the degree to which this risk reduction in genetic diversity and fitness loss risks would occur, and on which life stages, is unknown relative to Alternative 1.

Under Alternative 4, the number of juvenile hatchery-origin Chinook salmon released to contribute to total fisheries harvest and escapement to Snohomish River basin marine and freshwater areas would be reduced by one-half relative to Alternative 1 (Table 3). The number of hatchery-origin adult Skykomish Chinook salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest would also be reduced by one-half relative to Alternative 1 (Table 15). The number of adult Chinook salmon produced under Alternative 4, when combined with the natural-origin component of the Skykomish population, would lead to a total return of 14,972 fish. This total return compares with historical equilibrium abundance level for the Skykomish and population of 51,000 fish (Section 3.3.1, Puget Sound Chinook Salmon). With respect to considerations regarding the extent to which the Wallace River Hatchery and Tulalip Hatchery Chinook salmon harvest augmentation programs mitigate for lost natural production of Skykomish Chinook salmon, total hatchery-origin adult fish production plus recent year average natural-origin Skykomish Chinook salmon returns under Alternative 1 would be 29.4 percent of the historical equilibrium spawner abundance level of 51,000 Chinook salmon produced under properly functioning habitat conditions in the Skykomish River watershed (Table 15). Under Alternative 4, the level of adult Skykomish Chinook salmon production would be reduced to a medium extent relative to Alternative 1.

The watershed recovery plan for the Snohomish River basin (SSPS 2005), as updated annually in the Three Year Work Plan, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of anthropogenic limiting factors and threats on habitat processes and conditions critical for Chinook salmon population viability, while monitoring VSP parameters. Projects helping to remediate habitat limiting factors to Chinook salmon would be expected to increase smolt to adult return rates for fish produced by the hatchery programs. Under Alternative 4, fewer Chinook salmon that could benefit from these recovery plan actions would be produced (Table 15). However, habitat restoration actions implemented to improve salmon survival and productivity in the watershed as part of the watershed recovery plan would remain the same as under Alternative 1, as the actions are not affected by, or included as part of, the proposed hatchery programs.

Under Alternative 4, over the short term, fisheries that directly harvest hatchery-origin Snohomish River basin Chinook salmon would continue at reduced levels, as returns of adult Chinook salmon available for harvest would be reduced by one-half. Fisheries that directly or incidentally harvest hatchery-origin Chinook salmon in Puget Sound would likely be further restricted, due to reduced production of hatchery-origin Chinook salmon commensurate with reduction on releases through the Snohomish River basin harvest augmentation hatchery

programs for the species. Snohomish River basin-origin Chinook salmon would continue to be harvested incidentally in Puget Sound, and in directed Snohomish River basin fisheries targeting coho salmon. However, coho fisheries that may incidentally harvest Chinook salmon in the Snohomish River basin would likely be restricted relative to fisheries allowed under Alternative 1, because the Wallace River Hatchery, Tulalip Creek Ponds, and Everett Bay Net-Pen programs which produce coho salmon would be reduced by one-half, reducing the adult coho returns currently supporting fisheries directed at natural-origin and hatchery-origin fish. Under Alternative 4, the adverse effects of any fisheries on natural-origin fish populations would potentially increase to a negligible to low extent in mixed stock marine areas, and a low to medium in Snohomish River basin fishing areas, relative to effects under Alternative 1, as harvests of the natural populations would increase as the number and proportion of hatchery-origin fish contributing to total fisheries harvests in mixed stock harvest areas decreases.

Over the longer term, new fisheries with direct harvest impacts on restored Snohomish River basin Chinook salmon populations could potentially be initiated under Alternative 4, but at a slower pace than under Alternative 1, because hatchery production of Skykomish Chinook salmon that could contribute to increasing population viability would be reduced by one-half. Under Alternative 1, a portion of hatchery-origin Chinook salmon are coded-wire tagged, and recoveries of these fish are used as indicators of marine survival and harvest rates for natural production. The information collected from these tagged fish is part of the coast-wide coded-wire tag database, used by Pacific Salmon Commission technical committees in advising the Commission on implementation of the Pacific Salmon Treaty as well as in other important salmon research. Under Alternative 4, it would be possible to maintain the current coded-wire tag programs for Chinook and Coho salmon. However, with lower production levels than Alternative 1, there would be increased risk of not being able to produce sufficient production to maintain current tagging levels. Therefore, assuming the existing coded-wire tag programs for Chinook and Coho salmon continued to be implemented under Alternative 4, there would be a low adverse effect on the information benefits of the hatchery program for management of natural-origin fish, relative to Alternative 1. In summary, over the long term, harvest-related risks to natural-origin Chinook salmon in Snohomish River basin fisheries under Alternative 4 would be expected to increase to a low extent relative to Alternative 1, with negligible differences in effects between the alternatives likely in mixed stock marine area fisheries where Snohomish River basin Chinook salmon would be harvested incidentally.

For the above reasons, under Alternative 4, adverse hatchery-related effects on Chinook salmon and the species' habitat would be reduced to a negligible to low extent relative to Alternative 1, and beneficial effects would also be reduced to a medium extent relative to Alternative 1.

### 4.3.2 Puget Sound Steelhead (ESA-listed)

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, no steelhead would be produced as part of the hatchery actions, and the hatchery programs would be operated the same as under baseline conditions, as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, the salmon hatchery-related effects described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer, and

facility effects, would not change relative to baseline conditions as they pertain to effects on steelhead life history, abundance, diversity, spatial structure, and productivity. (Subsection 3.3, Salmon and Steelhead). Population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, no fisheries resulting from implementation of the salmon HGMPs would directly harvest natural-origin Snohomish River basin natural-origin steelhead. Tribal and recreational fisheries directed at hatchery-origin early winter-run steelhead would retain the same regulations under Alternative 1 as described for baseline conditions (Subsection 3.3.2, Salmon and Steelhead – Puget Sound Steelhead). There would be a low likelihood that natural-origin steelhead would be encountered and harvested incidentally in Snohomish River basin fisheries targeting coho salmon. Coho salmon-directed fisheries are scheduled from September through early November within the action area in most years. These coho fisheries occur too early in the season to result in interaction with, and incidental harvest of natural-origin winter-run steelhead, which return in the late winter and spring months. Under Alternative 1, and as under baseline conditions, annual tribal and recreational fisheries harvests of hatchery-origin winter-run steelhead would remain similar to recent year average levels (Subsection 3.3.2, Salmon and Steelhead – Puget Sound Steelhead). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery early-winter-run steelhead-directed tribal and recreational fisheries, and incidental harvests of natural-origin steelhead under Alternative 1 would likely remain the same as under baseline conditions.

For these reasons, effects under Alternative 1 would remain from the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the operation of the Snohomish River basin salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on natural-origin steelhead and their habitat as under Alternative 1. There would be less certainty under Alternative 1 regarding specific hatchery program implementation measures, and hence the magnitude of any hatchery-related effects, because the programs would not be approved under and regulated by the ESA. However, any changes that might occur in hatchery program implementation because ESA authorization was lacking would be speculative, and negligible changes would be expected in risks associated with genetic diversity loss, competition and predation, fish disease transfer, and facility effects relative to Alternative 1 (Subsection 3.3, Salmon and Steelhead). Effects on steelhead: life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1.

Under Alternative 2, as under Alternative 1, no fisheries resulting from implementation of the salmon HGMPs would directly harvest natural-origin Snohomish River basin natural-origin steelhead. Tribal and recreational fisheries directed at hatchery-origin early winter-run steelhead would retain the same regulations under Alternative 2 as described for Alternative 1 (Subsection 3.3.2, Salmon and Steelhead – Puget Sound Steelhead). There would continue to be a low

likelihood that natural-origin steelhead would be encountered and harvested incidentally in Snohomish River basin fisheries targeting coho salmon. Coho salmon-directed fisheries are scheduled from September through early November within the action area in most years. These coho fisheries occur too early in the season to result in interaction with, and incidental harvest of natural-origin winter-run steelhead, which return in the late winter and spring months. Under Alternative 2, and as under Alternative 1, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin winter-run steelhead would remain similar to recent year average levels (Subsection 3.3.2, Salmon and Steelhead – Puget Sound Steelhead). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery early-winter-run steelhead-directed tribal and recreational fisheries, and incidental harvests of natural-origin steelhead under Alternative 2 would likely remain the same as Alternative 1.

For the above reasons, effects under Alternative 2 would remain the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate risks described in Subsection 3.3 associated with genetic diversity loss, competition and predation effects, fish disease transfer, and facility effects to natural-origin Snohomish River basin steelhead attributable to the salmon hatchery programs operating in the action area, because the programs would be terminated. Any Snohomish River basin salmon hatchery-related effects on natural-origin steelhead life history, and population abundance, diversity, spatial structure, and productivity occurring under Alternative 1 would therefore be eliminated, and become negligible, under Alternative 3. Similarly, any population viability and nutrient cycling benefits for natural-origin Snohomish River basin steelhead populations conferred under Alternative 1 would be eliminated, and become negligible, under Alternative 3, after hatchery-origin salmon originating from action area hatchery programs stop returning to the basin to spawn (Subsection 3.3, Salmon and Steelhead).

Under Alternative 3, salmon-directed fisheries effects on steelhead may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural-origin Snohomish River basin steelhead. Although hatchery programs producing coho salmon would be terminated under Alternative 3, Snohomish River natural-origin steelhead may continue to be incidentally harvested in Puget Sound and Snohomish River basin fisheries targeting coho salmon, assuming currently robust, natural-origin Snohomish River coho salmon populations continue to support fisheries. Because the hatchery-origin component of the total coho salmon return would be eliminated, the total harvest rate on coho salmon in basin waters would be reduced, potentially leading to a negligible to low decrease in the number of steelhead harvested incidentally relative to Alternative 1. Under Alternative 3, and as under Alternative 1, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin early winter-run steelhead would remain similar to recent year average levels (Subsection 3.3.2, Salmon and Steelhead - Puget Sound Steelhead). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, and incidental harvests of natural-origin steelhead under Alternative 3 would likely remain unchanged from Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to steelhead under Alternative 3 as the program continues into the future would be reduced to a low extent relative to Alternative 1. Under Alternative 3, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a low extent over the long term. Harvest-related risks to steelhead in the Snohomish River basin and Puget Sound under Alternative 3 would be expected to decline to a low extent relative to Alternative 1, with no changes in effects on steelhead likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, potential adverse effects under Alternative 3 would be reduced to a negligible to low extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Snohomish River basin natural-origin steelhead, because juvenile hatchery salmon release levels would be reduced by one-half relative to Alternative 1. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related effects on steelhead life history, population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1. Any population viability benefits for Snohomish River basin steelhead resulting from implementation of Alternative 1 would be reduced to a negligible to low extent under Alternative 4 after hatchery-origin salmon return in reduced abundances to the basin to spawn (Subsection 3.3, Salmon and Steelhead).

Under Alternative 4, salmon-directed fisheries effects on steelhead may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural origin Snohomish River basin steelhead. Although hatchery programs producing coho salmon would be reduced under Alternative 4, Snohomish River natural-origin steelhead may continue to be incidentally harvested in Puget Sound and Snohomish River basin fisheries targeting coho salmon, assuming currently robust, natural-origin Snohomish River coho salmon populations continue to support fisheries. Although the hatchery-origin component of the total coho salmon return would be reduced by one-half, leading to a reduction in the total harvest rate for coho salmon in basin waters, there would be a negligible decrease in the number of steelhead harvested incidentally relative to Alternative 1. Under Alternative 4, and as under Alternative 1, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin early winter-run steelhead would remain similar to recent year average levels (Subsection 3.3.2,

Salmon and Steelhead – Puget Sound Steelhead). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, and incidental harvests of natural-origin steelhead under Alternative 4 would likely remain the same as Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to steelhead under Alternative 4 as the program continues into the future would be reduced to a negligible to negligible to low extent relative to Alternative 1. Under Alternative 4, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a low extent over the long term. Harvest-related risks to steelhead in the Snohomish River basin and Puget Sound under Alternative 4 would be expected to decline to a negligible to low extent relative to Alternative 1, with no changes in effects on steelhead likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For the above reasons, potential adverse effects under Alternative 4 would be reduced to a negligible to low extent relative to Alternative 1.

### 4.3.3 Puget Sound Fall Chum Salmon (Non-listed)

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the hatchery programs, including the fall chum salmon program, would be operated the same as under baseline conditions, as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related risks to fall chum salmon associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to baseline conditions. As described in Subsection 3.3, Salmon and Steelhead, there is no associated natural chum salmon population in any Tulalip Bay tributaries that would be used as broodstock or affected by the Tulalip Bay chum salmon hatchery program. The use of PNI as a metric to determine genetic effects is therefore not applicable. The pHOS for the Tulalip Bay program in areas where natural Skykomish and Snoqualmie chum salmon spawn would be negligible (zero) for the reasons described in Subsection 3.3, Salmon and Steelhead, and unchanged from the baseline. Effects under Alternative 1 on Snohomish River basin chum salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would also remain the same relative to the baseline.

Under Alternative 1, as under baseline conditions, an estimated annual average of 60,000 hatchery-origin adult fall chum salmon would contribute to total fisheries harvest, and escapement to Snohomish River basin marine and freshwater areas (Table 16). After removal of approximately 10,000 adult fish for use as hatchery broodstock, remaining surplus hatchery-origin fall chum salmon would be available for commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. When combined with average natural-origin fish abundance levels, this total fall chum salmon return to basin areas augmented by the hatchery program (90,079 fish) compares with the 44-year high natural-origin abundance level for the Snohomish River basin of 278,000 fish (Section 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery fall chum salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin fall chum salmon, total hatchery-origin adult fish production plus recent year average natural-origin fall chum salmon returns under Alternative 1 would be 32 percent of the 44-year high fall run chum salmon abundance level produced in the basin (Table 16). Under Alternative 1, this comparative level of adult fish production would remain the same as the baseline condition.

Table 16. Total annual Snohomish River basin adult fall chum salmon return by alternative compared with estimated historical abundance (numbers of fish).

| Alternative | Hatchery-Origin Adult Return [1] | Natural-Origin Adult Return [2] | Total Adult Return | Historical Abundance [3] | Total Return Percent of Historical Abundance |
|---|---|---|---|---|---|
| 1 | 60,000 | 30,079 | 90,079 | 278,000 | 32 |
| 2 | 60,000 | 30,079 | 90,079 | 278,000 | 32 |
| 3 | 0 | 30,079 | 30,079 | 278,000 | 11 |
| 4 | 30,000 | 30,079 | 60,079 | 278,000 | 22 |

[1] Adult return estimates from Table 4, assuming smolt release levels in Table 3, and a hatchery-origin fry to adult return rate of 0.5 percent (minimum goal level from Tulalip 2013b), the Tulalip Creek program under baseline conditions, Alternative 1, and Alternative 2 may produce adults each year (total contribution to terminal area fisheries and escapement). Termination under Alternative 3 would produce no adults, and reduction of the fry release program by one-half under Alternative 4 would produce 30,000 adult fish.

[2] Average annual total Puget Sound (Area 4B) Snohomish River basin natural-origin fall chum salmon run size estimate for 2002-2012 from Puget Sound Chinook Run Reconstruction (A. Dufault, WDFW unpublished data, May 14, 2014).

[3] The historical (pre-European settlement period) abundance of fall chum salmon in the basin is unknown. The value presented as a surrogate was the largest natural-origin Snohomish River basin fall chum run size (Area 4B entering run for return year 2006) observed over the past 44 years (1968-2012) (A. Dufault, WDFW unpublished data, May 14, 2014). Historical (pre-European settlement) abundance was likely higher, given extensive fish habitat loss and degradation that has occurred in the basin (Section 3.3, Salmon and Steelhead) since that time, that has likely suppressed natural-origin salmon productivity.

Under Alternative 1, as under baseline conditions, fisheries directed at hatchery-origin fall chum salmon produced by the Tulalip Tribes would continue to occur in Snohomish River basin marine areas. Natural-origin Snohomish River basin chum salmon would continue to be harvested both directly and incidentally in Snohomish River basin, Puget Sound, and U.S. and Canadian mixed-stock marine area fisheries.

For the above reasons, effects on chum salmon under Alternative 1 would be the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the hatchery programs, including the fall chum salmon program, would be operated the same as under Alternative 1 as habitat restoration and harvest management actions and monitoring are implemented to improve salmon survival and productivity. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures would remain the same, salmon hatchery-related risks to fall chum salmon associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to Alternative 1. Effects under Alternative 2 on Snohomish River basin chum salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would remain the same as under Alternative 1 (Subsection 3.3.3 - Salmon and Steelhead – Puget Sound Chum Salmon).

Under Alternative 2, as under Alternative 1, an estimated annual average of 60,000 hatchery-origin adult fall chum salmon would contribute to total fisheries harvest, and escapement to Snohomish River basin marine and freshwater areas (Table 16). After removal of the required number of adult fish for use as hatchery broodstock, remaining surplus hatchery-origin fall chum salmon would be available for commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. When combined with average natural-origin fish abundance levels, this total fall chum salmon return to basin areas resulting from the hatchery program compares with the 44-year high natural-origin abundance level for the Snohomish River basin of 278,000 fish (Section 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery fall chum salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin fall chum salmon, total hatchery-origin adult fish production plus recent year average natural-origin fall chum salmon returns under Alternative 2 would be 32 percent of the 44-year high abundance level of 278,000 fall run chum salmon produced in the basin (Table 16). Under Alternative 2, there would be no change in this comparative level of adult fish production relative to Alternative 1.

Under Alternative 2, fisheries effects on Snohomish River basin fall chum salmon would persist at similar levels relative to Alternative 1. Fisheries directed at hatchery-origin fall chum salmon produced by the Tulalip Tribes would continue to occur in Snohomish River basin marine areas. Natural-origin Snohomish River basin chum salmon would continue to be harvested both directly and incidentally in Snohomish River basin, Puget Sound, and U.S. and Canadian mixed-stock marine area fisheries.

For the above reasons, effects under Alternative 2 would remain the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate salmon hatchery-related risks associated with genetic diversity loss, competition and predation, facility effects, incidental fishing effects, or disease transfer to natural-origin Snohomish River basin fall chum salmon, because the action area hatchery salmon programs would be terminated. There is no associated natural chum salmon population in any Tulalip Bay tributaries that would be used as broodstock or affected by the Tulalip Bay chum salmon hatchery program, so the use of PNI as a metric to determine genetic effects is not applicable. Similar to Alternative 1, the pHOS for the Tulalip Bay program in areas where Skykomish and Snoqualmie chum salmon spawn would remain negligible (zero) for the reasons described in Subsection 3.3, Salmon and Steelhead. Because these circumstances have been longstanding consistent with program operation under Alternative 1, any reduction under Alternative 3 in genetic effects that were a legacy of past natural spawning by hatchery chum salmon would be negligible. Any salmon hatchery-related effects on fall chum salmon: life history, and population abundance, diversity, spatial structure, and productivity occurring under Alternative 1 would therefore be eliminated, and become negligible, under Alternative 3. Similarly, any population viability and nutrient cycling benefits for natural-origin Snohomish River basin fall chum salmon populations conferred under Alternative 1 would be eliminated, and become negligible, under Alternative 3, after hatchery-origin salmon stop returning to the basin to spawn (Subsection 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). However, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in natural-origin chum salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat)

Under Alternative 3, no hatchery-origin adult fall chum salmon fry would be produced to contribute to total fisheries harvest and escapement to Snohomish River basin marine and freshwater areas (Table 16). There would be no hatchery-origin adult fall chum salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest, and only fish that are part of the natural-origin component of the Snohomish River basin populations would return. The recent eleven-year (2002-2012) average total all-natural-origin fall chum salmon return to basin areas under Alternative 3 of 30,079 fish compares with the 44-year high natural-origin abundance level for the Snohomish River basin of 278,000 fish (Subsection 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery fall chum salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin fall chum salmon, total hatchery-origin adult fish production plus recent year average natural-origin fall chum salmon returns under Alternative 3 would be 11 percent of the 44-year high abundance level of 278,000 fall run chum salmon produced in the basin (Table 16). Under Alternative 3, the level of adult Snohomish River basin fall chum salmon production would be reduced to a medium extent relative to Alternative 1.

Under Alternative 3, Snohomish River basin fisheries directed at returning adult hatchery-origin fall chum salmon would not occur, because the tribal program supporting harvest of the species would be terminated. Natural-origin Snohomish River basin fall chum salmon would continue to be harvested both directly and incidentally in Snohomish River basin, Puget Sound, and U.S. and Canadian mixed-stock marine area fisheries for coho salmon and other species. Incidental

harvests of commingled natural-origin chum salmon populations occurring during preterminal area net fisheries, which are typically not directed only at hatchery-origin fall chum salmon, would be increased to a low extent relative to Alternative 1 from cessation of hatchery-origin fall chum salmon production that buffers fishery impacts in mixed-stock fishing areas. Under Alternative 1, the presence of hatchery-origin chum salmon returning to Tulalip Bay Hatchery focuses tribal fishing effort on hatchery-origin fish in the hatchery terminal area, and removed from natural-origin chum salmon migration areas. There is therefore a greater likelihood under Alternative 1 that natural-origin chum would not be harvested to the full allowable extent when hatchery-origin fish are available. Under Alternative 3, with loss of hatchery-origin chum salmon returns drawing fishing effort into Tulalip Bay, there is increased likelihood relative to Alternative 1 that natural-origin chum will be harvested to their full allowable extent. The adverse effects of any fisheries on natural-origin Snohomish River basin fall chum salmon populations would therefore potentially increase to a low extent relative to effects under Alternative 1, because harvests of the natural populations would increase as hatchery-origin fish returns to the action area are terminated.

For the above reasons, under Alternative 3, adverse hatchery-related effects on chum salmon and the species' habitat would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a medium extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks associated with genetic diversity loss, competition and predation, facility effects, incidental fishing effects, or disease transfer to Snohomish River basin natural-origin fall chum salmon, because juvenile hatchery salmon release levels would be reduced by one-half relative to Alternative 1. There is no associated natural chum salmon population in any Tulalip Bay tributaries that would be used as broodstock or affected by the Tulalip Bay chum salmon hatchery program, so the use of PNI as a metric to determine genetic effects is not applicable. Similar to Alternative 1, the pHOS for the Tulalip Bay program in areas where Skokomish and Snoqualmie chum salmon spawn would remain negligible (zero) for the reasons described in Subsection 3.3, Salmon and Steelhead. Because these circumstances have been longstanding consistent with program operation under Alternative 1, any reduction under Alternative 4 in genetic effects that were a legacy of past natural spawning by hatchery chum salmon would be negligible. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related effects on natural-origin fall chum salmon life history, population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1. Any population viability and nutrient cycling benefits for Snohomish River basin fall chum salmon resulting from implementation of Alternative 1 would be reduced to a negligible to low extent under Alternative 4 after hatchery-origin salmon return in reduced abundances to the basin to spawn (Subsection 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). However, reducing salmon hatchery production by one-half in the action area would not be expected to result in measurable increases in natural-

origin chum salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Under Alternative 4, hatchery-origin adult fall chum salmon fry releases would be reduced by one-half relative to the level under Alternative 1 (Table 3). Therefore, the number of hatchery-origin fall chum salmon adults produced to contribute to total fisheries harvest and escapement to Snohomish River basin marine and freshwater areas would also be reduced by one-half (Table 16). There would be less hatchery-origin adult fall chum salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. The total fall chum salmon return to basin areas under Alternative 4 of 60,079 fish compares with the 44-year high natural-origin abundance level for the Snohomish River basin of 278,000 fish (Section 3.3.3, Salmon and Steelhead - Puget Sound Chum Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery fall chum salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin fall chum salmon, total hatchery-origin adult fish production plus recent year average natural-origin fall chum salmon returns under Alternative 4 would be 22 percent of the 44-year high abundance level of 278,000 fall run chum salmon produced in the basin (Table 16). Under Alternative 4, the level of adult Snohomish River basin fall chum salmon production would be reduced to a medium extent relative to Alternative 1.

Under Alternative 4, Snohomish River basin fisheries directed at returning adult hatchery-origin fall chum salmon would be reduced, commensurate with a reduced number of adult fish available for harvest. Reductions in fisheries directed at hatchery-origin fall chum salmon would reduce incidental harvest effects on commingled natural-origin chum salmon populations in the action area relative to Alternative 1. Natural-origin and hatchery-origin Snohomish River basin chum salmon would continue to be harvested both directly and incidentally in Snohomish River basin, Puget Sound, and U.S. and Canadian mixed-stock marine area fisheries for chum salmon and other species. Incidental harvests of commingled natural-origin chum salmon populations occurring during preterminal area net fisheries, which are typically not directed only at hatchery-origin fall chum salmon, would be increased to a negligible to low extent relative to Alternative 1 from cessation of hatchery-origin fall chum salmon production that buffers fishery impacts in mixed-stock fishing areas. Under Alternative 1, the presence of hatchery-origin chum salmon returning to Tulalip Bay Hatchery focuses tribal fishing effort on hatchery-origin fish in the hatchery terminal area, and removed from natural-origin chum salmon migration areas. There is therefore a greater likelihood under Alternative 1 that natural-origin chum would not be harvested to the full allowable extent when hatchery-origin fish are available. Under Alternative 4, with reduction of hatchery-origin chum salmon returns drawing fishing effort into Tulalip Bay, there is increased likelihood relative to Alternative 1 that natural-origin chum will be harvested to a greater extent, and up to allowable harvest levels. The adverse effects of any fisheries on natural-origin Snohomish River basin fall chum salmon populations would therefore potentially increase to a negligible to low extent relative to effects under Alternative 4, because harvests of the natural populations would increase as hatchery-origin fish returns to the action area are reduced. The adverse effects of any fisheries on natural-origin Snohomish River basin chum salmon populations would potentially increase to a negligible to low extent relative to effects under Alternative 1, because harvests of the natural populations would increase as the number and proportion of hatchery-origin fish contributing to total fisheries harvests decreases.

For the above reasons, under Alternative 4, adverse hatchery-related effects on chum salmon and the species' habitat would be reduced to a negligible to low extent relative to Alternative 1, and beneficial effects would also be reduced to a medium extent relative to Alternative 1.

### 4.3.4 Puget Sound Pink Salmon (Non-listed)

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, no pink salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under baseline conditions as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to Snohomish River basin pink salmon associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to baseline conditions. Effects on pink salmon life history, and population abundance, diversity, spatial structure, and productivity would remain the same under Alternative 1 relative to the baseline conditions for the species described in Subsection 3.3.4 Salmon and Steelhead - Puget Sound Pink Salmon.

Under Alternative 1, as under baseline conditions, no fisheries resulting from implementation of the salmon HGMPs would directly harvest natural-origin Snohomish River basin natural-origin pink salmon. Under Alternative 1, as under baseline conditions, Puget Sound pink salmon are directly harvested in Snohomish River basin fisheries and in Puget Sound, as well as directly and incidentally harvested in U.S. and Canadian mixed-stock marine area fisheries. Effects of fisheries on Snohomish River basin pink salmon would persist at similar levels relative to baseline conditions.

For these reasons, effects on pink salmon under Alternative 1 would remain the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the hatchery programs would be operated the same as under Alternative 1 as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures would remain the same, salmon hatchery-related risks to pink salmon associated with hatchery program implementation (i.e., genetic effects, competition and predation, fish disease transfer, and facility) would persist at similar levels relative to Alternative 1 (Subsection 3.3, Salmon and Steelhead). Effects under Alternative 2 on Snohomish River basin pink salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would remain the same as Alternative 1 (Subsection 3.3.4 - Salmon and Steelhead – Puget Sound Pink Salmon).

Under Alternative 2, as under Alternative 1, no fisheries resulting from implementation of the salmon HGMPs would directly harvest natural-origin Snohomish River basin natural-origin pink

salmon. Under Alternative 2, as under Alternative 1, Puget Sound pink salmon would continue to be directly harvested in Snohomish River basin fisheries and in Puget Sound, as well as directly and incidentally harvested in U.S. and Canadian mixed-stock marine area fisheries. Effects of fisheries on Snohomish River basin pink salmon would persist at similar levels relative to Alternative 1.

For the above reasons, effects on pink salmon under Alternative 2 would remain the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to natural-origin Snohomish River basin pink salmon from hatchery salmon originating from within the action area, because the programs would be terminated. Any effects on pink salmon population viability and life history from the action area hatchery programs occurring under Alternative 1 would therefore be eliminated, and become negligible, under Alternative 3. Similarly, any population viability and nutrient cycling benefits for natural-origin Snohomish River basin pink salmon populations conferred by the hatchery salmon programs under Alternative 1 would be eliminated, and become negligible, under Alternative 3, after hatchery-origin salmon produced by the salmon hatchery programs within the action area stop returning to the basin to spawn (Subsection 3.3, Salmon and Steelhead). However, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in natural-origin pink salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat)

Alternative 3 would have no effect on fisheries affecting Puget Sound pink salmon relative to Alternative 1. Under Alternative 3, as under Alternative 1, fisheries remaining after cessation of the hatchery programs would continue to directly harvest natural-origin Snohomish River basin natural-origin pink salmon. Under Alternative 3 and Alternative 1, Snohomish River basin pink salmon would continue to be harvested in pink salmon-directed fisheries in Snohomish River basin waters and in Puget Sound. Pink salmon from the basin would also continue to be harvested directly and incidentally in U.S. and Canadian mixed-stock marine area fisheries. Effects of fisheries on Snohomish River basin pink salmon would persist at similar levels relative to Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to pink salmon under Alternative 3 as the program continues into the future would be reduced to a low extent relative to Alternative 1. Under Alternative 3, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a low extent over the long term. Harvest-related risks to pink salmon in the

Snohomish River basin and Puget Sound under Alternative 3 would be expected to decline to a low extent relative to Alternative 1, with no changes in effects on pink salmon likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, potential adverse effects under Alternative 3 would be reduced to a negligible to low extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Snohomish River basin natural-origin pink salmon, because juvenile hatchery salmon release levels would be reduced by one-half relative to Alternative 1. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related effects on natural-origin pink salmon life history, population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1. Any population viability and nutrient cycling benefits for Snohomish River basin pink salmon resulting from implementation of Alternative 1 would be reduced to a negligible to low extent under Alternative 4 after hatchery-origin salmon return in reduced abundances to the basin to spawn (Subsection 3.3, Salmon and Steelhead). However, reducing salmon hatchery production in the action area by one-half would not be expected to result in measurable increases in natural-origin pink salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Under Alternative 4, as under Alternative 1, no fisheries resulting from implementation of the salmon HGMPs would directly harvest natural-origin Snohomish River basin natural-origin pink salmon. Under Alternative 4 and Alternative 1, Snohomish River basin pink salmon would continue to be harvested in pink salmon-directed fisheries in Snohomish River basin waters and in Puget Sound. Pink salmon from the basin would also continue to be harvested directly and incidentally in U.S. and Canadian mixed-stock marine area fisheries. Effects of fisheries on Snohomish River basin pink salmon would persist at similar levels relative to Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to pink salmon under Alternative 4 as the program continues into the future would be reduced to a low extent relative to Alternative 1. Under Alternative 4, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a negligible to low extent over the long term. Harvest-related risks to pink salmon in the Snohomish River basin and Puget Sound under Alternative 4 would be expected to

decline to a negligible to low extent relative to Alternative 1, with no changes in effects on pink salmon likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, potential adverse effects on pink salmon under Alternative 4 would be reduced to a negligible to low extent relative to Alternative 1.

### 4.3.5 Puget Sound Coho Salmon (Non-listed)

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the hatchery programs, including the three coho salmon programs, would be operated the same as under baseline conditions as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures would remain the same, salmon hatchery-related risks to coho salmon associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to baseline conditions. As described in Subsection 3.3, Salmon and Steelhead, data are unavailable with regards to the proportion of hatchery coho salmon spawning naturally. Because natural-origin coho salmon are incorporated as broodstock at Wallace River Hatchery, and considering lower juvenile coho salmon release levels relative to Chinook salmon release levels at the hatchery, it is likely that the estimated PNI for the coho salmon program is similar to the Wallace River Hatchery Chinook salmon program (0.77). Further, the estimated pHOS for the coho program at Wallace River Hatchery is similarly low (at or below the 12 percent). Because of their release locations, and high harvest rates applied in Tulalip Bay fisheries, coho salmon released through the Tulalip Bay Hatchery and Everett Bay Net Pen program are unlikely to stray at substantial rates into areas in the Snohomish River watershed where natural populations of the species spawn. For these reasons, similar to the baseline, genetic effects on natural coho salmon associated with the hatchery coho salmon programs are likely negligible under Alternative 1. Effects under Alternative 1 on Snohomish River basin coho salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would also remain the same relative to the baseline.

Under Alternative 1, as under baseline conditions, an estimated annual average of 132,837 hatchery-origin adult coho salmon would contribute to total fisheries harvest, and escapement to Snohomish River basin marine and freshwater areas (Table 17). After removal of the required number of adult fish for use as hatchery broodstock, remaining surplus hatchery-origin coho salmon would be available for commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. When combined with average natural-origin fish abundance levels, the total coho salmon return to basin areas augmented by the hatchery programs (271,537 fish) is slightly below the 46 year high natural-origin abundance level for the Snohomish River basin of 294,379 fish (Subsection 3.3.5, Salmon and Steelhead - Puget Sound Coho Salmon; Table 17). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery coho salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin coho salmon, total hatchery-origin adult fish production plus recent year average natural-origin

coho salmon returns under Alternative 1 would be 92 percent of the 46-year high coho salmon abundance level produced in the basin (Table 17). Under Alternative 1, there would be no change in this comparative level of adult fish production relative to the baseline condition.

Table 17. Total annual Snohomish River basin adult coho salmon return by alternative compared with estimated historical abundance (numbers of fish).

| Alternative | Hatchery-Origin Adult Return [1] | Natural-Origin Adult Return [2] | Total Adult Return | Historical Abundance [3] | Total Return Percent of Historical Abundance |
|---|---|---|---|---|---|
| 1 | 132,837 | 138,700 | 271,537 | 294,379 | 92 |
| 2 | 132,837 | 138,700 | 271,537 | 294,379 | 92 |
| 3 | 0 | 138,700 | 138,700 | 294,379 | 47 |
| 4 | 66,418 | 138,700 | 205,118 | 294,379 | 70 |

1 Adult return estimates from Table 4, assuming smolt release levels in Table 3, and smolt to adult survival rates of 5.97 percent for Wallace River and Eagle Creek hatchery yearling coho salmon (WDFW 2013b); 6.0 percent for Tulalip Bay Hatchery yearling coho salmon (Tulalip 2013a); and 3.29 percent for Everett Bay Net Pen delayed released coho salmon (WDFW 2013c), basin programs under baseline conditions, Alternative 1, and Alternative 2 may produce 132,837 adults each year (total contribution to terminal area fisheries and escapement). Termination under Alternative 3 would produce no hatchery-origin adults, and reduction of the smolt release programs by one-half under Alternative 4 would produce 66,418 adult hatchery-origin fish.
2 Average annual total Puget Sound (Area 4B) Snohomish River basin natural-origin coho salmon run size for 2002-2011 from Puget Sound Coho Run Reconstruction (J. Haymes, WDFW unpublished data, January 7, 2013).
3 The historical (pre-European settlement period) abundance of coho salmon in the basin is unknown (Section 3.3.5 – Puget Sound Coho Salmon). The value presented as a surrogate is the largest natural-origin Snohomish River basin-origin coho salmon run size observed over the past 46 years (Area 4B entering run for return year 2001, for the period 1965-2011) (J. Haymes, WDFW unpublished data, May 14, 2014). Historical (pre-European settlement) abundance was likely higher, given extensive fish habitat loss and degradation that has occurred in the basin (Section 3.3, Salmon and Steelhead) that have likely suppressed natural-origin salmon productivity.

Under Alternative 1, as under baseline conditions, fisheries directed at hatchery-origin coho salmon produced by the Wallace River Hatchery, Eagle Creek Hatchery, Tulalip Creek Hatchery, and Everett Bay Net-Pen programs would continue to occur in Snohomish River basin marine and freshwater areas. Natural-origin Snohomish River basin coho salmon would continue to be harvested both directly and incidentally in Snohomish River basin, Puget Sound, and U.S. and Canadian mixed-stock marine area fisheries.

For these reasons, effects on coho salmon under Alternative 1 would be the same as baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the hatchery programs, including the coho salmon programs, would be operated the same as under Alternative 1 as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures would remain the same, salmon hatchery-related risks to coho salmon associated with hatchery program

implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to Alternative 1 (Subsection 3.3.5, Salmon and Steelhead - Puget Sound Coho Salmon). Effects of Alternative 2 on Snohomish River basin coho salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would remain the same as Alternative 1 (Subsection 3.3.5, Salmon and Steelhead - Puget Sound Coho Salmon).

Under Alternative 2, as under Alternative 1, an estimated annual average of 132,837 hatchery-origin adult coho salmon would contribute to total fisheries harvest, and escapement to Snohomish River basin marine and freshwater areas (Table 17). After removal of the required number of adult fish for use as hatchery broodstock, remaining surplus hatchery-origin coho salmon would be available for commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. When combined with average natural-origin fish abundance levels, the total coho salmon return to basin areas augmented by the hatchery programs (271,537 fish) would be slightly below the 46-year high natural-origin abundance level for the Snohomish River basin of 294,379 fish (Subsection 3.3.5, Salmon and Steelhead - Puget Sound Coho Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery coho salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin coho salmon, total hatchery-origin adult fish production plus recent year average natural-origin coho salmon returns under Alternative 2 would be 92 percent of the 46-year high coho salmon abundance level produced in the basin (Table 17). Under Alternative 2, this comparative level of adult fish production would be the same as under Alternative 1.

Under Alternative 2, the effects of fisheries on Snohomish River coho salmon would persist at similar levels relative to Alternative 1. The number of hatchery-origin adult coho salmon produced under Alternative 2 and Alternative 1 would not be substantially different because juvenile-to-adult survival rates affecting fish returns – largely determined by ocean productivity conditions – would not be different between the two alternatives. As under Alternative 1, fisheries directed at the harvest of hatchery-origin and natural-origin coho salmon would continue to occur each year in the Snohomish River basin and Puget Sound. Snohomish River basin coho salmon would also continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant stocks.

For the above reasons, effects on coho salmon under Alternative 2 would be the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin.**

Implementation of Alternative 3 would eliminate risks associated with genetic diversity loss, competition and predation, facility effects, incidental fishing effects, or disease transfer to natural-origin Snohomish River basin coho salmon from salmon hatchery programs, because the programs would be terminated. Any salmon hatchery-related effects on coho salmon: life history, and population abundance, diversity, spatial structure, and productivity occurring under Alternative 1 would therefore be eliminated, and become negligible, under Alternative 3. In particular, genetic diversity and fitness reduction effects resulting from natural spawning by

hatchery coho salmon would be eliminated, and become undetectable. Under Alternative 3, the estimated (demographic) PNI for the Wallace River Hatchery program affecting natural coho salmon populations in the Snohomish River watershed would be 1.0, relative to an expected level of 0.77 under Alternative 1 (Subsection 3.3, Salmon and Steelhead). Expected pHOS levels for both the Wallace River Hatchery and Tulalip Bay Hatchery coho salmon programs in areas where Skokomish and Snoqualmie coho salmon spawn would be reduced to zero for the Wallace River program, and remain zero for the Tulalip Bay program for the reasons described in Subsection 3.3, Salmon and Steelhead. Any reduction under Alternative 3 in genetic effects that were a legacy of past natural spawning by hatchery coho salmon would be negligible, as PNI (and pHOS) levels under Alternative 1 (and hence, the baseline) would have been adequately protective of natural coho salmon population genetic diversity and fitness (Subsection 3.3, Salmon and Steelhead). Similarly, any population viability and nutrient cycling benefits for natural-origin Snohomish River basin coho salmon populations conferred under Alternative 1 would be eliminated, and become negligible, under Alternative 3, after hatchery-origin salmon stop returning to the basin to spawn (Subsection 3.33.3, Salmon and Steelhead). However, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in natural-origin coho salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Under Alternative 3, no hatchery-origin adult coho salmon smolts would be produced to contribute to total fisheries harvest and escapement to Snohomish River basin marine and freshwater areas (Table 17). There would be no hatchery-origin adult coho salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest, and only fish that are part of the natural-origin component of the Snohomish River basin populations would return. The total all natural-origin coho salmon return to basin areas under Alternative 3 of 138,700 fish compares with the 46-year high abundance level for Snohomish River basin-origin coho salmon of 294,379 fish (Section 3.3.5 Salmon and Steelhead - Puget Sound Coho Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery coho salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin coho salmon, total hatchery-origin adult fish production plus recent year average natural-origin coho salmon returns under Alternative 3 would be 47 percent of the 46-year high abundance level for coho salmon produced in the basin (Table 17). Under Alternative 3, the level of adult Snohomish River basin coho salmon production would be reduced to a medium to high extent relative to Alternative 1.

Under Alternative 3, Snohomish River basin fisheries directed at returning adult hatchery-origin coho salmon would not occur, because the three programs supporting harvest of the species would be terminated. Natural-origin Snohomish River basin coho salmon would continue to be harvested both directly and incidentally in Puget Sound, U.S., and Canadian mixed-stock marine area fisheries for coho salmon and other species. Snohomish River basin natural-origin coho salmon populations intercepted in these fisheries would be increased to a negligible to low extent relative to Alternative 1, resulting from cessation of hatchery-origin coho salmon production that buffers fishery impacts on natural stocks in mixed-stock fishing areas. Under Alternative 1, the presence of hatchery-origin coho salmon returning to Tulalip Bay Hatchery focuses tribal fishing effort on hatchery-origin fish in the hatchery terminal area, and removed from natural-origin coho salmon migration areas. There is therefore a greater likelihood under Alternative 1 that

natural-origin coho salmon would not be harvested to the full allowable extent when hatchery-origin fish are available. Under Alternative 3, with loss of hatchery-origin coho salmon returns drawing fishing effort into Tulalip Bay, there is increased likelihood relative to Alternative 1 that natural-origin coho salmon will be harvested to their full allowable extent. The adverse effects of any fisheries on natural-origin Snohomish River basin coho salmon populations would therefore potentially increase to a low extent relative to effects under Alternative 1, because harvests of the natural populations would increase as hatchery-origin fish returns to the action area are terminated.

For the above reasons, under Alternative 3, adverse hatchery-related effects on coho salmon and the species' habitat would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a medium extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks associated with genetic diversity loss, competition and predation, facility effects, incidental fishing effects, or disease transfer to Snohomish River basin natural-origin coho salmon, because juvenile hatchery salmon release levels would be reduced by one-half relative to Alternative 1. Any genetic diversity and fitness reduction effects resulting from natural spawning by hatchery coho salmon would be reduced relative to Alternative 1. Under Alternative 4, with reduced juvenile fish production, natural coho salmon adults would continue to be used as broodstock to sustain the Wallace River Hatchery program. The PNI for the Wallace River Hatchery program affecting natural coho salmon populations in the Snohomish River watershed would likely be similar to or above the 0.77 level expected under Alternative 1 (Subsection 3.3, Salmon and Steelhead). The estimated pHOS expected for both the Wallace River Hatchery coho salmon programs in areas where Skokomish and Snoqualmie coho salmon spawn would be reduced by half relative to Alternative 1, because the number of adult coho salmon produced by the program that may stray into natural spawning areas would be reduced by half. Similar to Alternative 1, the pHOS for the Tulalip Bay program in areas where Skokomish and Snoqualmie coho salmon spawn would remain negligible (zero) for the reasons described in Subsection 3.3, Salmon and Steelhead. Any reduction under Alternative 4 in genetic effects that were a legacy of past natural spawning by hatchery coho salmon would be negligible, as PNI (and pHOS) levels under Alternative 1 (and hence, the baseline) would have been adequately protective of natural coho salmon population genetic diversity and fitness (Subsection 3.3, Salmon and Steelhead). Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related effects on natural-origin coho salmon life history, population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1. Any population viability and nutrient cycling benefits for Snohomish River basin coho salmon resulting from implementation of Alternative 1 would be reduced to a negligible to low extent under Alternative 4 after hatchery-origin salmon return in reduced abundances to the basin to spawn (Subsection 3.3, Salmon and Steelhead). However, reducing salmon hatchery production by one-half in the action area would not be expected to result in measurable increases in natural-origin coho salmon

abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Under Alternative 4, hatchery-origin adult coho salmon smolt releases would be reduced by one-half relative to the level under Alternative 1 (Table 3). Therefore, the number of hatchery-origin coho salmon adults produced to contribute to total fisheries harvest and escapement to Snohomish River basin marine and freshwater areas would be reduced by one-half, to 66,418 fish (Table 17). There would be less hatchery-origin adult coho salmon available for annual commercial, tribal ceremonial and subsistence, and recreational fisheries harvest. The total coho salmon return to basin areas under Alternative 4 of 205,118 fish compares with the 46-year high natural-origin abundance level for the Snohomish River basin of 294,379 fish (Section 3.3.5, Salmon and Steelhead - Puget Sound Coho Salmon). With respect to considerations regarding the extent to which the Tulalip Bay Hatchery coho salmon harvest augmentation program mitigates for lost natural production of Snohomish River basin coho salmon, total hatchery-origin adult fish production plus recent year average natural-origin coho salmon returns under Alternative 4 would be70 percent of the 46-year high coho salmon abundance level produced in the basin (Table 17). Under Alternative 4, the level of adult Snohomish River basin coho salmon production would be reduced to a medium extent relative to Alternative 1.

Under Alternative 4, Snohomish River basin fisheries directed at returning adult hatchery-origin coho salmon would be reduced, commensurate with a reduced number of adult fish available for harvest. Reductions in fisheries directed at hatchery-origin coho salmon would reduce incidental harvest effects on commingled natural-origin coho salmon populations in the action area relative to Alternative 1. Natural-origin and hatchery-origin Snohomish River basin coho salmon would continue to be harvested both directly and incidentally in Puget Sound, U.S., and Canadian mixed-stock marine area fisheries for coho salmon and other species. Snohomish River basin natural-origin coho salmon populations intercepted in these fisheries would be increased to a negligible extent relative to Alternative 1, resulting from reduction of hatchery-origin coho salmon production that buffers fishery impacts on natural stocks in mixed-stock fishing areas. Under Alternative 1, the presence of hatchery-origin coho salmon returning to Tulalip Bay Hatchery focuses tribal fishing effort on hatchery-origin fish in the hatchery terminal area, and removed from natural-origin coho salmon migration areas. There is therefore a greater likelihood under Alternative 1 that natural-origin coho salmon chum would not be harvested to the full allowable extent when hatchery-origin fish are available. Under Alternative 4, with reduction of hatchery-origin coho salmon returns drawing fishing effort into Tulalip Bay, there is increased likelihood relative to Alternative 1 that natural-origin coho salmon will be harvested to a greater extent, and up to allowable harvest levels. The adverse effects of any fisheries on natural-origin Snohomish River basin coho salmon populations would therefore potentially increase to a negligible to low extent relative to effects under Alternative 1, because harvests of the natural populations would increase as hatchery-origin fish returns to the action area are reduced.

For the above reasons, under Alternative 4, adverse hatchery-related effects on coho salmon and the species' habitat would be reduced to a negligible to low extent relative to Alternative 1, and beneficial effects would also be reduced to a medium extent relative to Alternative 1.

### 4.3.6 Sockeye Salmon (Non-listed)

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, no sockeye salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under baseline conditions as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to sockeye salmon associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to baseline conditions. Any nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, there are no persistent sockeye salmon populations in the Snohomish River basin. Therefore, the effects of Alternative 1 on sockeye salmon are undetectable.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the operation of the Snohomish River basin salmon hatchery programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the impacts of the hatchery programs on sockeye salmon and their habitat would remain the same as under Alternative 1.

Implementation of Alternative 2 would have a negligible effect on fisheries affecting sockeye salmon relative to Alternative 1, as the Snohomish River basin salmon hatchery programs would not produce sockeye salmon and there are no known persistent populations of sockeye salmon in the Snohomish River basin. Therefore, the effects of Alternative 2 on sockeye salmon remain undetectable, and the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Under Alternative 3, Snohomish River basin salmon hatchery programs would be terminated. Because there are no persistent sockeye salmon populations in the Snohomish River basin, effects of Alternative 3 on sockeye salmon are undetectable, and the same as Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, Snohomish River basin salmon hatchery programs would be reduced by one-half relative to Alternative 1. Because there are no persistent sockeye salmon populations in the Snohomish River basin, effects of Alternative 4 on sockeye salmon are undetectable, and the same as Alternative 1.

## 4.4 Other Fish Species

Effects of the alternatives on other fish species in the Snohomish River basin besides salmon are summarized here (see Table 18), and analyzed below.

Table 18. Summary of effects on other fish species in the Snohomish River basin.

| Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Undetectable effects. | Same as Alt 1. | Negligible to Low reduction in effects. | Negligible to Low reduction in effects. |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, no other fish species besides salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under baseline conditions as habitat protection and restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to other fish species in the Snohomish River basin associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar levels relative to baseline conditions. Effects under Alternative 1 on life history, and population abundance, diversity, spatial structure, and productivity would remain the same as under baseline conditions for the species described in Subsection 3.4, Other Fish Species.

Bull trout, an ESA-listed species present in the Snohomish River basin, are likely to be affected by the salmon hatchery programs through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations. Adverse effects on the listed Puget Sound/Washington Coastal bull trout DPS or its four component populations in the Snohomish River basin are expected to be negligible under Alternative 1, and the same as under baseline conditions, for the following reasons: (1) bull trout would largely benefit from having hatchery-origin salmon released into the Snohomish River watershed and Tulalip Bay because they eat juvenile salmon; (2) few bull trout would be expected to be intercepted at hatchery weirs and during in-river broodstock collection activities in the Wallace River, because primary spawning and rearing habitat for bull trout in the Skykomish River Basin is in the upper North Fork Skykomish River and the upper South Fork Skykomish River, well removed from Wallace River Hatchery operations; and, (3) bull trout that are part of the listed DPS are not found exclusively in the Snohomish River basin or nearby marine waters. The estimated total number of bull trout that are part of the four delineated populations in the Snohomish River watershed is low (only 500 to 1,000 fish (USFWS 2004), and there are no bull trout in the Tulalip Bay tributaries where the Tulalip Tribes' hatchery programs are located. No bull trout have ever been encountered in any of the Tulalip Tribes' hatchery programs after more than 30 years of operations, nor have they ever been captured in nearby marine waters during juvenile salmonid monitoring surveys. For these reasons, similar to baseline conditions, the risks of encounters, handling, ecological impacts, and mortalities

associated with salmon broodstock collection, juvenile salmon production, and other operational activities at the hatcheries would likely be negligible.

Pacific lamprey, western brook lamprey, all rockfish species, and Pacific herring are not located exclusively in the Snohomish River basin or nearby marine waters. In most cases, these areas are a very small percentage of the total range of these species. Similar to baseline conditions, any adverse or beneficial effects on these species as a result of competition, predation, or marine-derived nutrients associated with salmon production through the hatchery programs under Alternative 1 are expected to have a negligible impact on the overall size, health, survival, or status of those species.

Under Alternative 1, as under baseline conditions, fisheries would continue to directly harvest other fish species in the Snohomish River basin and in Puget Sound. At levels similar to baseline conditions, fish species (e.g., rockfish) susceptible to harvest in net and sport gear types used in tribal, commercial, and recreational salmon fisheries would continue to be encountered incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon. Other fish species susceptible to these gear types would also potentially be harvested incidentally in Puget Sound and Snohomish River basin fisheries targeting coho salmon, pink salmon, hatchery-origin Chinook salmon, and hatchery-origin steelhead. Fisheries effects under Alternative 1 would be the same as under baseline conditions.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to other fish species under Alternative 1 as the hatchery programs continue into the future would be increased to a medium extent relative to the baseline level. Similar to baseline conditions, new fisheries with direct harvest impacts on restored Snohomish River salmon populations could potentially be initiated over the long term under Alternative 1. Harvest-related risks to other fish species in the Snohomish River basin and Puget Sound under Alternative 1 would be expected to be increased to a low extent above baseline levels, with no changes in effects likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, effects on other fish species under Alternative 1 would essentially remain the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, no other fish species besides salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under Alternative 1 as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to other fish species

in the Snohomish River basin associated with hatchery program implementation (i.e., those described in Subsection 3.3, including genetic diversity loss, competition and predation effects, fish disease transfer effects, and facility effects) would persist at similar, negligible levels relative to Alternative 1). Effects under Alternative 2 on other fish species life history, and population abundance, diversity, spatial structure, and productivity would remain negligible, and the same as Alternative 1 for the species described in Subsection 3.4, Other Fish Species.

Bull trout, an ESA-listed species present in the Snohomish River basin, may be affected by the salmon hatchery programs through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations. Adverse effects on the listed Puget Sound/Washington Coastal bull trout DPS or its four component populations in the Snohomish River basin are expected to be negligible under Alternative 2, and the same as Alternative 1, for the following reasons: (1) bull trout would largely benefit from having hatchery-origin salmon released into the Snohomish River watershed and Tulalip Bay because they eat juvenile salmon; (2) few bull trout would be expected to be intercepted at hatchery weirs and during in-river broodstock collection activities in the Wallace River because primary spawning and rearing habitat for bull trout in the Skykomish River basin is in the upper North Fork Skykomish River and upper South Fork Skykomish River, well removed from Wallace River Hatchery operations; and, (3) bull trout that are part of the listed DPS are not found exclusively in the Snohomish River basin or nearby marine waters. The estimated total number of bull trout that are part of the four delineated populations in the Snohomish River watershed is low (only 500 to 1,000 fish (USFWS 2004), and there are no bull trout in the Tulalip Bay tributaries where the Tulalip Tribes' hatchery programs are located. No bull trout have ever been encountered in any of the Tulalip Tribes' hatchery programs after more than 30 years of operations, nor have they ever been captured in nearby marine waters during juvenile salmonid monitoring surveys. For these reasons, similar to Alternative 1, the risks of encounters, handling, ecological impacts, and mortalities associated with salmon broodstock collection, juvenile salmon production, and other operational activities at the hatcheries would likely be negligible.

Pacific lamprey, western brook lamprey, all rockfish species, and Pacific herring are not located exclusively in the Snohomish River basin or nearby marine waters. In most cases, these areas are a very small percentage of the total range of these species. Similar to Alternative 1, any adverse or beneficial effects on these species as a result of competition, predation, or marine-derived nutrients associated with salmon production through the hatchery programs under Alternative 2 are expected to have a negligible impact on the overall size, health, survival, or status of those species.

Under Alternative 2, as under Alternative 1, fisheries would continue to directly harvest other fish species in the Snohomish River basin and in Puget Sound. Fish species (e.g., rockfish) susceptible to harvest in net and sport gear types used in tribal, commercial, and recreational salmon fisheries would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon. Other fish species susceptible to these gear types would also potentially be harvested incidentally in Puget Sound and Snohomish River basin fisheries targeting coho salmon, pink salmon, hatchery-origin Chinook salmon, and

hatchery-origin steelhead. Fisheries effects under Alternative 2 would be the same as Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to other fish species under Alternative 2 as the program continues into the future would be the same as under Alternative 1. Similar to Alternative 1, new fisheries with direct harvest impacts on restored Snohomish River salmon populations could potentially be initiated over the long term under Alternative 2. Harvest-related risks to other fish species in the Snohomish River basin and Puget Sound under Alternative 2 would be expected to be the same as Alternative 1, with no changes in effects likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, effects on other fish species under Alternative 2 would essentially remain the same as Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate risks to other fish species associated with facility operation, competition and predation, incidental fishing effects, broodstock collection activities, or disease transfer from salmon hatchery programs in the basin, because the salmon hatchery programs in the action area would be terminated. Any action area salmon hatchery-related effects on other fish species': life history, and population abundance, diversity, spatial structure, and productivity occurring under Alternative 1 would therefore be eliminated, remaining negligible under Alternative 3. Similarly, any population viability and nutrient cycling benefits other fish species conferred under Alternative 1 would be eliminated, and also remain negligible, under Alternative 3, after hatchery-origin salmon stop returning to the basin to spawn (Subsection 3.33.3, Salmon and Steelhead). However, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in the natural-origin abundance of other fish species because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Risks to bull trout posed by the Snohomish River basin salmon hatchery programs through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations would be eliminated under Alternative 3. The salmon hatchery programs within the action area would be terminated, and there would be no juvenile fish releases, adult fish returns, or local hatchery operational activities that would potentially affect bull trout. Under Alternative 3, benefits to bull trout population viability and nutrient cycling that would enhance the species would also be eliminated through termination of hatchery salmon production from the Snohomish River basin hatchery programs. Under Alternative 3, adverse effects on the listed Puget Sound/Washington Coastal bull trout DPS or its

four component populations in the Snohomish River basin are expected to be similarly negligible relative to Alternative 1 for the following reasons: (1) a prey source for bull trout that would benefit from having hatchery-origin salmon released into the Snohomish River basin would be eliminated; and (2) no bull trout would be expected to be intercepted at hatchery weirs and during in-river broodstock collection activities in the Wallace River because the programs these activities would support would be eliminated; and, (3) bull trout that are part of the listed DPS are not found exclusively in the Snohomish River basin or nearby marine waters. The estimated total number of bull trout that are part of the four delineated populations in the Snohomish River watershed is low (only 500 to 1,000 fish (USFWS 2004), and there are no bull trout in the Tulalip Bay tributaries where the Tulalip Tribes' hatchery programs are located. No bull trout have ever been encountered in any of the Tulalip Tribes' hatchery programs after more than 30 years of operations, nor have they ever been captured in nearby marine waters during juvenile salmonid monitoring surveys. For these reasons, similar to Alternative 1, the risks of encounters, handling, ecological impacts, and mortalities associated with salmon broodstock collection, juvenile salmon production, and other operational activities at the hatcheries would likely be negligible.

Pacific lamprey, Western brook lamprey, all rockfish species, and Pacific herring are not located exclusively in the Snohomish River basin or nearby marine waters. In most cases, these areas are a very small percentage of the total range of these species. Similar to Alternative 1, any adverse or beneficial effects on these species as a result of competition, predation, or marine-derived nutrients associated with salmon production through the salmon hatchery programs in the action area under Alternative 3 are expected to be negligible regarding impacts on the overall size, health, survival, or status of those species.

Under Alternative 3, Snohomish River basin hatchery-origin Chinook, coho, and chum salmon would no longer be available for harvest in Puget Sound and in-river fisheries, because the hatchery programs producing the species would be terminated. Adult hatchery-origin salmon returns to the hatchery release locations would cease, and fisheries previously targeting the salmon in Puget Sound and the Snohomish River basin would be restricted or terminated. These fisheries restrictions or terminations would occur, assuming habitat protection and restoration actions are inadequate, and natural-origin Chinook, coho and chum salmon cannot sustain harvests in tribal and Washington State fisheries. However, it is likely that salmon produced naturally in the Snohomish River basin would continue to be harvested incidentally at levels similar to Alternative 1 in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. For these reasons, any adverse effects of fisheries on other fish species susceptible to harvest in commercial or recreational salmon fishing gear may be assumed to decrease to a low extent relative to Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to other fish species under Alternative 3 as the program continues into the

future would be reduced to a low extent relative to Alternative 1. Under Alternative 3, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a low extent over the long term. Harvest-related risks to other fish species in the Snohomish River basin and Puget Sound under Alternative 3 would be expected to decline to a low extent relative to Alternative 1, with no changes in effects on other fish species likely in mixed stock marine area fisheries where Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For these reasons, potential adverse and beneficial effects on other fish species under Alternative 3 would be reduced to a negligible to low extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to other fish species, because juvenile hatchery salmon release levels from the salmon hatchery programs in the action area would be reduced by one-half relative to Alternative 1. Considering that risk averse measures implemented to reduce effects on natural-origin fish, including salmon release timings, locations, life stages, and methods; and fish health management procedures, would remain the same, salmon hatchery-related effects from the Snohomish River basin programs on other fish species' life history, population abundance, diversity, spatial structure, and productivity would remain similar and negligible under Alternative 4 relative to Alternative 1. Any population viability and nutrient cycling benefits for other fish species resulting from implementation of Alternative 1 would remain negligible under Alternative 4 after hatchery-origin salmon return in reduced abundances to the basin to spawn (Subsection 3.3, Salmon and Steelhead). However, reducing salmon hatchery production by one-half in the action area would not be expected to result in measurable increases in natural-origin coho salmon abundance because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat).

Risks to bull trout posed by the salmon hatchery programs in the action area through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations would remain negligible under Alternative 4, similar to Alternative 1. Salmon production from the Snohomish River basin hatchery programs would be reduced relative to Alternative 1, as there would be one-half the number of juvenile fish released in the action area under Alternative 4, reducing the potential for juvenile and adult fish interactions, and hatchery operational activities that could harm bull trout. Under Alternative 4, benefits to bull trout population viability and to nutrient cycling that would enhance the species would also be reduced through reduced hatchery salmon production from the Snohomish River basin hatchery programs. Under Alternative 4, adverse effects on, and benefits to, the listed Puget Sound/Washington Coastal bull trout DPS or its four component populations in the Snohomish River basin are expected to remain negligible, similar to Alternative 1 for the following reasons: (1) a prey source for bull trout that would benefit from having hatchery-origin salmon released into the Snohomish River watershed and Tulalip Bay would be reduced; and (2) no bull trout would be expected to be intercepted at hatchery weirs and during in-river broodstock collection activities in the Wallace River because the programs these activities would

support would be eliminated; and (3) bull trout that are part of the listed DPS are not found exclusively in the Snohomish River basin or nearby marine waters. The estimated total number of bull trout that are part of the four delineated populations in the Snohomish River watershed is low (only 500 to 1,000 fish (USFWS 2004), and there are no bull trout in the Tulalip Bay tributaries where the Tulalip Tribes' hatchery programs are located. No bull trout have ever been encountered in any of the Tulalip Tribes' hatchery programs after more than 30 years of operations, nor have they ever been captured in nearby marine waters during juvenile salmonid monitoring surveys. For these reasons, similar to Alternative 1, the risks of encounters, handling, ecological impacts, and mortalities associated with salmon broodstock collection, juvenile salmon production, and other operational activities at the hatcheries would likely be negligible.

Pacific lamprey, Western brook lamprey, all rockfish species, and Pacific herring are not located exclusively in the Snohomish River basin or nearby marine waters. In most cases, these areas are a very small percentage of the total range of these species. Similar to Alternative 1, any adverse or beneficial effects on these species as a result of competition, predation, or marine-derived nutrients associated with salmon production through the hatchery programs under Alternative 4 are expected to be negligible regarding impacts on the overall size, health, survival, or status of those species.

Under Alternative 4, Snohomish River basin hatchery-origin Chinook, coho, and chum salmon would be harvested to a reduced extent in Puget Sound and in-river fisheries relative to Alternative 1, because the action area salmon hatchery programs producing the species would be reduced by one-half. Adult hatchery-origin salmon returns to the basin would be reduced, and salmon fisheries in Puget Sound and the Snohomish River basin would be restricted relative to those under Alternative 1 if reduced harvest rates were required to protect Snohomish River basin natural-origin Chinook, coho and chum salmon in tribal and Washington State fisheries. However, salmon produced naturally in the watershed would continue to be harvested incidentally at levels similar to Alternative 1 in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. For these reasons, any adverse effects of fisheries on other fish species susceptible to harvest in commercial or recreational fishing gear used to harvest salmon would remain similar but decrease slightly relative to those of Alternative 1.

Over the long term, continued operation of the Chinook, coho, and fall chum salmon hatchery programs as proposed in Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to help restore the natural-origin and total populations for the species in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased juvenile and adult Chinook, coho, and fall chum salmon abundances to other fish species under Alternative 4 as the program continues into the future would be reduced to a negligible to low extent relative to Alternative 1. Under Alternative 4, the potential for new fisheries with direct harvest impacts on restored Snohomish River salmon populations would be reduced to a negligible to low extent over the long term. Harvest-related risks to other fish species in the Snohomish River basin and Puget Sound under Alternative 4 would be expected to decline to a negligible extent relative to Alternative 1, with no changes in effects on other fish species likely in mixed stock marine area fisheries where

Snohomish River basin-origin Chinook, coho, and fall chum salmon would continue to be harvested incidentally.

For the above reasons, potential adverse effects under Alternative 4 would be reduced to a negligible to low extent relative to Alternative 1.

## 4.5 Wildlife

Effects of the alternatives on wildlife are summarized here (see Table 19), and analyzed below.

Table 19. Summary of effects on wildlife in the analysis area.

| Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Undetectable effect | Same as Alt 1 | Low reduction in risks; Low to Medium reduction in benefits | Low reduction in risks; Low reduction in benefits |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the hatchery programs would be operated the same as under baseline conditions over the short and long terms, so the risk of transfer of toxic contaminants from hatchery-origin fish to wildlife, and risks associated with operation of broodstock collection activities (e.g., weirs), predator control programs, physical damage or disruption of riparian vegetation from angler access or physical disruption of streambed material from wading or motorized boat (Subsection 3.5, Wildlife) would remain the same as under baseline conditions. Similarly, as under baseline conditions, salmon collected through the hatchery programs as broodstock and spawned, or determined surplus to broodstock needs, would be distributed within the watershed for nutrient enrichment purposes. Naturally spawning hatchery-origin salmon would also contribute to nutrient cycling. These hatchery-origin salmon and carcasses will bring nutrients from the marine ecosystem to the terrestrial ecosystem in the watershed, which will benefit plants, wildlife, and habitat. Under Alternative 1, these nutrient cycling benefits would remain the same as under baseline conditions.

Increasing the total number of Snohomish River basin-origin salmon above levels currently achievable naturally through the implementation of the Snohomish River basin salmon hatchery programs under Alternative 1 would increase the total amount of food available for marine mammals such as killer whales, seals, and sea lions. However, because Snohomish River basin salmon commingle with many other hatchery-origin and natural-origin salmon (and steelhead) from the Puget Sound, Fraser River, Columbia River, and Washington Coast while in marine waters, the impact on the abundance of salmon available as marine mammal prey would be negligible (i.e., at the lower levels of detection), and the same as under baseline conditions.

Production of juvenile and adult salmon through implementation of the Snohomish River basin salmon hatchery programs under Alternative 1 would increase food availability for other salmon predators (e.g., river otters) and scavengers (e.g., gulls, bald eagles), which may have a beneficial impact on these wildlife populations. Hatchery salmon production under Alternative 1 would also increase the number of salmon competitors for food for some wildlife species, and the

number of salmon predators on some invertebrates and amphibian species. These interactions might have an adverse impact on the abundance of certain bird, invertebrate, and amphibian species in the basin. Because juvenile fish production levels are the same as those under baseline conditions, these effects are expected to remain the same, and negligible, relative to effects under baseline conditions.

Similar to baseline conditions, implementation of Alternative 1 would not be expected to change the population size, health, survival, or Federal ESA listing status of Northern spotted owl, marbled murrelet, Southern resident killer whale, or Steller sea lion, because none of these species is located exclusively in the Snohomish River basin or nearby marine waters, and the analysis area represents a very small percentage of their total range. Effects of Alternative 1 on these species would remain the same as under baseline conditions.

Over the long term, continued operation of the salmon hatchery programs in the Snohomish River basin under Alternative 1, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) as modified annually under the 3-Year Workplan, would be expected to help restore the natural-origin and total populations of salmon in the Snohomish River basin. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to plants, animals and their habitats under Alternative 1 as the programs continue into the future would be increased above the baseline level. New fisheries with direct harvest impacts on restored Snohomish River basin salmon populations could potentially be initiated over the long term under Alternative 1. Harvest-related risks to wildlife species in the Snohomish River basin and Puget Sound under Alternative 1 would be expected to be increased above baseline levels, with no differences in effects likely in mixed stock marine area fisheries where Snohomish River basin salmon would continue to be harvested incidentally. For these reasons, both adverse and beneficial effects on wildlife species over the long term are expected to increase to a low extent relative to baseline conditions.

For these reasons, effects on wildlife under Alternative 1 would essentially remain the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the hatchery programs would be operated the same as under Alternative 1 over the short and long terms, so the risk of transfer of any contaminants from hatchery-origin fish to wildlife, and risks associated with operation of broodstock collection activities (e.g., weirs), predator control programs, physical damage or disruption of riparian vegetation from angler access or physical disruption of streambed material from wading or motorized boats (Subsection 3.5, Wildlife) would remain the same as Alternative 1. Similarly, as under Alternative 1, salmon collected through the hatchery programs as broodstock and spawned, or determined surplus to broodstock needs, would be distributed within the watershed for nutrient enrichment purposes. Naturally spawning hatchery-origin salmon would also contribute to nutrient cycling. These hatchery-origin salmon and carcasses will bring nutrients from the marine ecosystem to the freshwater aquatic and terrestrial ecosystems in the watershed, which

will benefit wildlife. Under Alternative 2, these nutrient cycling benefits would remain the same as Alternative 1.

Increasing the total number of Snohomish River basin-origin salmon above levels currently achievable naturally through the implementation of the Snohomish River basin salmon hatchery programs under Alternative 2 would increase the total amount of food available for marine mammals such as killer whales, seals, and sea lions. However, because Snohomish River basin salmon commingle with many other hatchery-origin and natural-origin salmon (and steelhead) from the Puget Sound, Fraser River, Columbia River, and Washington Coast while in marine waters, the impact on the abundance of salmon available as marine mammal prey would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Production of juvenile and adult salmon through implementation of the Snohomish River basin salmon hatchery programs under Alternative 2 would increase food availability for other salmon predators (e.g., river otters) and scavengers (e.g., gulls, bald eagles), which may have a beneficial impact on these wildlife populations. Hatchery salmon production under Alternative 2 would also increase the number of salmon competitors for food for some wildlife species, and the number of salmon predators on some invertebrates and amphibian species. These interactions might have a negligible adverse impact on the abundance of certain bird, invertebrate, and amphibian species in the basin. Because juvenile fish production levels are the same as those under Alternative 1, these effects are expected to remain the same as effects under Alternative 1.

Similar to Alternative 1, implementation of Alternative 2 would not be expected to change the population size, health, survival, or Federal ESA listing status of Northern spotted owl, marbled murrelet, Southern resident killer whale, or Steller sea lion, because none of these species is located exclusively in the Snohomish River basin or nearby marine waters, and the analysis area represents a very small percentage of their total range. Effects of Alternative 2 on these species would remain the same as effects under Alternative 1.

Over the long term, continued operation of the salmon hatchery programs as proposed under Alternative 2, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) and Three Year Work Plan, would be expected to help restore the natural-origin and total populations of salmon in the Snohomish River basin to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to fish, wildlife, and plant species and their habitats under Alternative 2 as the programs continue into the future would be the same as under Alternative 1. Similar to Alternative 1, new fisheries with direct harvest impacts on restored Snohomish River basin salmon populations could potentially be initiated over the long term under Alternative 2. Harvest-related risks to wildlife species in the Snohomish River basin and Puget Sound under Alternative 2 would be expected to remain the same as under Alternative 1, with no differences in effects likely in mixed stock marine area fisheries where Snohomish River basin salmon would continue to be harvested incidentally. For these reasons, adverse and beneficial effects on wildlife species over the long term under Alternative 2 are expected to remain the same as Alternative 1.

For the above reasons, effects on other fish species under Alternative 2 would essentially remain the same as effects under Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Implementation of Alternative 3 would eliminate risks to wildlife associated with transfer of any contaminants from hatchery-origin fish to wildlife, operation of broodstock collection activities (e.g., weirs), predator control programs, physical damage or disruption of riparian vegetation from angler access or physical disruption of streambed material from wading or motorized boat traffic (Subsection 3.5, Wildlife), because the salmon hatchery programs (and associated fisheries in the immediate action area) would be terminated. Similarly, any nutrient cycling benefits for wildlife would be eliminated after hatchery-origin fish stop returning to the watershed to spawn commensurate with termination of the hatchery programs (Subsection 3.5, Wildlife). Risks to wildlife species under Alternative 3 would remain the same as under Alternative 1 (negligible). Benefits to wildlife species resulting from termination of the six salmon hatchery programs under Alternative 3 would decrease to a low to medium extent relative to Alternative 1.

Decreasing the total number of Snohomish River basin-origin salmon through termination of the Snohomish River basin salmon hatchery programs under Alternative 3 would decrease the total amount of food available for marine mammals such as killer whales, seals, and sea lions. Further, eliminating salmon hatchery production in the action area would not be expected to result in measurable increases in the abundance of natural-origin salmon available to predators, because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat). However, because Snohomish River basin salmon commingle with many other hatchery-origin and natural-origin salmon (and steelhead) from the Puget Sound, Fraser River, Columbia River, and Washington Coast while in marine waters, the impact of salmon hatchery program termination under Alternative 3 on the abundance of marine mammals would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Implementation of Alternative 3 would also decrease food availability for salmon predators (e.g., river otters) and scavengers (e.g., bald eagles), which may have an adverse impact on these wildlife populations. Again, eliminating hatchery production would not be expected to result in measurable increases in natural-origin salmon abundance to meet predator needs because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat). In fact, the opposite could occur under this alternative. Evidence suggests that spawning by hatchery-origin Chinook salmon in the Wallace River and in the South Fork Skykomish River above Sunset Falls has increased the abundance of returning natural-origin adults, accounting for substantial proportions of total natural-origin Skykomish Chinook returns in past years (data from Tulalip 2012 and WDFW 2013a). Decreasing the number of juvenile and adult salmon in the Snohomish River basin would also decrease the number of salmon competitors for food for some wildlife species, and the number of salmon predators on some invertebrates and amphibian species. These interactions might have a beneficial impact on the abundance of birds, invertebrates, and amphibian species in the watershed. Because juvenile and adult salmon production would be terminated under Alternative 3, these effects are expected to be reduced to a low to medium extent under Alternative 3 relative to Alternative 1.

Similar to Alternative 1, implementation of Alternative 3 would not be expected to change the size, health, survival, or Federal listing status of Northern spotted owl, marbled murrelet, southern resident killer whale, or Steller sea lion. Termination of the salmon hatchery programs under Alternative 3 would not substantially affect the status of these species because none of them are located exclusively in the Snohomish River basin or nearby marine waters, and the analysis area represents a very small percentage of their total range. The very small proportion of the total numbers of fish present in the Salish Sea and Pacific Ocean areas where these ESA-listed species occur that would be represented by Snohomish River basin hatchery-origin salmon provides further rationale that effects of hatchery program termination would be unsubstantial. Effects of Alternative 3 on these species would remain the same as effects under Alternative 1.

Over the long term, termination of the salmon hatchery programs as proposed under Alternative 3 would eliminate contribution of salmon produced by the programs to restoration of natural-origin and total populations of salmon in the Snohomish River basin to a viable status, approaching historical levels. Potential nutrient cycling and population viability benefits from increased salmon abundance levels afforded by the program under Alternative 1 to wildlife species would be eliminated under Alternative 3, and reduced to a low extent relative to Alternative 1. Ove the long term, the ability to implement new fisheries with direct harvest impacts on restored natural-origin Snohomish River basin salmon populations would decrease to a low extent under Alternative 3 relative to Alternative 1, because the timing of restoration of robust natural-origin salmon populations would be delayed. Harvest-related risks to wildlife species in the Snohomish River basin and Puget Sound under Alternative 3 would therefore be expected to decrease to a low extent relative to Alternative 1, because the pace at which new fisheries could be implemented would be slowed under Alternative 3. There would be no differences in effects on wildlife between the alternatives in mixed stock marine area preterminal fisheries where Snohomish River basin salmon would continue to be harvested incidentally at the same relative rate under both alternatives. For these reasons, adverse and beneficial effects on wildlife species over the long term are expected to decrease to a low extent under Alternative 3 relative to Alternative 1.

For the above reasons, under Alternative 3, adverse hatchery-related effects on wildlife would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a low to medium extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Implementation of Alternative 4 would reduce risks to wildlife associated with any transfer of contaminants from hatchery-origin fish to wildlife, operation of broodstock collection activities (e.g., weirs), predator control programs, physical damage or disruption of riparian vegetation from angler access or physical disruption of streambed material from wading or motorized boat traffic (Subsection 3.5, Wildlife), because the salmon hatchery programs (and associated fisheries in the immediate action area) would be reduced by one-half relative to Alternative 1. Similarly, any nutrient cycling benefits for wildlife would be reduced when adult hatchery-origin salmon begin returning in reduced numbers to the watershed to spawn commensurate with

reduction in juvenile hatchery salmon releases from the hatchery programs (Subsection 3.5, Wildlife). Risks to wildlife species under Alternative 4 would remain the same as under Alternative 1(negligible). Benefits to wildlife species resulting from reduction of juvenile salmon releases from the six salmon hatchery programs under Alternative 4 would decrease to a low extent relative to Alternative 1.

Decreasing the total number of Snohomish River basin-origin salmon through reduction of the fish releases from Snohomish River basin salmon hatchery programs under Alternative 4 would decrease the total amount of food available for marine mammals such as killer whales, seals, and sea lions. Further, reducing salmon hatchery production in the action area by one half would not be expected to result in measurable increases in the abundance of natural-origin salmon available to predators, because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat). However, because Snohomish River basin salmon commingle with many other hatchery-origin and natural-origin salmon (and steelhead) from the Puget Sound, Fraser River, Columbia River, and Washington Coast while in marine waters, the impact of reduction of the salmon hatchery programs under Alternative 4 on the abundance of marine mammals would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Implementation of Alternative 4 would also decrease food availability for salmon predators (e.g., river otters) and scavengers (e.g., bald eagles), which may have an adverse impact on these wildlife populations. Again, reducing salmon hatchery production would not be expected to result in measurable increases in natural-origin salmon abundance to meet predator needs because of the current condition of salmon habitat in the Snohomish River basin (Subsection 3.2, Fish Habitat). In fact, the opposite could occur under Alternative 3. Evidence suggests that spawning by hatchery-origin Chinook salmon in the Wallace River and in the South Fork Skykomish River above Sunset Falls has increased the abundance of returning natural-origin adults, accounting for substantial proportions of total natural-origin Skykomish Chinook returns in past years (data from Tulalip 2012 and WDFW 2013a). Decreasing the number of juvenile and adult salmon in the Snohomish River basin would also decrease the number of salmon competitors for food for some wildlife species, and the number of salmon predators on some invertebrates and amphibian species. These interactions might have a beneficial impact on the abundance of birds, invertebrates, and amphibian species in the watershed. Because juvenile and adult salmon production levels would be reduced by one-half relative to Alternative 1, these effects are expected to be reduced to a low extent under Alternative 4 relative to Alternative 1.

Similar to Alternative 1, implementation of Alternative 4 would not be expected to change the size, health, survival, or Federal listing status of Northern spotted owl, marbled murrelet, southern resident killer whale, or Steller sea lion. Reductions in the salmon hatchery programs under Alternative 4 would not substantially affect the status of these species because none of them are located exclusively in the Snohomish River basin or nearby marine waters, and the analysis area represents a very small percentage of their total range. The very small proportion of the total numbers of fish present in the Salish Sea and Pacific Ocean areas where these ESA-listed species occur that would be represented by Snohomish River basin hatchery-origin salmon provides further rationale that effects of hatchery program reduction by one-half would be

unsubstantial. Effects of Alternative 4 on these species would remain the same as effects under Alternative 1.

Over the long term, termination of the salmon hatchery programs as proposed under Alternative 4 would reduce contribution of salmon produced by the programs to restoration of natural-origin and total populations of salmon in the Snohomish River basin to a viable status, approaching historical levels. Potential nutrient cycling and population viability benefits from increased salmon abundance levels afforded by the program under Alternative 1 to wildlife species would be reduced under Alternative 4, and reduced to a negligible to low extent relative to Alternative 1. Ove the long term, the ability to implement new fisheries with direct harvest impacts on restored natural-origin Snohomish River basin salmon populations would decrease to a negligible to low extent under Alternative 3 relative to Alternative 1, because the timing of restoration of robust natural-origin salmon populations may be delayed. Harvest-related risks to wildlife species in the Snohomish River basin and Puget Sound under Alternative 4 would therefore be expected to decrease to a negligible to low extent relative to Alternative 1, because the pace at which new fisheries could be implemented would be slowed under Alternative 4. There would be no differences in effects on wildlife between the alternatives in mixed stock marine area preterminal fisheries where Snohomish River basin salmon would continue to be harvested incidentally at the same relative rate under both alternatives. For these reasons, adverse and beneficial effects on wildlife species over the long term are expected to decrease to a negligible to low extent under Alternative 4 relative to Alternative 1.

For these reasons, under Alternative 4, adverse hatchery-related effects on wildlife would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a negligible to low extent relative to Alternative 1.

## 4.6 Socioeconomics

Effects of the alternatives on socioeconomics are summarized here (see Table 20), and analyzed below.

Table 20. Summary of effects on socioeconomics in the analysis area.

| Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Undetectable effect | Same as Alt 1 | Medium effect | Low to Medium effect |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the hatchery programs would be operated the same as under baseline conditions, so employment opportunities or the local procurement of goods and services for hatchery operations would persist at similar levels relative to baseline levels (Subsection 3.6, Socioeconomics).

Under Alternative 1 and the baseline, salmon fisheries managed by the Tulalip Tribes and WDFW, and mixed stock marine area fisheries affecting salmon returns to the Snohomish River basin, would be implemented with the same timings and durations. Fishery impacts on salmon

produced in the Snohomish River basin and associated socioeconomic benefits would therefore remain the same as under baseline conditions. In addition, there would be no change in how the hatchery programs were implemented (e.g., no changes in juvenile fish release levels) under Alternative 1 relative to the baseline, and hatchery-origin salmon would be expected to continue to survive and return as adults for potential harvest at similar abundance levels under Alternative 1. However, over the longer term, as salmon produced through the hatchery programs return, and assuming other watershed actions to protect and restore fish habitat and restore natural-origin salmon to levels approaching historical abundances, such as those described in the Shared Strategy for Puget Sound Recovery Plan (SSPS 2005), are enforced and implemented, socioeconomic benefits associated with fisheries are expected to increase to a medium extent under Alternative 1 relative to baseline conditions.

Under baseline conditions, considering only benefits conferred by annual operation of the six Snohomish River basin salmon hatchery programs, approximately $900,000 (through the procurement of local goods and services) and 9 full-time, and up to 22 temporary jobs are contributed to the regional economy (Section 3.6 - Socioeconomics). These benefits conferred by the hatchery operations and employment to operate the hatcheries would not likely change over the longer term under Alternative 1 relative to the baseline. Under Alternative 1, it is unknown how much the economy within the action area would benefit from all salmon fisheries-related expenditures, or through employment, sales, income, value added impacts, expenditures on fishing trips, and expenditures on durable equipment associated with implementation of the salmon hatchery programs. A facet of the local economy for which data can be estimated are local commercial net fisheries for hatchery-origin Chinook and coho salmon produced through the Snohomish River basin programs, which would generate about $318,301 in ex-vessel value each year (Section 3.6 - Socioeconomics). Encompassing expanded impacts to the local economy inclusive of and beyond just ex-vessel value for local commercial net fisheries for hatchery-origin Chinook and coho salmon, the estimated annual impact for the commercial net fishery harvest in Snohomish River basin marine areas is $682,954 (Section 3.6 - Socioeconomics). These estimated values of the commercial Chinook and coho salmon fisheries to the economy within the action area under Alternative 1 would remain the same as under baseline conditions. The value to the economy within the action area of hatchery-origin Chinook and coho salmon caught in recreational fisheries each year is unknown, but that value may be important to sectors of the community through fishery-related expenditures.

Commercial, ceremonial and subsistence, and recreational salmon fisheries in Snohomish River basin marine and freshwater areas are of high socioeconomic value to the Tulalip Tribes and to the local region and that high value would not change under Alternative 1. This status is especially true for tribal fishers participating in hatchery-origin salmon Chinook, coho, and fall chum salmon fisheries in Tulalip Bay, where Tulalip tribal members who are most dependent on salmon for income and sustenance are able to fish using methods requiring minimal costs. For the reasons described in Subsection 3.6 - Socioeconomics), the relative contribution of the fisheries, and other fisheries supported by the Snohomish River basin salmon hatchery programs to the total Washington State economy is likely very low under both Alternative 1 and baseline conditions.

The level of socioeconomic impacts relative to baseline levels is expected to change as natural salmon populations change over the longer term under Alternative 1. For example, increased fisheries-related expenditures resulting from an increase in the number of harvestable salmon (if salmon recovery plan actions are successfully implemented and are effective) would be beneficial for local entities supporting recreational fishing in the action area, and would be particularly beneficial to the Tulalip Tribes. Effects on the purchase of fishing-related supplies at local businesses, and benefits to the regional economy from salmon fisheries-related activities (Subsection 3.6, Socioeconomics), would be expected to be the same as under baseline conditions over the short term. If natural salmon population abundance increases in response to successful recovery plan implementation, Alternative 1 may also increase the likelihood of these benefits to a low extent over the longer term relative to the baseline. If natural salmon abundance remains stable, or decreases over time due to continued habitat loss and degradation, and climate change (Subsection 3.2 - Fish Habitat), socioeconomic benefits under Alternative 1 may be similar to, or decrease to a low to medium extent, respectively, relative to the baseline.

For these reasons, socioeconomic effects under Alternative 1 would remain the same as effects under baseline conditions for the foreseeable future.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the operation of the Snohomish River basin salmon hatchery programs would be the same as under Alternative 1, so employment opportunities and local procurement of goods and services for hatchery operations would persist at similar levels relative to baseline conditions.

Under Alternative 2 and the Alternative 1, salmon fisheries managed by the Tulalip Tribes and WDFW, and mixed stock marine area fisheries affecting salmon returns to the Snohomish River basin, would be implemented with the same timings and durations. Fishery impacts on salmon produced in the Snohomish River basin and associated socioeconomic benefits under Alternative 2 would therefore remain the same as effects under Alternative 1. In addition, there would be no change in how the salmon hatchery programs were implemented (e.g., no changes in juvenile fish release levels) under Alternative 2 relative to Alternative 1, and hatchery-origin salmon would be expected to continue to survive and return as adults for potential harvest at similar abundance levels under Alternative 2. Over the longer term, as salmon produced through the hatchery programs return, and assuming other watershed actions to protect and restore fish habitat and restore natural-origin salmon to levels approaching historical abundances, such as those described in the Shared Strategy for Puget Sound Recovery Plan (SSPS 2005), are enforced and implemented, socioeconomic benefits associated with fisheries under Alternative 2 are expected to remain similar to Alternative 1.

Under Alternative 1, considering only benefits conferred by annual operation of the six Snohomish River basin salmon hatchery programs, approximately $900,000 (through the procurement of local goods and services) and 9 full-time, and up to 22 temporary jobs are contributed to the regional economy (Section 3.6 - Socioeconomics). These benefits conferred by the hatchery operations and employment to operate the hatcheries would not likely change

over the longer term under Alternative 2 relative to Alternative 1. Under Alternative 2, it is unknown how much the economy within the action area would benefit from all salmon fisheries-related expenditures, or through employment, sales, income, value added impacts, expenditures on fishing trips, and expenditures on durable equipment associated with implementation of the salmon hatchery programs. A facet of the local economy for which data can be estimated are local commercial net fisheries for hatchery-origin Chinook and coho salmon produced through the Snohomish River basin programs, which would generate about $318,301 in ex-vessel value each year (Section 3.6 - Socioeconomics). Encompassing expanded impacts to the local economy inclusive of and beyond just ex-vessel value for local commercial net fisheries for hatchery-origin Chinook and coho salmon, the estimated annual impact for the commercial net fishery harvest in Snohomish River basin marine areas is $682,954 (Section 3.6 - Socioeconomics). These estimated values of the commercial Chinook and coho salmon fisheries to the economy within the action area under Alternative 2 would remain the same as under Alternative 1. The value to the economy within the action area of hatchery-origin Chinook and coho salmon caught in recreational fisheries each year is unknown, but that value may be important to sectors of the community through fishery-related expenditures.

Commercial, ceremonial and subsistence, and recreational salmon fisheries in Snohomish River basin marine and freshwater areas are of high value and socioeconomic benefit to the Tulalip Tribes and to the local region. The high value and benefit would not change under Alternative 2 relative to Alternative 1. This status is especially true for tribal fishers participating in hatchery-origin salmon Chinook, coho, and fall chum salmon fisheries in Tulalip Bay, where Tulalip tribal members who are most dependent on salmon for income and sustenance are able to fish using methods requiring minimal costs. For the reasons described in Subsection 3.6 - Socioeconomics), the relative contribution of the fisheries, and other fisheries supported by the Snohomish River basin salmon hatchery programs to the total Washington State economy is likely very low under both Alternative 2 and Alternative 1.

The level of socioeconomic impacts is expected to remain the same as effects under Alternative 1 as natural salmon populations change over the longer term. For example, increased fisheries-related expenditures resulting from an increase in the number of harvestable salmon (if salmon recovery plan actions are successfully implemented and are effective) would be beneficial for local entities supporting recreational fishing in the action area, and would be particularly beneficial to the Tulalip Tribes. Effects on the purchase of fishing-related supplies at local businesses, and benefits to the regional economy from salmon fisheries-related activities (Subsection 3.6, Socioeconomics), would be expected to be the same as under Alternative 1 over the short term. If natural salmon population abundance increases in response to successful recovery plan implementation, these benefits would remain the same when comparing the two alternatives. The same is true if natural salmon abundance remains stable, or decreases over time due to continued habitat loss and degradation, and climate change (Subsection 3.2 - Fish Habitat) - socioeconomic benefits under Alternative 2 would remain the same as benefits under Alternative 1.

For the above reasons, socioeconomic effects under Alternative 2 would remain the same as effects under Alternative 1 for the foreseeable future.

**Alternative 3 –Termination of hatchery salmon programs in the Snohomish River basin**

Under Alternative 3, the salmon hatchery programs, and the fisheries they support, would be closed and no longer contribute to the regional economy through revenue and jobs, although the exact economic impact of Alternative 3 is unknown.

Under Alternative 3, the Chinook, coho, and fall chum salmon programs which operate to contribute harvestable adult fish to tribal and Washington State fisheries would be closed. In contrast to Alternative 1, under Alternative 3, a loss of approximately $900,000 (reduction in procurement of local goods and services) and 9 full-time, and up to 22 temporary jobs to the regional economy would occur as a result of ending operation of the hatchery facilities supporting the salmon programs. These loss estimates for revenue and jobs may be higher if termination of hatchery-related monitoring and evaluation programs described in the HGMPs is assumed and taken into account. With termination of the Chinook, coho, and fall chum salmon programs under Alternative 3, hatchery-origin adult Chinook and coho salmon sustaining commercial net fisheries in Snohomish River basin marine areas would cease to return, leading to the estimated annual loss of $318,301 per year in ex-vessel economic benefits to tribal and non-Indian commercial fishers, and a loss of expanded benefits of $682,954 to the local economy inclusive of and beyond just ex-vessel value relative to Alternative 1 (Subsection 3.6, Socioeconomics). Similarly, with termination of the salmon hatchery programs, economic benefits from recreational fishery harvests of salmon in the same areas would also be lost under Alternative 3, relative to Alternative 1. Adverse socioeconomic effects on the local economy within the action area, especially to the Tulalip Tribes, would be increased relative to Alternative 1 to a medium to high extent under Alternative 3. However, although effects relative to Alternative 1 would be of medium severity at the local level, for the reasons described in Subsection 3.6 (Socioeconomics), Alternative 3 would result in negligible impacts at the Washington state economy level, an impact that is the same as under Alternative 1.

Commercial, ceremonial and subsistence, and recreational salmon fisheries in Snohomish River basin marine and freshwater areas are of high socioeconomic value and benefit to the Tulalip Tribes and to the local region. The value and socioeconomic benefit to these fisheries would be reduced to a medium to high extent under Alternative 3 relative to Alternative 1. Effects would be especially severe for tribal fishers participating in hatchery-origin salmon Chinook, coho, and fall chum salmon fisheries in Tulalip Bay, where Tulalip tribal members who are most dependent on salmon for income and sustenance are able to fish using methods requiring minimal costs. However, for the reasons described in Subsection 3.6 - Socioeconomics), the relative contribution of the fisheries, and other fisheries supported by the Snohomish River basin salmon hatchery programs to the total Washington State economy is likely very low under both Alternative 3 and Alternative 1.

Under Alternative 3, adult fish production efforts implemented through the salmon hatchery programs would be terminated. Curtailment of adult hatchery-origin salmon returns to the basin under Alternative 3 would lead to substantially lower numbers of naturally spawning salmon relative to Alternative 1. With termination of the hatchery programs, over the longer term, natural-origin Chinook, coho, and fall chum salmon populations in the Snohomish River basin would be expected to require a longer time, possibly decades, to rebuild to abundances that

would support sustainable fisheries harvest under Alternative 3 relative to Alternative 1. With substantial reductions in the numbers of salmon spawning naturally, combined with the degraded condition of habitat in the watershed, rebuilding of natural-origin only salmon returns to healthy abundance levels that would sustain fisheries would be delayed to a medium extent under Alternative 3 relative to Alternative 1, to the detriment of local socioeconomic resources over the longer term.

For these reasons, under Alternative 3, overall socioeconomic benefits within the analysis area would be reduced to a medium extent relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, juvenile salmon releases and adult salmon returns would be reduced by one-half relative to Alternative 1. The hatchery programs would contribute less revenue and fewer jobs to the regional economy through operation of the hatcheries, and production of salmon that would be harvested in fisheries.

Under Alternative 4, reduction in the size of the six Snohomish River basin salmon hatchery programs would result in a loss to the regional economy relative to Alternative 1 of approximately $450,000 (reduction in procurement of local goods and services by the hatcheries by one-half) and 4.5 full-time, and up to 11 temporary jobs. Under Alternative 4, returns of hatchery-origin adult Chinook, coho, and fall salmon sustaining commercial net fisheries for the species in marine waters would be reduced by one-half relative to Alternative 1. Assuming static fishing effort in the face of declining availability of harvestable salmon and profitability, this reduction would lead to an estimated annual ex-vessel value loss of $159,151 per year in economic benefits to commercial fishers in Chinook and coho salmon-directed fisheries relative to Alternative 1 (Subsection 3.6, Socioeconomics). Relative to Alternative 1, Alternative 4 would lead to a loss of expanded benefits of $341,477 to the local economy inclusive of and beyond just ex-vessel value. Similarly, with reduction of the salmon hatchery programs, economic benefits from recreational fishery harvests of salmon in the marine and freshwater areas would also be reduced by one-half relative to Alternative 1, assuming static effort levels in the face of declining numbers of salmon available to provide adequate opportunity. Adverse effects on the local economy within the action area, especially effects on the Tulalip Tribes, would be increased relative to Alternative 1 to a low to medium extent under Alternative 4. However, although effects relative to Alternative 1 would be of low to medium severity at the local level, for the reasons described in Subsection 3.6 (Socioeconomics), Alternative 4 would result in similarly negligible impacts at the Washington State economy level, remaining the same as under Alternative 1.

Commercial, ceremonial and subsistence, and recreational salmon fisheries in Snohomish River basin marine and freshwater areas are of high socioeconomic value and benefit to the Tulalip Tribes and to the local region. The value and socioeconomic benefit to these fisheries would be reduced to a medium extent under Alternative 4 relative to Alternative 1. Effects would be especially severe for tribal fishers participating in hatchery-origin salmon Chinook, coho, and fall chum salmon fisheries in Tulalip Bay, where Tulalip tribal members who are most dependent

on salmon for income and sustenance are able to fish using methods requiring minimal costs. However, for the reasons described in Subsection 3.6 - Socioeconomics), the relative contribution of the fisheries, and other fisheries supported by the Snohomish River basin salmon hatchery programs to the total Washington State economy is likely very low under both Alternative 4 and Alternative 1.

Under Alternative 4, adult fish production efforts implemented through the salmon hatchery programs would be reduced by one-half. The resultant reduction in adult hatchery-origin salmon returns to the basin under Alternative 4 would lead to lower numbers of naturally spawning salmon relative to Alternative 1. With reductions in the hatchery programs, over the longer term, natural-origin Chinook, coho, and fall chum salmon populations in the Snohomish River basin would be expected to require a longer time to rebuild to abundances that would support sustainable fisheries harvest under Alternative 4 relative to Alternative 1. With substantial reductions in the numbers of salmon spawning naturally, combined with the degraded condition of habitat in the watershed, rebuilding of natural-origin only salmon returns to healthy abundance levels that would sustain fisheries would be delayed to a low extent under Alternative 4 relative to Alternative 1, to the detriment of local socioeconomic resources over the longer term.

For these reasons, under Alternative 4, overall socioeconomic benefits within the analysis area would be reduced to a low to medium extent relative to Alternative 1.

## 4.7 Cultural Resources

Effects of the alternatives on cultural resources are summarized here (see Table 21), and analyzed below.

Table 21. Summary of effects on cultural resources in the Snohomish River basin.

| Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Undetectable effect | Negligible to Low effect | High effect | Medium to High effect |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the same as under baseline conditions, no cultural artifacts would be disrupted or destroyed. It is assumed under this alternative that the hatchery programs would continue to operate to produce hatchery salmon in the same numbers as under baseline conditions in both the near and long-terms. Under Alternative 1, risks identified in Subsection 3.3 to the survival and well-being of salmon posed by the hatchery programs, operating in the midst of degraded and lost habitat, would persist at similar levels relative to baseline conditions. There would therefore be no differences between Alternative 1 and the baseline regarding the effects on the well-being of the Tulalip Tribes, considering the inextricable linkage between tribal cultural resource values and salmon in the Snohomish River basin (Subsection 3.7, Cultural Resources). However, over the longer term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances

approaching historical levels, cultural resource benefits to the tribe associated with the well-being of salmon are expected to increase to a medium extent under Alternative 1 relative to the baseline.

The Tulalip Tribes' "usual and accustomed" fishing area includes the Snohomish River basin and marine waters extending from the Canadian border to mid-Puget Sound, including Possession Sound, Port Susan, and Port Gardner Bay (Subsection 3.7, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas are of particular cultural value and importance to the Tulalip Tribes (Subsection 3.7, Cultural Resources). Under Alternative 1, salmon production levels from the Snohomish River basin salmon hatchery programs would persist at similar levels relative to the baseline, and there would be no differences between Alternative 1 and the baseline in resultant adult hatchery-origin salmon return levels to tribal fishing areas in the Snohomish River basin, Possession Sound, and Port Susan, where the hatchery salmon returns can be effectively targeted. There would, therefore, be no expected differences between Alternative 1 and the baseline in cultural resource benefits or effects associated with the Tulalip Tribes' participation in commercial, ceremonial, and subsistence fisheries in the portion of the Tribes' usual and accustomed fishing area. However, over the longer term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, the tribal cultural benefits associated with participation in salmon fisheries are expected to increase from low under the baseline to medium under Alternative 1.

For these reasons, effects on cultural resources under Alternative 1 would remain the same as effects under baseline conditions for the foreseeable future.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, as under Alternative 1, no cultural artifacts would be disrupted or destroyed. The hatchery programs would continue to apply the same program operation measures as implemented under Alternative 1 in both the short and long term (Subsection 2.2, Alternative 2). Under Alternative 2, the survival and well-being of salmon as affected by hatchery program operations would persist at similar levels relative to Alternative 1. There would therefore, be no change between Alternative 2 and Alternative 1 regarding any attendant effects on the well-being of the Tulalip Tribes, considering the inextricable linkage between tribal cultural resource values and salmon in the Snohomish River basin (Subsection 3.7, Cultural Resources). However, over the long term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, cultural resource benefits to the Tribes are expected to increase to a medium extent relative to baseline conditions under both Alternative 1 and Alternative 2. There would be a relative negligible to low cultural benefit relative to Alternative 1 resulting from the increased likelihood that the hatchery programs will be able to continue that Alternative 2 would provide through ESA authorization of the hatchery programs.

The Tulalip Tribes' "usual and accustomed" fishing area includes the entire Snohomish River basin and marine waters extending from the Canadian border to mid-Puget Sound, including Possession Sound, Port Susan, and Port Gardner Bay (Subsection 3.7, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Tulalip Tribes' culture. Ceremonial and subsistence fisheries in these areas are of particular cultural value and importance to the Tribes (Subsection 3.7, Cultural Resources). Under Alternative 2, salmon production levels from the Snohomish River basin salmon hatchery programs would persist at similar levels relative to Alternative 1, and there would be no differences between Alternative 2 and Alternative 1 in resultant adult hatchery-origin salmon return levels to tribal fishing areas, where the hatchery salmon returns can be effectively targeted. There would, therefore, be no change between Alternative 2 and Alternative 1 in cultural resource benefits or effects associated with the Tulalip Tribes' participation in commercial, ceremonial, and subsistence fisheries targeting Snohomish River basin hatchery-origin salmon in the Tribes' usual and accustomed fishing areas. However, Alternative 2 may increase the likelihood of these benefits over the long term to a negligible to low extent relative to Alternative 1 because of the increased likelihood that the hatchery programs would continue under Alternative 2.

For the above reasons, effects on cultural resources under Alternative 2 would increase to a negligible to low extent relative to effects under Alternative 1 for the foreseeable future.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Under Alternative 3, the Snohomish River basin salmon hatchery programs would be terminated. As under Alternative, no cultural artifacts would be disrupted or destroyed. Because the hatchery programs would be terminated, they would no longer apply the same program operations measures as implemented under Alternative 1 in both the short and long term (Subsection 2.2, Alternative 3). Therefore, under Alternative 3, the survival and well-being of salmon as affected by hatchery program operation would be reduced to a medium extent relative to Alternative 1. Under Alternative 3, there may, therefore, be a high increase from Alternative 1 in adverse effects on the well-being of the Tulalip Tribes, considering the inextricable linkage between tribal cultural resource values and salmon in the Snohomish River basin (Subsection 3.7, Cultural Resources), including the dependence of the tribes' harvest on the hatchery production that would be eliminated.

The Tulalip Tribes' "usual and accustomed" fishing area includes the Snohomish River basin and marine waters extending from the Canadian border to mid-Puget Sound, including Possession Sound, Port Susan, and Port Gardner Bay (Subsection 3.7, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Tulalip Tribes' culture. Ceremonial and subsistence fisheries in these areas are of particular cultural value and importance to the Tribes (Subsection 3.7, Cultural Resources). Under Alternative 3, salmon production through the Snohomish River basin salmon hatchery programs would be terminated. Resultant adult hatchery-origin salmon return levels to Tulalip tribal fishing areas would be reduced to zero. There would be a high reduction under Alternative 3 relative to Alternative 1 in cultural resource benefits, and a high reduction relative to Alternative 1 in adverse effects on the Tulalip Tribes' participation in commercial,

ceremonial, and subsistence fisheries targeting Snohomish River basin hatchery-origin salmon in the Tribes' usual and accustomed fishing areas.

Because habitat conditions in the Snohomish River basin are currently limiting the survival, productivity, and abundance of natural-origin salmon in the watershed, implementation of Alternative 3 – termination of the hatchery programs and cessation of hatchery-origin adult salmon returns – would reduce total salmon abundance over the long term to a medium extent relative to Alternative 1. It is uncertain how long it would take habitat to recover to properly functioning conditions and for the salmon species to recover to healthy, fishable abundance levels through natural production only. Therefore, relative to Alternative 1, Alternative 3 would reduce the Tulalip Tribes' access to salmon for ceremonial and other cultural practices, and would be expected to reduce the well-being of the Tulalip Tribes over the long term, to a high extent.

For these reasons, effects on cultural resources under Alternative 3 would be high relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, the Snohomish River basin salmon hatchery programs would be reduced by one-half relative to Alternative 1. As under Alternative 1, no cultural artifacts would be disrupted or destroyed. Because the hatchery programs would be reduced by one-half, program operations measures implemented under Alternative 4 would be reduced in both the short and long term relative to Alternative 1 (Subsection 2.2, Alternative 4). Therefore, under Alternative 4, the survival and well-being of salmon as affected by hatchery program operation would be reduced to a low extent relative to Alternative 1. Under Alternative 4, there may therefore be a medium to high increase from Alternative 1 in adverse effects on the well-being of the Tulalip Tribes, considering the inextricable linkage between tribal cultural resource values and salmon in the Snohomish River basin (Subsection 3.7, Cultural Resources).

The Tulalip Tribes' "usual and accustomed" fishing area includes the Snohomish River basin and marine waters extending from the Canadian border to mid-Puget Sound, including Possession Sound, Port Susan, and Port Gardner Bay (Subsection 3.7, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Tulalip Tribes' culture. Ceremonial and subsistence fisheries in these areas are of particular cultural value and importance to the Tribes (Subsection 3.7, Cultural Resources). Under Alternative 4, salmon production through the Snohomish River basin salmon hatchery programs would be reduced by one-half. Resultant adult hatchery-origin salmon return levels to Tulalip tribal fishing areas where the hatchery salmon returns could be effectively harvested would also be reduced by one-half. With decreased salmon availability and consequent decreased fisheries profitability, participation in tribal fisheries may be reduced to an enhanced degree. There would be a medium to high reduction under Alternative 4 relative to Alternative 1 in cultural resource benefits, and a medium to high reduction relative to Alternative 1 in adverse effects on the Tulalip Tribes' participation in commercial, ceremonial, and

subsistence fisheries targeting Snohomish River basin hatchery-origin salmon in the Tribes' usual and accustomed fishing areas.

Because habitat conditions in the Snohomish River basin are currently limiting the survival, productivity, and abundance of natural-origin salmon in the watershed, implementation of Alternative 4 – reduction by one-half of the hatchery programs and in hatchery-origin adult salmon return levels – would reduce total salmon abundance over the long term to a medium extent relative to Alternative 1. It is uncertain how long it would take habitat to recover to properly functioning conditions and for the salmon species to recover to healthy, fishable abundance levels through predominately natural production. Therefore, relative to Alternative 1, Alternative 4 would reduce the Tulalip Tribes' access to salmon for ceremonial and other cultural practices, and would be expected to reduce the well-being of the Tulalip Tribes over the long term to a medium to high extent.

For these reasons, effects on cultural resources under Alternative 4 would be medium to high relative to Alternative 1.

## 4.8 Human Health and Safety

Effects of the alternatives on human health and safety are summarized here (see Table 22), and analyzed below.

Table 22. Summary of effects on human health and safety in the Snohomish River basin.

| Alternative 1 (No Action) | Alternative 2 | Alternative 3 | Alternative 4 |
|---|---|---|---|
| Undetectable effect | Same as Alt 1 | Medium effect | Low effect |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the Snohomish River basin salmon hatchery programs would continue to operate as under baseline conditions, and the risk of exposure of hatchery workers to chemicals or pathogens would persist at similarly negligible levels, and remain the same as under baseline conditions. Likewise, potential nutritional benefits of the hatchery programs to human health and the risk of consumer exposure to contaminants would persist at similar levels and remain the same as under baseline conditions (Subsection 3.8, Human Health and Safety). However, over the long term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recover plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, nutritional benefits associated with salmon consumption are expected to increase to a low extent under Alternative 1 relative to the baseline.

For these reasons, human health and safety effects under Alternative 1 would remain the same as under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the Snohomish River basin salmon hatchery programs would continue as under Alternative 1, and the risk of exposure of hatchery workers to chemicals or pathogens would persist at similarly negligible levels, and remain the same as effects under Alternative 1. Likewise, potential nutritional benefits of the hatchery programs to human health and the risk of consumer exposure to contaminants would persist at similar levels, and remain the same as benefits under Alternative 1 (Subsection 3.8, Human Health and Safety). However, over the long term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, nutritional benefits associated with salmon consumption are expected to increase to a medium extent under both Alternative 1 and Alternative 2 relative to baseline conditions. There would be some increase in the likelihood that the hatchery programs and associated funding would continue, thereby increasing by a medium degree the likelihood for, and continuity of, relative nutritional benefits, as Alternative 2 would provide ESA authorization of the hatchery programs.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Under Alternative 3, the salmon hatchery programs would be terminated. Therefore, relative to Alternative 1, Alternative 3 would reduce the risk of exposure of hatchery workers to chemicals or pathogens, but risks would remain negligible under both alternatives. Alternative 3 would reduce to a medium degree the potential nutritional benefits of the hatchery programs to human health at the local level (e.g., improved cardiovascular health). This reduced benefit level would be expected because the number of juvenile hatchery-origin salmon, and therefore the total number of returning adult salmon available for harvest in fisheries for human consumption, would decrease under Alternative 3 relative to Alternative 1. The risk of consumer exposure to contaminants relative to Alternative 1 (Subsection 3.8, Human Health and Safety) would remain negligible, and the same under Alternative 3.

For the above reasons, overall effects on human health and safety under Alternative 3 would be low to medium relative to effects under Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, juvenile salmon releases and resultant adult hatchery-origin salmon returns would be reduced by one-half relative to Alternative 1. Therefore, relative to Alternative 1, Alternative 4 would reduce the risk of exposure of hatchery workers to chemicals or pathogens, but risks would remain negligible under both alternatives. Alternative 4 would reduce to a low degree the potential nutritional benefits of the hatchery programs to human health at the local level (e.g., improved cardiovascular health), because the return of adult salmon available for harvest and use for food would be reduced by one-half relative to Alternative 1. The risk of consumer exposure to contaminants relative to Alternative 1 (Subsection 3.8, Human Health and Safety) would remain negligible, and the same under Alternative 4.

For the above reasons, overall effects on human health and safety under Alternative 4 would be low relative to effects under Alternative 1.

## 4.9 Environmental Justice

Consistent 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, in the action area, one Native American Tribe, the Tulalip Tribes, has been identified as an environmental justice community of concern, consistent (Subsection 3.9, Environmental Justice). Further, based on the above Executive Order and Act, the Asian population within the analysis area is also an environmental justice community of concern (Subsection 3.9, Environmental Justice). Effects of the alternatives on environmental justice are summarized here (see Table 23), and analyzed below.

Table 23. Summary of effects on environmental justice in the analysis area.

| **Alternative 1 (No Action)** | **Alternative 2** | **Alternative 3** | **Alternative 4** |
|---|---|---|---|
| Undetectable effect | Same as Alt 1 | High effect | Medium effect |

**Alternative 1 (No Action) – Do Not Make a Determination under the 4(d) Rule**

Under Alternative 1, the salmon hatchery programs would continue to be operated the same as under baseline conditions. Water quantity or water quality risks on environmental justice communities would persist at similar levels relative to baseline levels (Subsection 4.2, Fish Habitat). Juvenile salmon production levels, and resultant adult salmon return abundances, would remain the same as baseline levels (Table 3). Effects on environmental justice communities including: maintenance of hatchery-origin adult salmon returns (Subsection 4.3, Salmon and Steelhead); employment opportunities or the local procurement of goods and services (Subsection 4.6, Socioeconomics); and, cultural resource benefits (Subsection 4.7) would remain the same relative to baseline conditions. Effects of Alternative 1 on these factors relative to the baseline would therefore be negligible. Under Alternative 1, nutritional benefits of the hatchery programs to human health within environmental justice communities and the risk of consumer exposure to toxic contaminants would persist at similar levels relative to baseline conditions (Subsection 4.8, Human Health and Safety). Again, effects of Alternative 1 on these factors relative to the baseline would therefore be negligible. However, over the longer term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, cultural and nutritional benefits would be expected to increase to a medium degree relative to the baseline. Because of the greater availability of salmon and steelhead for food, risks of consumer exposure to toxic contaminants to the environmental justice communities would also be expected to be relatively greater under Alternative 1, but would remain negligible in effects under both Alternative 1 and the baseline.

For these reasons, for the foreseeable future, environmental justice effects under Alternative 1 would remain the same as effects under baseline conditions.

**Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule**

Under Alternative 2, the salmon hatchery programs would be operated the same as under Alternative 1. Water quantity or water quality effects on environmental justice communities would persist at similar levels relative to Alternative 1 (Subsection 4.2, Fish Habitat). Juvenile salmon production levels, and resultant adult salmon return abundances, would remain the same as levels and abundances under Alternative 1. Effects on environmental justice communities including: maintenance of hatchery-origin adult salmon returns (Subsection 4.3, Salmon and Steelhead); employment opportunities or the local procurement of goods and services Subsection 4.6, Socioeconomics) and, cultural resource benefits (Subsection 4.7) would remain the same relative to Alternative 1. Under Alternative 2, nutritional benefits of the hatchery programs to human health within environmental justice communities, and the risk of consumer exposure to toxic contaminants relative to baseline conditions (Subsection 4.8, Human Health and Safety) would be the same. Therefore, for all of the above factors, effects of Alternative 2 relative to Alternative 1 would be negligible. Over the longer term, as salmon produced through the hatchery programs return, and as other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005) help restore natural-origin and total fish abundances approaching historical levels, cultural and nutritional benefits would remain the same as under Alternative 1. Risks of consumer exposure to toxic contaminants to the environmental justice communities would remain negligible and also be the same as under Alternative 1. In addition, there would be some increase in the likelihood that the hatchery programs and associated funding would be able to continue, resulting in low additional cultural and nutritional benefits under Alternative 2, attendant with ESA authorization of the hatchery programs.

For the above reasons, for the foreseeable future, environmental justice effects under Alternative 2 would remain the same as effects under Alternative 1.

**Alternative 3 – Termination of hatchery salmon programs in the Snohomish River basin**

Under Alternative 3, the Snohomish River basin salmon hatchery programs would be terminated. The following ecological, cultural, human health, economic, or social impacts on environmental justice communities would be expected relative to Alternative 1:

- An undetectable and likely negligible increase in the amount of surface and ground water that would be available to environmental justice communities, in the portion of the east and west forks of Tulalip Creek between the formerly-located hatchery intakes and outfalls, for other uses besides the hatchery production of salmon (Subsection 3.2, Fish Habitat);
- An undetectable and likely negligible increase (taking into account hatchery program compliance under Alternative 1 with NPDES permit discharge requirements) in water quality in watershed areas downstream of the hatcheries;
- A medium to high impact on the Tulalip Tribes' economy, a low impact on the action area economy, and a negligible impact on the regional economy resulting from loss of $900,000 through the procurement of local goods and services and the loss of 22 full-time jobs in environmental justice communities;

- A medium impact on socioeconomic conditions for fisheries in the action area and a negligible impact on socioeconomic conditions for regional fisheries resulting from a loss of $318,301 annually in potential net economic benefits from commercial Chinook, coho, and fall chum salmon fisheries (Subsection 4.6, Socioeconomics);
- A high impact resulting from a reduction in the Tulalip Tribes' access to salmon for ceremonial, subsistence, religious and other cultural practices (Subsection 4.7, Cultural Resources);
- A medium to high impact resulting from reduction in the potential nutritional benefits of the hatchery programs to human health within environmental justice communities (Subsection 4.8, Human Health and Safety);
- An undetectable to negligible reduction in the risk of consumer exposure to toxic contaminants, due to fewer salmon available for consumption (Subsection 4.8, Human Health and Safety);
- A low to medium reduction in Chinook salmon available to the marine and freshwater food chains, and in marine derived nutrients in the terrestrial system of the Snohomish River basin. This reduction could reduce the viability of many organisms of cultural and economic importance to the Tulalip Tribes (Subsection 3.3.1, Puget Sound Chinook Salmon (ESA-listed));
- A medium increase in terminal area harvest of Snohomish River basin natural-origin Chinook salmon due to the requirement to shift a portion of tribal fishing from hatchery fish to wild fish (Subsection 3.3.1, Puget Sound Chinook Salmon (ESA-listed)); and,
- A high impact resulting from fewer harvestable salmon available in the Tulalip Tribes' usual and accustomed fishing areas in Snohomish River basin marine and freshwater areas (Subsection 4.9, Environmental Justice).

For these reasons, under Alternative 3, overall effects on environmental justice within the analysis area would be high relative to Alternative 1.

**Alternative 4 – Reduction of hatchery salmon release levels from programs in the Snohomish River basin**

Under Alternative 4, juvenile salmon releases and resultant adult hatchery-origin salmon returns would be reduced by one-half relative to Alternative 1. The following ecological, cultural, human health, economic, or social impacts on environmental justice communities would be expected relative to Alternative 1:

- An undetectable and likely negligible increase in the amount of surface and ground water that would be available to environmental justice communities, in the portion of the east and west forks of Tulalip Creek between the formerly-located hatchery intakes and outfalls, for other uses besides the hatchery production of salmon (Subsection 3.2, Fish Habitat);
- An undetectable and likely negligible increase (taking into account hatchery program compliance under Alternative 1 with NPDES permit discharge requirements) in water quality in watershed areas downstream of the hatcheries;
- A medium to high impact on the Tulalip Tribes' economy, a low impact on the action area economy, and a negligible impact on the regional economy resulting from loss of

$450,000 through the procurement of local goods and services and the loss of 11 full-time jobs in environmental justice communities;

- A medium impact on socioeconomic conditions for fisheries in the action area and a negligible impact on socioeconomic conditions for regional fisheries resulting from a loss of $159,151 annually in potential net economic benefits from commercial Chinook and coho salmon fisheries (Subsection 4.6, Socioeconomics);
- A medium impact resulting from a reduction in the Tulalip Tribes' access to salmon for ceremonial and other cultural practices (Subsection 4.7, Cultural Resources);
- A medium impact resulting from reduction in the potential nutritional benefits of the hatchery programs to human health within environmental justice communities (Subsection 4.8, Human Health and Safety);
- An undetectable to negligible reduction in the risk of consumer exposure to toxic contaminants, due to fewer salmon available for consumption (Subsection 4.8, Human Health and Safety);
- A low reduction in Chinook salmon available to the marine and freshwater food chains, and in marine-derived nutrients in the terrestrial system of the Snohomish River basin. This reduction could reduce the viability of many organisms of cultural and economic importance to the Tulalip Tribes (Subsection 3.3.1, Puget Sound Chinook Salmon (ESA-listed));
- A low increase in terminal area harvest of Snohomish River basin natural-origin Chinook salmon due to the requirement to shift a portion of tribal fishing from hatchery fish to wild fish (Subsection 3.3.1, Puget Sound Chinook Salmon (ESA-listed)); and,
- A high impact resulting from fewer harvestable salmon and steelhead available in the Tulalip Tribes' usual and accustomed fishing areas in Snohomish River basin marine and freshwater areas (Subsection 4.9, Environmental Justice).

For these reasons, under Alternative 4, overall effects on environmental justice within the analysis area would be medium relative to Alternative 1.

# 5 CUMULATIVE IMPACTS

## 5.1 Introduction

The NEPA requires the analysis of cumulative impacts that reviews all relevant past, present, and reasonably foreseeable future actions, whether they are Federal or non-Federal actions, together (i.e., cumulatively) (40 CFR 1508.7). For this EA, actions analyzed include those similar to the Proposed Action that are hatchery-related, as well as non-hatchery related actions, including fish habitat loss and degradation from human development. This chapter considers the additional, cumulative impact on resources evaluated in this EA, including ESA-listed fish and their habitats, of the six Snohomish River basin salmon hatchery programs under the alternatives in the context of past actions, present conditions, and reasonably foreseeable future actions and conditions. The following chapters are referenced and incorporated in the cumulative effects considerations that culminate in Chapter 5:

- Chapter 3, Affected Environment, describes baseline conditions, which reflect the effects of past and existing actions, including hatchery production, habitat degradation and loss, and harvest.

- Chapter 4, Environmental Consequences, evaluates the direct and indirect effects of the Proposed Action relative to effects associated with implementation of Alternative 1, which reflects baseline conditions.

- Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders. This subsection describes plans, regulations, agreements, treaties, laws, and Secretarial and Executive Orders, in addition to NEPA and ESA, that when implemented, result in effects on resources evaluated in this EA, including salmon and steelhead.

A discussion of the geographic and temporal scales is presented first in this Chapter to identify the cumulative effects analysis area, and the expected duration of NMFS's ESA approval for the proposed hatchery actions evaluated. This section is followed by an evaluation of the cumulative effects of hatchery production for the entire Puget Sound region to address any additional effects on resources resulting from region-wide implementation of the same types of hatchery-related actions as proposed for the Snohomish River basin hatchery programs. Following the hatchery section is an analysis of cumulative, incremental effects of other programs, plans, and policies bearing on salmon and steelhead management that encompass the anthropogenic factors predominantly affecting the relative magnitude and intensity of Proposed Action and alternative effects on resources. This latter section, in particular, provides needed context for the immediately following evaluation of the cumulative effects of the alternatives on each of the resources evaluated in this EA. The Chapter concludes with an evaluation of potential cumulative effects that may result from NMFS implementation of ESA determinations and effects resulting from climate change.

### 5.1.1 Geographic and Temporal Scales

The cumulative effects analysis area is the Puget Sound region, with particular attention to the freshwater, estuarine, and adjacent nearshore marine areas of the Snohomish River basin (Figure 1). The project area encompasses locations including and immediately adjacent to the hatchery facilities, satellite salmon rearing ponds, and adult fish collection locations that are described in Subsection 1.4, Project Area and Analysis Area. The scope of the actions considered in this EA includes adult salmon collection for use as broodstock, and rearing and release of juvenile hatchery salmon in the Snohomish river basin. Adult collection and juvenile fish rearing and release activities would occur in localized areas only; the associated direct and indirect effects of these activities would occur to varying degrees in the project area and larger analysis areas, depending upon the affected resource, as analyzed in Chapter 4, Environmental Consequences.

NMFS considered whether areas outside of the Snohomish River basin and Puget Sound, including the Washington Coast, the Strait of Georgia, Alaskan marine areas, and the Northeast Pacific Ocean, should be included in the broad analysis area in this EA. However, for the purpose of analyzing the cumulative effects, NMFS was unable to detect effects of the Proposed

Action beyond the Snohomish River basin and adjacent areas in Puget Sound. Available knowledge and research abilities are insufficient to discern the role and contribution of the Proposed Action to resources far removed from the Snohomish River basin, including salmon and steelhead survival and productivity in the Pacific Ocean. For example, NMFS's general conclusion is that the influence of density-dependent interactions on salmon and steelhead survival and productivity is likely negligible, compared with the effects of interannual or decadal fluctuations in Pacific Ocean environmental conditions. Although the effects of the Proposed Action on resources in the Snohomish River basin may contribute to effects outside that area, any effects would be undetectable. While there is evidence that hatchery production, on a scale many times larger than the Proposed Action, can impact salmon survival and production in the Pacific Ocean, the degree of impact or level of influence is not yet understood or predictable, nor is there any evidence that hatchery programs like those included in the Proposed Action have effects on ocean resources. For these reasons, detectable impacts of the Proposed Action on resources outside of the Snohomish River basin are not expected.

The ESA 4(d rule, limit 6 determination that would be issued by NMFS for the hatchery programs encompassed by the Proposed Action would provide an open-ended authorization for exemption of the programs from ESA section 9 take prohibitions. The authorization would remain in effect subject to program operator compliance with implementation terms and reporting requirements specified by NMFS in its determination. NMFS would review annual report provided by the applicants to determine whether the Proposed Action was being implemented consistent with activities and listed fish take levels described in the approved hatchery plans, and with the NMFS implementation terms.

### 5.1.2 Hatchery Production

Hatchery production in the Puget Sound region, including within the action area, is assumed to continue, and affect resources including salmon and steelhead at the same impact levels that presently occur. Current and future hatchery reviews, such as those identified in the Puget Sound Hatchery DEIS (NMFS 2014), are likely to affect impact levels resulting from hatchery operations in the region. However, proposed adjustments in all hatchery operations to meet hatchery objectives, such as supportive breeding, harvest augmentation, and listed fish risk reduction (as described in the Puget Sound Hatchery DEIS), have not yet occurred. NMFS' calculation of both baseline conditions and cumulative impacts for hatcheries therefore relies on an assumption of the same baseline resource impacts continuing indefinitely.

Appendix A, taken from the Puget Sound Hatchery DEIS (NMFS 2014), describes all recent year and on-going hatchery salmon and steelhead programs implemented in the Puget Sound region, including the six salmon hatchery salmon programs reviewed in this document. Included in Appendix A are annual juvenile fish production levels by hatchery program and species, fish sizes and life stages at release, fish release timings, and fish release locations. The ongoing effects of these recent year and on-going hatcheries in the Puget Sound region have the potential to raise cumulative effects for consideration in association with the Proposed Action. Although unlikely to have substantial effects on listed salmon and steelhead and non-listed salmon originating from the Snohomish River basin, hatcheries in other watersheds within the region may affect other salmon and steelhead populations, including listed populations that are also part of the Puget Sound Chinook Salmon ESU, Hood Canal Summer-run Chum Salmon ESU, and

Puget Sound Steelhead DPS. These hatchery-related effects are the same potentially adverse or beneficial effects described and evaluated in this EA. With the proposed programs considered in this document, on-going effects of other regional hatchery programs accumulate with regards to region-wide hatchery effects on the status of listed Chinook salmon, summer-run chum salmon, and steelhead, and unlisted salmon populations, at the ESU-wide and DPS-wide levels.

NMFS has identified twenty-two independent natural-origin populations of Chinook salmon that are part of the Puget Sound Chinook Salmon ESU, two independent populations of summer-run chum salmon (each including multiple spawning aggregations), and thirty-two distinct independent natural-origin populations of steelhead that are part of the Puget Sound Steelhead DPS. Included in this total are the two listed Chinook salmon populations and five steelhead populations in the Snohomish River basin. Hatchery programs in the Puget Sound region have the potential to adversely affect these listed natural-origin populations and their habitat through genetic risks, competition and predation, hatchery facility effects, incidental fishing effects, and fish disease pathogen transfer. The general mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations are described in Table 7. The Puget Sound Hatchery DEIS (NMFS 2014) describes these general mechanisms in more detail, and information pertaining to programmatic, Puget Sound region-wide hatchery effects. The effects analysis in this region-wide assessment of Puget Sound region-wide hatchery-related effects on listed Chinook salmon, summer chum salmon, and steelhead is incorporated by reference where cited.

The Puget Sound Treaty Tribes and WDFW currently release approximately 160.2 million juvenile hatchery-origin salmon and steelhead into Puget Sound freshwater and marine areas each year (S. Leider, NMFS, pers. comm. October 3, 2016). The total of 160.2 million fish includes 47.7 million Chinook salmon; 14.9 million coho salmon; 50.0 million chum salmon; 4.1 million pink salmon; 42.3 million sockeye salmon; and 1.15 million steelhead (NMFS 2014). Puget Sound run size and escapement monitoring data indicate that hatchery-origin fish make up 76 percent of total adult returns of Chinook salmon, 47 percent of coho salmon, 12 percent of summer-run chum salmon; 29 percent of fall chum salmon, 30 percent of sockeye salmon, 2 percent of pink salmon, and an unknown proportion of total steelhead returns (NMFS 2014; PNPTT and WDFW 2014).

Juvenile hatchery salmon and steelhead release numbers included and evaluated in the Puget Sound Hatchery DEIS are likely higher than current release levels. Based on co-manager submittals of updated HGMPs to NMFS in more recent years, it is apparent that some programs reviewed in the DEIS have been terminated, and juvenile fish release levels from others have been reduced. Considering decreasing funding levels for hatchery programs, and actions taken by the co-managers to limit hatchery-related effects on listed species, it is unlikely that future total hatchery fish production levels in Puget Sound would substantially exceed current levels. However, while future actions are not reasonably certain to occur, given the continued, degraded condition of natural fish habitat, the onset of climate change, and the long-standing use of hatchery production in the region to offset natural-origin fish production losses, NMFS assumes for the sake of this analysis that production similar to current production levels is likely to continue into the future for all species. Current juvenile hatchery fish release levels remain similar to levels described in the Puget Sound Hatchery DEIS, and therefore DEIS fish release

levels and effects analyses are useful for the purposes of indicating the cumulative effects of overall hatchery salmon and steelhead production in Puget Sound on the listed Puget Sound Chinook salmon ESU, Hood Canal summer-run chum salmon ESU, and Puget Sound steelhead DPS. These effects can be expected to continue into the foreseeable future, given likely continuance of the hatchery programs into the future at current juvenile fish release levels.

Under juvenile fish release levels evaluated in the Puget Sound Hatchery DEIS, current levels of potential effects to listed salmon and steelhead species in Puget Sound were identified (Alternative 1 in Table S-4, and Appendix G "Hood Canal Summer-run Chum Salmon Effects Analysis by Population" in NMFS 2014). Puget Sound region-wide hatchery salmon and steelhead production poses a moderate risk and low benefit to the listed Puget Sound Chinook salmon ESU. For the Chinook salmon ESU overall, the competition risk in freshwater is moderate, predation risk in freshwater is high, genetic risk is moderate, and hatchery facilities risk (including disease transfer) is low (Table 3.2-10 in NMFS 2014). Effects on the Hood Canal summer-run chum salmon ESU are summarized in Table 4.2-10 in NMFS (2014), where identified risk levels reflect averages from individual hatchery programs for each of the two populations as described in Appendix G. Considering current risks for all hatchery-related risk categories, the overall Puget Sound region-wide risk to the ESU would be low (NMFS 2014 - Table 4.2-10). The most important influencing factors would be low competition and low predation risks from fall-run chum salmon, Chinook salmon, coho salmon, pink salmon, and steelhead hatchery programs in freshwater and marine areas (Appendix G, Hood Canal Summer-run Chum Salmon Effects Analysis by Population). Other Puget Sound region-wide hatchery-related risks to the listed summer-run chum salmon ESU were determined to be negligible.

For the listed Puget Sound Steelhead DPS, the DEIS's analysis found Puget Sound region-wide hatchery salmon and steelhead production poses a moderate risk to the DPS, and confers a low benefit (Table 3.2-16 in NMFS 2014). Regarding specific region-wide hatchery-related effects on the DPS, the risk of competition (i.e., for food and space) is moderate, genetic risk is low, and hatchery facilities risk (including fish disease transfer) is low (NMFS 2014).

The operation of salmon and steelhead hatcheries in Puget Sound could result in adverse ecological effects (competition and predation) on listed Puget Sound Chinook salmon and steelhead in the Salish Sea and Pacific Ocean. These marine waters are shared by salmon and steelhead from all Puget Sound watersheds, and from other Pacific Northwest watersheds, including those located on the Washington Coast, in the Columbia River, and in Canada. As discussed in the DEIS (NMFS 2014 - Subsection 2.4.2.4), little information exists to determine the precise nature and extent of such effects.

For other fish species, including the listed Puget Sound/Washington Coastal bull trout DPS, Puget Sound region hatchery salmon and steelhead production poses a low risk of hatchery-related effects, and confers low benefits (Subsection 4.2.7.7, Summary of Risks and Benefits by Alternative, in NMFS 2014).

With regard to non-listed salmon, the Puget Sound region-wide hatchery salmon and steelhead production poses a moderate risk to the Puget Sound fall chum salmon, Puget Sound pink salmon, and Puget Sound coho salmon ESUs, and confers a low benefit (NMFS 2014). Specific

region-wide hatchery-related effects on the ESUs included moderate risks of competition (i.e., for food and space); low genetic risks, and low hatchery facilities risk (including fish disease transfer) (NMFS 2014). The operation of salmon and steelhead hatcheries in Puget Sound could result in adverse ecological effects (competition and predation) on non-listed fall chum, pink, and coho salmon in the Salish Sea and Pacific Ocean. As discussed in the DEIS (NMFS 2014 - Subsection 2.4.2.4), little information exists to determine the precise nature and extent of such effects in marine waters shared by salmon and steelhead from all Puget Sound watersheds, and from other Pacific Northwest watersheds, including those located on the Washington Coast, in the Columbia River, and in Canada.

To the extent that ongoing salmon and steelhead hatchery activities in the Puget Sound region have occurred in the past, and/or are currently occurring under an approved HGMP (e.g., salmon and steelhead hatchery programs in the Elwha River, Dungeness, and Hood Canal basins), their effects are included in the baseline of this EA (whether they are Federal, WDFW, or tribal). To the extent these same activities are reasonably certain to occur in the future, their future effects are included in the cumulative effects analysis. This is the case even if the ongoing co-manager-managed activities become the subject of ESA take determinations or permits in the future. The effects of such activities are treated as cumulative effects affecting resources under all alternatives considered in this EA equally, unless and until an ESA section 7 biological opinion for the determination or permit has been issued.

### 5.1.3 Other Programs, Plans, and Policies

Other actions are expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA for the Proposed Action and alternatives. These actions include other plans, regulations, agreements, laws, and orders that may affect the status of resources impacted by Snohomish River basin hatchery actions (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders). Most of the actions identified in Subsection 1.6 (specifically, regulations specified in Subsections 1.6.13 through 1.6.24) direct, regulate, and/or effectuate salmon habitat protection and restoration activities assisting in the return of natural habitat within the action area to properly functioning conditions, capable of restoring fish populations in the Snohomish River basin to a viable status. The habitat protection and restoration actions implemented in the action area are intended to meet salmon habitat-related recovery objectives included in the Snohomish River watershed chapter of the Shared Strategy for Puget Sound recovery plan (SSPS 2005), and the NMFS supplement to the recovery plan for the listed Puget Sound Chinook salmon ESU (NMFS 2007) (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders). As authorized by NMFS for listed fish effects, implementation of harvest management agreement, policies, and plans that together account for cumulative fishery-related mortality on all salmon and steelhead stocks, also would impact resources affected by the proposed hatchery actions considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders; Subsection 3.3, Salmon and Steelhead).

Plans, regulations, agreements, laws, and orders other than the ESA and NEPA, when implemented, may affect the condition of fish habitat, and by extension, the status of fish species supported by that habitat. Their effects will therefore bear on the magnitude and intensity of any

effects on fish resources posed by the Proposed Action and the alternatives. For federal actions and actions with a federal funding nexus affecting ESA-listed fish species habitat, NMFS, USFWS, and EPA are responsible for evaluating and approving project effects and enforcing federal laws designed to protect listed species habitats. The federal agencies are also responsible for stewardship of tribal treaty-reserved rights for the harvest of salmon that are completely dependent on effective habitat protection. For non-Federal actions, including those identified in Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders, the State of Washington and local jurisdictions have responsibilities for permitting and regulating activities affecting habitat important for salmon and steelhead, including through growth management planning.

Notwithstanding these Federal and non-Federal agency obligations and responsibilities, past and on-going loss of habitat quantity and degradation of habitat quality is reducing the ability of the Snohomish River basin to support viable salmon populations (Judge 2011, Center for American Progress 2016; Conservation Science Partners 2016). A key problem is that habitat protection measures have not yet been appropriately linked with salmon recovery objectives nor coordinated with recovery actions (Treaty Indian Tribes of Western Washington 2011, Judge 2011). Making such a linkage to stem the incremental impacts of continued fish habitat loss is necessary in order for the Proposed Action and alternatives described in this document to be effective in meeting salmon harvest augmentation and listed salmon and steelhead population risk minimization and recovery objectives. Consistent with the Federal Trust Responsibility (Subsection 1.6.8 - Federal Trust Responsibility), harmonization of habitat protection initiatives and associated regulations among federal and non-federal agencies to support salmon and steelhead productivity and recovery is critical for restoration of viable salmon populations in the Snohomish River basin.

Another key problem is that habitat protection and restoration called for under the ESA, in recovery plans, and through other laws and policies have not been linked with tribal treaty rights, as they pertain to the essential need for salmon preservation and recovery. This circumstance is counterintuitive because there is a natural linkage between treaty-reserved rights for availability of harvestable salmon and steelhead and the requirements of ESA-listed fish, with respect to the need to protect and restore habitat that must sustain both. The Treaty tribes of western Washington presented the Treaty Rights At Risk (TRAR) Initiative (Treaty Indian Tribes of Western Washington 2011) to the U.S. Federal Government to address increasing risks posed to treaty rights that are directly tied to declining quality and quantity of habitat (Subsection 1.6.11, Tribal Statement on Treaty Rights at Risk and Tribal Policy Statement). The TRAR Initiative emphasizes the need to coordinate, harmonize, and enforce environmental protection laws and statutes, including the ESA. In response, the CEQ mandated the heads of the Federal agencies with resource management jurisdiction in Washington State to work with the tribes to ensure the laws, regulations and statutes are aligned and enforced to protect Treaty Trust resources. Following up on this CEQ directive, the Tulalip Tribes, the Puget Sound Partnership, and Federal (including NMFS), State, and local governments are developing a pilot entity in the Snohomish River basin action area tasked with harmonizing regulations and laws affecting fish habitat. The pilot entity would review new regulations affecting fish habitat before adoption, and any existing laws affecting fish habitat proposed for revision. This collaboration would foster consistency among different agencies and entities necessary for adequate enforcement and

habitat protection to address cumulative impacts of Federal and non-Federal actions on fish habitat.

With respect to impacts from salmon and steelhead harvest, fishing regulations in the area from Southeast Alaska to south of the Columbia River are developed in a way that considers and controls cumulative harvest impacts on a number of watershed management units within the Puget Sound region, including the Snohomish River basin. These harvest impacts are predictable, and must be considered in conjunction with habitat protection and restoration and the proposed hatchery actions and alternatives evaluated in this EA. Planned fisheries that affect listed Snohomish River basin Chinook salmon have been evaluated and conditionally approved annually by NMFS (Subsection 3.3, Salmon and Steelhead). NMFS's most recent authorizations for salmon fisheries including those in the action area (NMFS 2016) analyzed a 2016 Puget Sound harvest plan assembled by the tribal co-managers (PSTT 2016). After adding the effects of the proposed harvest actions to the environmental baseline, and to cumulative effects, NMFS concluded that the harvest actions included in the plan were not likely to result in (1) appreciable reductions in the likelihood of both survival and recovery of listed salmon and steelhead in the wild by reducing their numbers, reproduction, or distribution; or (2) reduction in the value of designated or proposed critical habitat (NMFS 2016). This most recent authorization of a co-manager harvest plan remained relatively similar to those issued over the past several years, and is expected to continue to do so.

Because the outcome of salmon recovery efforts depends on the combined and incremental impacts of hatchery actions (such as those described in the Proposed Action and alternatives) and habitat and harvest management actions, the resource effects from one of these categories cannot be determined without considering the status of effects in the others. For example, assessment of the effects of a salmon harvest management plan on resources such as salmon and steelhead depends critically on the condition of salmon habitat. If natural habitat is in generally good condition (i.e. close to properly functioning conditions in all areas affecting all life stages of a salmon stock), then the failure of the stock to respond to a harvest rate reduction might mean that the harvest rate reduction was not sufficient to allow recovery. On the other hand, if the natural habitat available to a stock is substantially lost and degraded, then the failure of that stock to respond to a harvest rate reduction most likely cannot be addressed through further harvest rate reductions alone. Lost habitat must be restored and degraded habitat must be improved for harvest management to be effective. The same is true for hatchery management actions, including those reviewed in this document.

The proposed hatchery actions considered in this EA were developed under the assumption that commensurate, effective habitat and harvest management actions would be implemented to support recovery of salmon and steelhead in the Snohomish River basin. Considering the status of fish habitat in the action area, assessment of the cumulative effects of the Proposed Actions and the alternatives on salmon and steelhead and other associated resources must take into account the actual effects of concurrent habitat (and harvest) actions. The short and long-term status of the resources evaluated herein will be dependent on the cumulative effects of all hatchery, habitat, and harvest, and actions, and all must be considered concurrently when the status of each of those resources is assessed.

To address this need for comprehensive, holistic assessment and management of cumulative factors affecting salmon and steelhead and associated resources, the Tulalip Tribes developed a framework to guide "All-H" management actions in listed fish recovery plan implementation (Subsection 1.6.12, Recovery Plans for Puget Sound Salmon and Washington Salmon Recovery Act (77.85 RCW)). This framework, based on the concepts of adaptive management, builds upon the Snohomish River Basin Salmon Recovery Plan (SSP 2005) as updated in the Three Year Work Plan, and previous work completed by NMFS (NMFS 1996; PSRITT in press) and the Hatchery Scientific Review Group (HSRG 2015). The framework is applied in this EA to describe the impact on the environment that results from the incremental effects of the proposed hatchery actions when considered with past, on-going, and likely future habitat and harvest conditions and actions.

A key premise of the framework is that hatchery, harvest, and habitat management actions interact to affect processes that determine the status of viable salmonid population (VSP) parameters for natural salmon and steelhead populations, as illustrated by Figure 7.

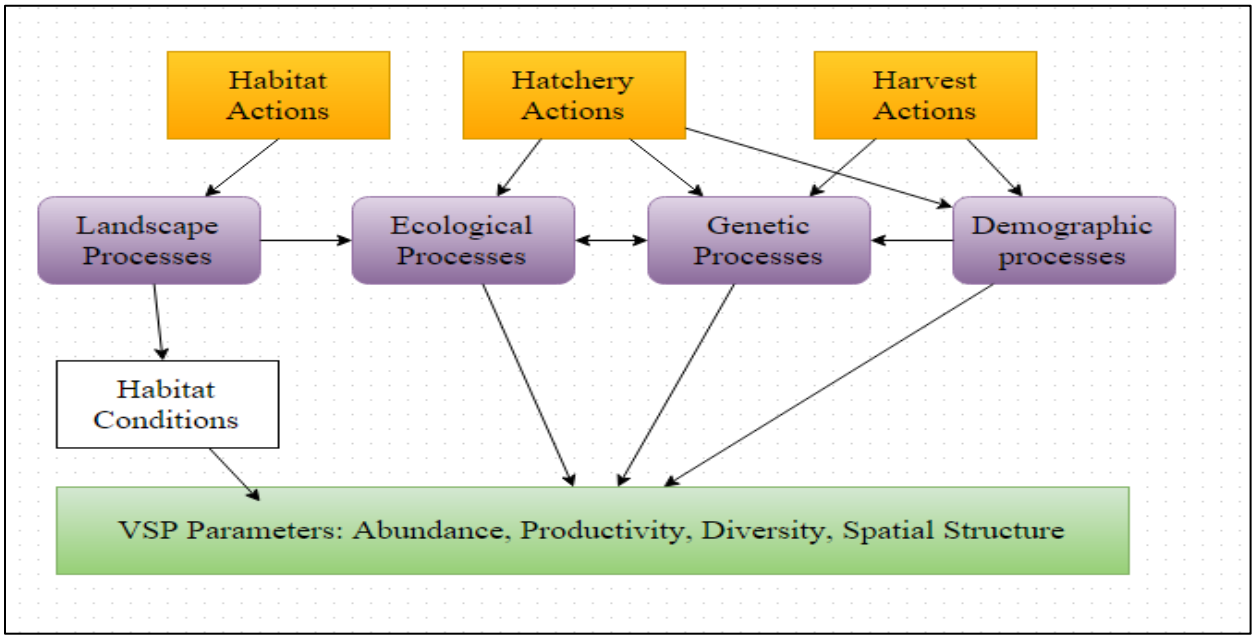


Figure 7. Interacting effects of habitat, hatchery, and harvest actions and how they cumulatively affect processes that determine salmonid VSP parameter status (from Rawson and Crewson 2016, after Figure 2 in PSTRT 2003).

The condition of habitat resulting from habitat management actions on landscape processes (Figure 7) can be described using indicators that reflect the status of key ecological attributes (PSRITT in press). NMFS (1996) developed standards that indicate whether habitat can be considered to represent "properly functioning conditions" (PFC) necessary to support viable natural salmon populations. When combined, such indicators of habitat condition can be used to classify habitat on a gross scale to indicate the habitat's status for supporting salmon (Table 24).

Table 24. Habitat status categories based on key ecological attributes and "properly functioning conditions" (PFC) category assignments.

| Habitat Status Category | Habitat Condition |
|---|---|
| Poor | Habitat cannot support natural or hatchery-produced populations |
| Fair | Habitat can support hatchery salmon and hatchery-supplemented natural populations |
| Good | Habitat supports self-sustaining natural salmon production |
| Very Good | Habitat supports salmon at historic or pre-European contact viability status |

Under this habitat condition classification approach, habitats in the "Good" and "Very Good" categories are functioning at or above the PFC level. Habitats in the "Fair" and "Poor" categories are functioning below the PFC level and therefore are not able to support self-sustaining natural salmon and steelhead production.

The HSRG proposed an approach for conditioning guidelines for hatchery program operation and allowable effects, dependent on four defined phases of recovery for an associated natural salmon or steelhead population: "Preservation, Recolonization, Local Adaptation, or Full Restoration. They recommend different guidelines for hatchery production depending on the assigned recovery phase for a population (HSRG 2015, Table 2). However, identification of the recovery phase for a population alone is not sufficient to determine the appropriate hatchery response. This is because identification of the recovery phase is based on a consideration of both habitat condition and population performance. Figure 8 illustrates how the phase of recovery is determined by both the status of habitat and salmon population dynamics (i.e., abundance and productivity viability parameters). To move from one phase of recovery to another requires changes in habitat status and population dynamics. Based on the status of these parameters, and the chosen action pathway that would lead to the adjusted recovery phase, different management actions would be prioritized and enforced.

Applying this approach, cumulative effect evaluations factoring impacts of the proposed hatchery actions and the alternatives on natural salmon and steelhead population viability must consider the condition of habitat (Subsection 3.2, Fish Habitat) in conjunction with population status (Subsection 3.3, Salmon and Steelhead) to determine the incremental effects of management actions, including benefits and risks at various stages of recovery. If habitat is in good or very good condition, and the affected natural fish populations are moderate or low in viability status, then the hatchery actions would be expected to have a relatively higher potential for substantial incremental effects bearing on benefits and risks to population viability. However, if habitat is in fair or poor condition, resulting in low or moderate natural fish population viability statuses, then it is unlikely that the incremental effects of hatchery actions would rise to a level where the viability status of the affected natural salmon and steelhead populations, and the status of associated resources (e.g., Socioeconomics, Cultural Resources) would be substantially affected.

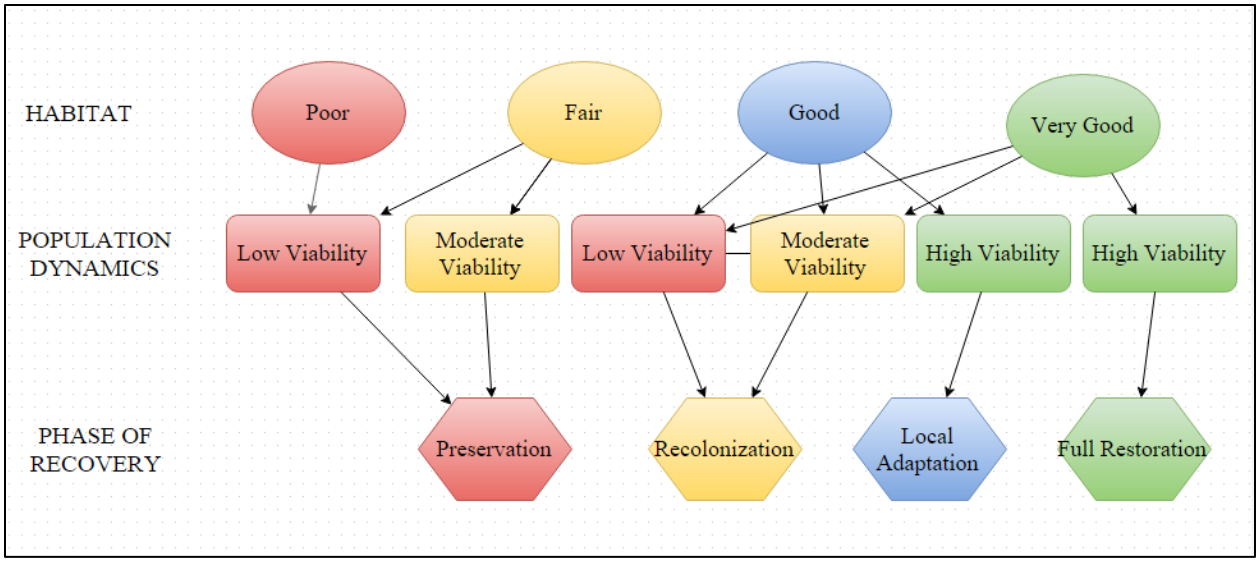

Figure 8. Linkage between habitat condition and salmon population viability status to identify phase of recovery (from Rawson and Crewson 2016).

For the listed Snohomish River basin Chinook salmon and steelhead populations, habitat is in poor to fair condition (Subsection 3.2, Fish Habitat), and all of the populations are low to moderate in viability status (Subsection 3.3, Salmon and Steelhead). When considered together, these metrics indicate that the populations in the actions area are in the "Preservation Phase" of recovery (Figure 8). In this case, the incremental effects of the proposed hatchery actions and the alternatives would not substantially add to the effects of the primary habitat-related factors limiting listed fish population viability, and affecting the status of other resources. The integrated Chinook salmon hatchery programs included in the Proposed Actions may impart some benefits to Skykomish Chinook population abundance and spatial structure during the Preservation Phase of recovery. These benefits would be substantially reduced under Alternatives 4, and become nil under Alternative 3 commensurate with reduced or terminated hatchery Chinook salmon production, respectively. However, any beneficial effects under the Proposed Action and Alternative 4 would not likely offset habitat loss and degradation impacts affecting the viability status of the population. Restoration and protection of habitat must be the first priorities for recovery actions, until the condition of habitat and the status of the populations can be improved so that the salmon and steelhead populations in the action area can be moved out of the Preservation Phase.

As the Snohomish River basin recovery plan (SSPS 2005) is fully implemented, continued habitat improvements may be expected from restoration projects that would presumably be counterbalanced by some continuing level of loss and degradation of habitat (Subsection 3.2, Fish Habitat). How much more habitat will be lost will depend on the effectiveness of habitat protection measures implemented under some of the authorities cited in Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders. Because it is unknown what the balance of gain from habitat restoration versus habitat loss from failed protection and restoration will be, it will be important to continue monitoring habitat concurrently, with monitoring of the hatchery programs and population dynamics as

described in the Proposed Action, to complete the information necessary to determine the phase of recovery as future actions are implemented. Guidelines developed by the HSRG (2015) and the co-managers could be applied to ensure that the hatchery programs under the Proposed Action are affecting resources consistent with expectations, considering cumulative effects of habitat and harvest actions.

For the above reasons, in light of all the other impacts on ESA-listed fish and their habitats, the Proposed Action and the alternatives are expected to have negligible additional impacts on the nine resources evaluated in this document. Considering previous NMFS analyses (NMFS 2016), harvest actions, taking into account cumulative effects, would also not contribute incrementally in a substantial way to resource effects in the action area. The condition of habitat is the primary factor affecting the status of salmon and steelhead populations, and other fish and wildlife species in the action area. Habitat condition is also the primary factor affecting all action area resources inextricably linked with the status of salmon and steelhead, including Socioeconomic, Cultural Resource, and Environmental Justice elements encompassing tribal treaty rights issues. The various plans and policies discussed in Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders, when successfully implemented, are likely to result in impacts that are beneficial to the resources evaluated in this EA under all alternatives, including prospects for improvements in the status of salmon and steelhead populations in the actions area (Subsection 3.3, Salmon and Steelhead) and the condition of habitat limiting listed fish recovery (Subsection 3.2, Fish Habitat). The Proposed Action also has the same or similar impacts as under baseline conditions (Alternative 1) on water quality and quantity, salmon and steelhead, other fish species and wildlife, socioeconomics, cultural resources, human health and safety, and environmental justice as discussed in Subsection 4, Environmental Consequences; any actions outside of the analysis area are not likely to affect Snohomish River basin resources compared to Alternative 1. Therefore, effects of the Proposed Action, when taken together with the effects of all hatchery programs in the Puget Sound region, and other programs, plans, and policies bearing on habitat and harvest management in the larger analysis area, are not expected cumulatively to rise to the level of significance.

## 5.2 Cumulative Effects on Resources

### 5.2.1 Fish Habitat

As described in Subsection 4.2, Fish Habitat, the only components of fish habitat that may have detectable effects resulting from implementation of the EA alternatives are water quantity and water quality. For other elements of fish habitat, for the Proposed Action and all alternatives, effects levels would remain the same as under baseline conditions. Water quantity and water quality effects of the Proposed Action and alternatives would be confined to certain sites within the action area that are in close proximity to the hatchery locations. For the reasons provided in Subsection 4.2, within these confined sites, effects on water quantity would range from undetectable to negligible; effects on water quality would be low across the alternatives. These assessed effects varied little between alternatives. Therefore, for the purpose of cumulative impacts analysis, the Proposed Action and alternatives are evaluated together because the differences in degree of cumulative effects on salmon and steelhead are not meaningfully different among the alternatives.

Considering the areal extent of the analysis area, the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat), and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders), the additional, cumulative impact on fish habitat resulting from implementation of the alternatives would be undetectable. Water quantity and water quality effects in the analysis area would be undetectable because water use and the release of hatchery effluent would be confined to only a few tributaries within the Snohomish River basin. Flows and water quality conditions in all other watersheds within the analysis area would be entirely unaffected. Operation of the Snohomish River basin hatchery programs would have no detectable effects on water quantity and quality in other Puget Sound watersheds, Puget Sound, or the Pacific Ocean. The causes of fish habitat degradation and loss in the analysis area, including water quantity and water quality effects, are assignable to human developmental actions that dwarf any effects from the hatchery actions (Subsection 3.2, Fish Habitat; Subsection 5.1.3, Other Programs, Plans, and Policies). The state of implementation of plans, regulations, agreements, laws, and orders within the analysis area that direct, regulate, and/or effectuate salmon habitat protection and restoration activities (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders) also is a primary, over-riding factor determining fish habitat status. These current habitat-related factors are expected to continue into the foreseeable future. In light of all the other impacts on fish habitat, the Proposed Action and the alternatives are expected to have undetectable cumulative effects on water quantity and water quality.

### 5.2.2 Salmon and Steelhead

This EA analyzed hatchery-related risks on salmon and steelhead that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative (Subsection 4.3, Salmon and Steelhead). For the six species analyzed, including ESA-listed Chinook salmon and steelhead, effects varied little between species under each alternative, and between alternatives, ranging from undetectable under Alternatives 1 and 2, to negligible to low reductions in risks and benefits under Alternatives 3 and 4. For these reasons, for the purpose of cumulative impacts analysis, the Proposed Action and alternatives are evaluated together because the differences in degree of cumulative effects would not be meaningfully different among the species and alternatives.

Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on salmon and steelhead resulting from implementation of the alternatives would be undetectable.

The Snohomish River basin is one of many watershed areas in Puget Sound where natural and hatchery salmon and steelhead production occurs. Hatchery-related effects resulting from the Proposed Action and alternatives would potentially affect at undetectable to low levels fish in the

Snohomish river basin, a small subset of the total number of salmon and steelhead populations in the analysis area (for e.g., two out of 22 Puget Sound Chinook salmon populations, and five of 32 Puget Sound steelhead populations). Annual juvenile salmon production levels under the Proposed Action and alternatives (ranging from 0 to 18.61 million fish) are a relatively small proportion (0 percent to 11.6 percent) of the total annual number of salmon and steelhead released from Puget Sound hatcheries each year (160.2 million fish from S. Leider, NMFS, pers. comm. October 3, 2016). Salmon and steelhead populations within the analysis area, and outside of the Snohomish River basin would not be affected to any detectable degree, through straying by adult hatchery fish, or through ecological effects in freshwater and marine areas. Considering current and expected future region-wide hatchery operations (Subsection 5.1.2, Hatchery Production), there would be no detectable incremental effects on salmon and steelhead resulting from implementation of the Proposed Action and alternatives currently, or in the future.

As discussed in Subsection 5.1.3, the degraded and lost condition of fish habitat is the primary factor determining salmon and steelhead population status in Puget Sound. The causes of fish habitat degradation and loss in the analysis area are assignable to human developmental actions that dwarf any effects on salmon and steelhead population status from the hatchery actions (Subsection 3.2, Fish Habitat). Considering the over-riding effects of fish habitat condition, the incremental effects of the Proposed Action and alternatives (ranging from undetectable to low in the Snohomish River basin) on salmon and steelhead populations across the analysis area would be undetectable.

The state of implementation of plans, regulations, agreements, laws, and orders within the analysis area that direct, regulate, and/or effectuate salmon and steelhead habitat protection and restoration activities (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders) also is a primary, over-riding factor determining fish habitat status. For the reasons described in Subsection 5.1.3, Other Programs, Plans, and Policies, the habitat-related actions listed in Subsection 1.6 have yet to be successful in preserving remnant fish habitat and restoring degraded and lost habitat required as the primary means to improve fish population status.

### 5.2.3 Other Fish Species

Hatchery-related effects on fish species other than salmon and steelhead that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.4, Other Fish Species). For the species analyzed, including ESA-listed bull trout, effects varied little between species under each alternative, and between alternatives, ranging from undetectable under Alternatives 1 and 2, to negligible to low reductions in risks and benefits under Alternatives 3 and 4, relative to Alternative 1. For these reasons, for the purpose of cumulative impacts analysis, the Proposed Action and alternatives are evaluated together because the differences in degree of cumulative effects on other fish species would not be meaningfully different among the species and alternatives.

Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in

Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on other fish species resulting from implementation of the alternatives would be undetectable.

Hatchery-related effects resulting from the Proposed Action and alternatives would potentially affect at undetectable to low levels other fish species in the Snohomish river basin. None of the other fish species occur only in the Snohomish River basin, and their distribution in other watersheds throughout the analysis area is widespread (NMFS 2014). Other fish species in the analysis area outside of the Snohomish River basin would not be affected to any detectable degree, through straying by adult hatchery fish, or ecological effects in freshwater and marine areas. Annual juvenile salmon production levels under the Proposed Action and alternatives (ranging from 0 to 18.61 million fish) that may affect other fish species are a relatively small proportion (0 percent to 11.6 percent) of the total annual number of salmon and steelhead released from Puget Sound hatcheries each year (160.2 million fish from S. Leider, NMFS, pers. comm. October 3, 2016). Considering current and expected future region-wide hatchery operations (Subsection 5.1.2, Hatchery Production), there would be no detectable incremental effects on salmon and steelhead resulting from implementation of the Proposed Action and alternatives currently, or in the future.

As discussed in Subsection 5.1.3, the degraded and lost condition of fish habitat is the primary factor determining salmon and steelhead population status in Puget Sound. The same is likely true for other fish species, which rely on the same habitat types and processes as salmon and steelhead for survival and productivity. The causes of fish habitat degradation and loss in the analysis area are assignable to human developmental actions that dwarf any effects on other fish species that may occur from the hatchery actions (Subsection 3.2, Fish Habitat). Considering the over-riding effects of fish habitat condition, the incremental effects of the Proposed Action and alternatives (ranging from undetectable to low in the Snohomish River basin) on other fish species populations across the analysis area would be undetectable.

The state of implementation of plans, regulations, agreements, laws, and orders within the analysis area that direct, regulate, and/or effectuate salmon and steelhead habitat protection and restoration activities (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders) also is a primary, over-riding factor determining status of fish habitat of shared value for other fish species. For the reasons described in Subsection 5.1.3, Other Programs, Plans, and Policies, the habitat-related actions listed in Subsection 1.6 have yet to be successful in preserving remnant fish habitat and restoring degraded and lost habitat required as the primary means to improve fish population status.

### 5.2.4 Wildlife

Hatchery-related effects on wildlife species that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.5, Wildlife). For the species analyzed, effects varied little between species under each alternative, and between alternatives, ranging from undetectable under Alternatives 1 and 2, to low reductions in risks, and low to medium reduction in benefits under Alternatives 3 and 4, relative to Alternative 1. For these reasons, for the purpose of cumulative impacts

analysis, the Proposed Action and alternatives are evaluated together because the differences in degree of cumulative effects on other fish species would not be meaningfully different among the species and alternatives.

Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on wildlife resulting from implementation of the alternatives would be undetectable.

Hatchery-related effects resulting from the Proposed Action and alternatives would potentially affect wildlife at undetectable to low risks levels, and medium benefit levels in the Snohomish river basin. None of the wildlife species analyzed for effects occur only in the Snohomish River basin, and their distribution in other watersheds throughout the analysis area is widespread (NMFS 2014). Wildlife species in the analysis area outside of the Snohomish River basin would not be affected to any detectable degree, through straying by adult hatchery fish, or ecological effects in freshwater and marine areas. Annual juvenile salmon production levels under the Proposed Action and alternatives (ranging from 0 to 18.61 million fish) that may affect wildlife species are a relatively small proportion (0 percent to 11.6 percent) of the total annual number of salmon and steelhead released from Puget Sound hatcheries each year (160.2 million fish from S. Leider, NMFS, pers. comm. October 3, 2016). Wildlife in the analysis area outside of the Snohomish River basin would not be put at risk or benefit to any detectable degree through straying by adult fish, or ecological effects in freshwater and marine areas. Considering current and expected future region-wide hatchery operations (Subsection 5.1.2, Hatchery Production), there would be no detectable incremental effects on wildlife resulting from implementation of the Proposed Action and alternatives currently, or in the future.

As discussed in Subsection 5.1.3, the degraded and lost condition of fish habitat is the primary factor determining salmon and steelhead population status in Puget Sound, and therefore the distribution and abundance of fish as wildlife species prey, predators, or competitors. The causes of fish habitat degradation and loss in the analysis area are assignable to human developmental actions that dwarf any effects on salmon and steelhead population status from the hatchery actions (Subsection 3.2, Fish Habitat). Considering the over-riding effects of fish habitat condition, the incremental effects of the Proposed Action and alternatives (ranging from undetectable to low or medium in the Snohomish River basin) on wildlife species across the analysis area would be undetectable.

### 5.2.5 Socioeconomics

Socioeconomic effects in the action area that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.6, Socioeconomics). Effects varied between alternatives, ranging from undetectable under Alternatives 1 and 2, to medium, and low to medium under Alternatives 3 and 4 respectively, relative to Alternative 1. Effects under alternatives 3 and 4 reflect the

socioeconomic value of salmon for fisheries dependent communities in the action area, in particular, the Tulalip Tribes. Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on socioeconomic conditions resulting from implementation of the alternatives would be undetectable.

The largest determiner of socioeconomic benefits that would be accrued from implementation of the Proposed Action and alternatives are smolt to adult survival rates for salmon released through the hatchery programs. The production of adult fish is what drives total salmon harvest levels, ex-vessel catch value, and total economic benefits from income, jobs, and recreational expenditures in the analysis area. Determining hatchery smolt to adult survival rates are the condition and resultant productivity of natural freshwater and marine habitat. Natural habitat needed to sustain hatchery salmon after their release from the hatcheries has been lost and become degraded relative to historical conditions (Subsection 3.2, Fish Habitat). Hatchery, and natural, salmon survival is adversely affected as a result. Fluctuating natural marine area productivity conditions that are largely out of human control also have a high effect on hatchery and natural salmon survival to adult return (Subsection 3.2, Fish Habitat).

Under all alternatives, the hatchery programs would apply best management practices leading to the release healthy juvenile salmon at sizes, times, locations promoting high survival to adult return rates (Subsection 1.2, Proposed Action). These fish produced in hatcheries circumvent disrupted natural spawning, incubation, and rearing conditions that limit natural salmon survival and productivity in freshwater. However, anthropogenic factors that have adversely affected fish habitat condition and productivity in the analysis area (Subsection 3.2, Fish Habitat; Subsection 5.1.3, Other Programs, Plans and Policies) have as an over-riding, high effect suppression of hatchery salmon survival after the hatchery fish are released. This condition applies under all alternatives. Natural-origin salmon that would contribute to socioeconomic conditions within the analysis area are adversely affected to a greater extent for the above reasons. Fluctuating natural marine area productivity conditions that are largely out of human control also have a high effect on hatchery and natural salmon survival to adult return.

As described in Subsection 3.6, Socioeconomics, but for the Snohomish River basin salmon hatchery programs, Tulalip tribal fisheries, and other non-Indian fisheries, contributing to local socioeconomic benefits would be adversely affected. The degree of local effects would range up to medium under Alternative 3. Hatchery salmon production under the Proposed Action and alternatives would contribute a low proportion of the total abundance of adult natural and hatchery salmon and steelhead providing fisheries socioeconomic benefits in the analysis area (Subsection 3.6, Socioeconomics; Subsection 5.1.2, Hatchery Production). Given salmon production ranges considered in this EA, cumulative effects on socioeconomic conditions would not be meaningfully different between the alternatives. Localized socioeconomic effects on the Tulalip Tribes under Alternatives 3 and 4 would be medium and low-medium, respectively.

However, with regards to cumulative effects, under all alternatives evaluated in this EA, no detectable increases or reductions in total harvest, ex-vessel value, and total economic benefit to income, jobs, and recreational expenditures would be expected across the analysis area.

### 5.2.6 Cultural Resources

Effects on cultural resources in the action area that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.7, Cultural Resources). Effects varied between alternatives, ranging from undetectable to negligible-low under Alternatives 1 and 2 respectively; and high to medium-high under Alternatives 3 and 4, respectively. Effects under alternatives 3 and 4 reflect the cultural value of salmon for certain communities in the action area, in particular, the Tulalip Tribes. Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on cultural resources resulting from implementation of the alternatives would be undetectable.

The largest determiner of cultural resource benefits that would be accrued from implementation of the Proposed Action and alternatives are smolt to adult survival rates for salmon released through the hatchery programs. The production of adult fish is what drives total salmon harvest levels, and resultant cultural benefits in the analysis area. The primary factor determiner of hatchery smolt to adult survival rates is the condition and resultant productivity of natural freshwater and marine habitat. Under all alternatives, natural habitat needed to sustain hatchery salmon after their release from the hatcheries has been lost and become degraded relative to historical conditions (Subsection 3.2, Fish Habitat). Hatchery and natural salmon survival is adversely affected as a result. Fluctuating natural marine area productivity conditions that are largely out of human control also have a high effect on hatchery and natural salmon survival to adult return (Subsection 3.2, Fish Habitat).

Under all alternatives, the hatchery programs would apply best management practices leading to the release healthy juvenile salmon at sizes, times, locations promoting high survival to adult return rates (Subsection 1.2, Proposed Action). These fish produced in hatcheries circumvent disrupted natural spawning, incubation, and rearing conditions that limit natural salmon survival and productivity in freshwater. However, anthropogenic factors that have adversely affected fish habitat condition and productivity in the analysis area; Subsection 5.1.3, Other Programs, Plans and Policies) have as an over-riding, high effect suppression of hatchery salmon survival after the hatchery fish are released. Natural-origin salmon that would contribute to socioeconomic conditions within the analysis area are adversely affected to a greater extent for the above reasons.

As described in Subsection 3.7, Cultural Resources, but for the Snohomish River basin salmon hatchery programs, Tulalip tribal fisheries, and other non-Indian fisheries, contributing to local cultural resource benefits would be adversely affected. The degree of local effects would range

up to high under Alternative 3. Hatchery salmon production under the Proposed Action and alternatives would contribute a low proportion of the total abundance of adult natural and hatchery salmon and steelhead providing cultural resource benefits in the analysis area (Subsection 3.6, Socioeconomics; Subsection 5.1.2, Hatchery Production). Given salmon production ranges considered in this EA, cumulative effects on cultural resource conditions would not be meaningfully different between the alternatives. Localized cultural resource effects on the Tulalip Tribes under Alternatives 3 and 4 would be high or medium-high, respectively. However, with regards to cumulative effects, under all alternatives evaluated in this EA, no detectable increases or reductions in cultural resources would be expected across the analysis area.

### 5.2.7 Human Health and Safety

Effects on human health and safety in the action area that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.8, Human Health and Safety). Effects varied between alternatives, ranging from undetectable under Alternatives 1 and 2 respectfully; and medium and low under Alternatives 3 and 4, respectively. Effects under alternatives 3 and 4 reflect the value of salmon as a healthy food source for fisheries dependent communities in the action area, in particular, the Tulalip Tribes. Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on human health and safety resulting from implementation of the alternatives would be undetectable.

Under all alternatives, the hatchery programs would apply best management practices for the use of fish disease control and other chemicals to ensure compliance with all safety programs, rules, and regulations protecting human health and safety in the action area (Subsection 4.8, Human Health and Safety). Risks to human health and safety would be adequately minimized. For this reason, the Proposed Action and alternatives would have undetectable effects on human health and safety in the broader analysis area through the use of chemicals.

For the reasons described above in Subsection 5.2.5, Socioeconomics and Subsection 5.2.6, Cultural Resources, the availability of adult hatchery salmon benefiting human health as food is determined primarily by the condition of fish habitat, and the state of implementation of policies, laws, and regulations affecting habitat condition. Under all alternatives, degraded and lost habitat in the analysis area suppresses hatchery salmon survival rates to adult return, decreasing the abundance of salmon for harvest and consumption to a high degree. This decrease may benefit human health, if contaminant levels in salmon reach levels of concern for human health. However, hatchery salmon production under the Proposed Action and alternatives would contribute a low proportion of the total abundance of adult natural and hatchery salmon and steelhead to treaty tribes and other groups relying on salmon as an important food source in the analysis area (Subsection 5.1.2, Hatchery Production). Considering the extent of the analysis

area, salmon production levels between alternatives are not meaningfully different. Although localized human health benefits for members of Tulalip Tribes under alternatives 3 and 4 would be medium and low, respectively, with regards to cumulative effects, under all alternatives evaluated in this EA, no detectable increases or reductions in human health effects would be expected across the analysis area.

### 5.2.8 Environmental Justice

Environmental justice effects in the action area that would result from implementation of the Snohomish River basin salmon hatchery programs under each alternative were analyzed in this EA (Subsection 4.9, Environmental Justice). Effects varied between alternatives, ranging from undetectable under Alternatives 1 and 2, high under Alternative 3, and medium under Alternative 4. High and medium effects under alternatives 3 and 4 reflect impacts to the Tulalip Tribes, and as a minority group in the action area, the Asian community. Considering the areal extent of the analysis area, the effects of all hatchery production, including those encompassed by the Proposed Action (Subsection 5.1.2, Hatchery Production); the relative magnitude of effects resulting from other human developmental activities across the area (Subsection 3.2 - Fish Habitat); and other actions expected to occur within the action area, in Puget Sound, and in the Pacific Ocean that would incrementally affect the resources considered in this EA (Subsection 1.6, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders); the additional, cumulative impact on environmental justice resulting from implementation of the alternatives would be undetectable.

For the reasons described above in Subsection 5.2.5, Socioeconomics and Subsection 5.2.6, Cultural Resources, the availability of adult hatchery salmon is determined primarily by the condition of fish habitat, and the state of implementation of policies, laws, and regulations affecting habitat condition. Under all alternatives, degraded and lost habitat in the analysis area suppresses hatchery salmon survival rates, affecting environmental justice factors including adult salmon return abundance, fisheries-related employment opportunities, local procurement of fisheries-related goods and services, and as discussed in Subsection 4.7, cultural resources. The condition of habitat also suppresses exposure of the environment justice communities to salmon potentially contaminated through pollution in natural rearing areas. However, hatchery salmon production under the Proposed Action and alternatives would contribute a low proportion of the total abundance of adult natural and hatchery salmon and steelhead to treaty tribes and other groups considered environmental justice communities in the analysis area (Subsection 5.1.2, Hatchery Production). Given salmon production ranges considered in this EA, cumulative environmental justice effects would not be meaningfully different between the alternatives. Although localized human health benefits for members of Tulalip Tribes under alternatives 3 and 4 would be high and medium, respectively, with regards to cumulative effects, under all alternatives evaluated in this EA, no detectable environmental justice effects would be expected across the analysis area.

## 5.3 Conservation Management under the ESA

The hatchery programs within the action area would be regulated by NMFS based on their effects on the ESA-listed Chinook salmon and steelhead populations originating in the Snohomish river basin. Effects of the hatchery programs at the Puget Sound Chinook salmon

ESU and Puget Sound steelhead DPS levels would also be considered in the NMFS review of the consistency of the proposed hatchery programs with ESA 4(d) rule, limit 6 criteria. If the cumulative effects of freshwater habitat conditions, other hatchery programs, fisheries, pinniped predation on salmonids, marine environmental conditions, or conservation efforts adversely affect escapement of adult salmon to the action area below levels sufficient to meet population recovery goals, hatchery broodstock collection goals, and treaty-reserved tribal fisheries needs, actions would be taken to address factors responsible, applicable under all alternatives.

If the cumulative effects of listed fish and habitat management efforts in the Snohomish River basin fail to recover listed Chinook salmon and steelhead, then resource impacts assigned in this EA to the hatchery programs within the action area would be substantially affected. For example, if the current, poor viability status of natural salmon and steelhead populations is not improved, then the effects of Alternative 3 and Alternative 4 on socioeconomic, cultural resource and environmental justice resources would likely become more severe. Hatchery salmon would be relied upon to a greater extent over the long term to maintain salmon abundance in the action area, sustaining benefits to resources that are critical for meeting tribal treaty rights. Salmon production decreases under these alternatives would run counter to the need to mitigate the continued poor status of natural salmon in the action area.

Any cumulative adverse impacts of the programs under all alternatives on recovery actions are expected to be minor. Application of best management practices in the hatchery operations that minimize risks to listed fish species, and ESA monitoring and reporting requirements would help ensure compatibility with recovery plans. As described in Subsection 3.2, Fish Habitat, and Subsection 5.1.3, Other Programs, Plans, and Policies, the hatchery actions reviewed in this EA are a small subset of a large suite of environmental factors and regulations that influence the overall health of listed Chinook salmon and steelhead populations and their habitat. Hatchery performance and effects monitoring is included in the proposed hatchery programs, and in any NMFS ESA authorization for the programs, so that the State and tribal comanagers can respond to any identified adverse effects by implementing actions that further reduce risks to listed fish.

## 5.4 Climate Change

The climate is changing in the Pacific Northwest due to human activities that increase greenhouse gasses in the atmosphere. These changes affect hydrologic patterns and water temperatures within regional watersheds. Regionally average air temperature rose approximately 1.5°F over the past century (with some areas experiencing increases up to 4°F), and average air temperatures are projected to increase another 3°F to 10°F during this century. Increases in winter precipitation and decreases in summer precipitation are projected by many climate models, although these projections are less certain than those for temperature (USGCRP 2009).

Higher temperatures are likely to increase the percentage of precipitation falling as rain rather than snow, which is expected to contribute to flooding, earlier snowmelt and reduced summer flows, and other seasonal changes in streamflow. The average snowpack, measured annually on April 1, has already declined substantially throughout the region (USGCRP 2009). The average decline in snowpack in the Cascade Mountains, for example, was about 25 percent over the past 40 to 70 years, with most of this due to the 2.5°F increase in cool season temperatures over that period. Further declines in Northwest snowpack are likely due to additional warming this

century, varying with latitude, elevation, and proximity to the coast. April 1 snowpack is likely to decline by as much as 40 percent from current levels in the Cascades by the 2040s (USGCRP 2009).

High and base stream flows are likely to change with warming. Increasing winter rainfall is likely to increase winter peak flows and flooding in some areas. Earlier snowmelt, and increased evaporation and water loss from vegetation, will advance timing and decrease the duration of spring runoff and result in decreased stream flows during the warm season (April through September). In some sensitive watersheds, both increased flood risk in winter and increased drought risk in summer are likely due to warming of the climate (USGCRP 2009), which can exacerbate risk from scouring flows to the extent that spawning under low flows is limited to areas more prone to flooding or major fluctuations in flow.

In areas where it snows, a warmer climate means major changes in the timing and intensity of runoff: increased stream flows during winter and early spring, and decreases in late spring, summer, and fall. Flow timing has shifted over the past 50 years, with the peak of spring runoff shifting from a few days earlier in some places to as much as 25 to 30 days earlier in others. This trend is likely to continue, with runoff shifting 20 to 40 days earlier within this century. Major shifts in the timing of runoff are not likely in watersheds dominated by rain rather than snow run-off (ISAB 2007; USGCRP 2009).

Fish habitat changes due to climate change are likely to create a variety of challenges for ESA-listed species of fish. Higher winter stream flows can scour streambeds, damaging spawning redds and washing away incubating eggs (USGCRP 2009). Earlier peak stream flows could flush young salmon and steelhead from rivers to estuaries before they are physically mature enough for the transition, increasing a variety of stresses and the risk of predation (USGCRP 2009). Lower summer stream flows and warmer water temperatures will degrade summer rearing conditions in many parts of the Pacific Northwest for a variety of salmon and steelhead species (USGCRP 2009), and are likely to reduce the survival of steelhead fry in streams with incubation in early summer. Other likely effects include alterations to migration patterns, increasingly frequent and amplified effects of flooding and redd scour from low summer flows that force mainstem spawning in thalweg areas more susceptible to the increased flooding, accelerated embryo development, premature emergence of fry, and increased competition and predation risk from warm-water, non-native species (ISAB 2007). The increased prevalence and virulence of diseases and parasites that tend to flourish in warmer water will further stress salmon and steelhead (USGCRP 2009). Overall, about one-third of the current habitat for the Pacific Northwest's coldwater fish species may well no longer be suitable for them by the end of this century as key temperature thresholds are projected to be exceeded (USGCRP 2009).

Climate change is already believed to be affecting fish productivity conditions in the Pacific Ocean. Historically, warm periods in the coastal Pacific Ocean have coincided with relatively low abundances of salmon and steelhead, while cooler ocean periods have coincided with relatively high abundances (USGCRP 2009). It is likely that, as ocean conditions continue to change with increasing magnitude, abundances of salmon and steelhead will continue to change accordingly, resulting in larger changes in marine survival and the abundances of adult salmonids returning to freshwater to spawn.

The climate change impacts described above directly apply to the Snohomish River basin action area and would affect all alternatives considered in this EA equally. Because a large portion of the Snoqualmie River basin drains high-elevation areas of the Cascade Mountains, snowmelt strongly influences the hydrology of the watershed (Haring 2002). Regarding the major tributaries, the Skykomish River is mostly influenced by snowmelt, as indicated by mean higher flows occurring in late-spring. Flows in the Snoqualmie River are similar in magnitude in the winter and spring, indicating that it is similarly influenced by winter rains and spring snowmelt. Under current conditions, the lowest mean monthly flows in basin waters occur in August, because most of the snow has melted and there is usually little rainfall or resultant runoff in western Washington streams during the summer months (Haring 2002). If climate change reduces the average snow pack, then reductions in already low summer-time flows would result, potentially reducing the amount and suitability of habitat required for salmon migration, spawning, egg incubation and yearling life stage rearing, to the detriment of the survival and abundance of some species, races, and life history types (e.g., yearling spring and summer Chinook salmon and steelhead). Climate change may also increase the frequency of major flooding events that can scour salmon redds and spawning during droughts could magnify these effects by forcing earlier spawners to spawn almost exclusively in mainstem thalweg areas on low flow years. Lower summer flows due to a reduced winter snow pack may increase water temperatures, which may lead to an increase in the abundance of non-native warm water species that can compete with, and prey on, listed salmon. Warmer water temperatures in freshwater and marine areas may alter species composition and timing of plankton blooms available to outmigrant salmonids or increase the occurrence and virulence of certain infectious fish pathogens resulting in increased incidence and intensity of disease outbreaks and mortalities in both natural- and hatchery-origin juvenile and sub adult salmon components of basin populations.

If climate change contributes to a substantial decline in the viability of listed natural-origin Chinook salmon populations in the Snohomish River basin through impacts on freshwater habitat and from changes in ocean conditions, the two hatchery programs for Skykomish Chinook salmon under the Proposed Action may serve as “safety net” programs to maintain genetic resources for one of the listed Chinook salmon populations in the basin. The adult and earliest life stages of fish held in the Chinook salmon hatchery programs would be somewhat protected from the possible increase in disease prevalence from warmer surface water temperatures induced by climate change, because well water is used during these periods and the fish are tested at spawning, during rearing, and prior to release to limit fish disease outbreaks and transmission of fish pathogens to the natural-origin salmon populations. The non-listed salmon species native to the watershed and propagated under the Proposed Action would benefit in the same way. This safety net benefit conferred to the propagated salmon species under the Proposed Action would be reduced to a low to medium extent under Alternative 4, and would become negligible under Alternative 3.

Climate change will likely have impacts on the abundance and/or distribution of ESA-listed and non-listed salmon; other fish species, and wildlife considered in this EA for effects under the Proposed Action and the alternatives. The hatchery management actions described in the HGMPs, including associated monitoring, provide the ability to evaluate hatchery program risks

and benefits as abundances change relative to risks and benefits posed by current and projected future habitat (protection and restoration), and harvest actions and conditions, make adjustments to these actions possible as depicted in the HGMP's adaptive management framework.

The hatchery programs would not substantially affect climate change under any alternative because salmon trapping, spawning, rearing, and release activities that are the primary actions at the hatcheries would stand as negligible sources of greenhouse gas emissions. However, under all of the alternatives except Alternative 3 (hatchery program termination), adult salmon trapped at the Sunset Falls Fishway for use as broodstock each year would be transported by truck weekly for up to three months from the fishway to Wallace River Hatchery. Trucks would also be used for one day each year to transfer coho salmon smolts from Wallace River Hatchery for rearing in the Everett Bay Net Pen program. The fish transport trucks used for these activities would be in compliance with Washington State emission control standards required for vehicle licensing to minimize air pollution. Emissions from these localized and infrequent activities would not be expected to contribute in any meaningful way to greenhouse gases adversely affecting the environment.

# 6 AGENCIES CONSULTED

Tulalip Tribes
Washington Department of Fish and Wildlife
Stillaguamish Tribe
Northwest Indian Fisheries Commission

# 7 REFERENCES CITED


Anderson, J.H., P. Faulds, W. Atlas, and T. Quinn. 2012. Reproductive success of captively bred and naturally spawned Chinook salmon colonizing newly accessible habitat. Evolutionary Applications ISSN 1752-4.

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

Beamish, R. J., Mahnken, C., and Neville, C. M. 1997. Hatchery and wild production of Pacific salmon in relation to large-scale, natural shifts in the productivity of the marine environment. ICES Journal of Marine Science, 54: 1200-1215.

Beechie T., E. Beamer, B. Collins, and L. Benda. 1996. Restoration of habitat-forming processes in Pacific Northwest watersheds: a locally adaptable approach to salmonid habitat restoration. In D. L. Peterson and C. V. Klimas (editors), The Role of Restoration in Ecosystem Management. Society for Ecological Restoration, Madison, Wisconsin. p. 48-67.

Berejikian, B.A., T. Johnson, R. Endicott, and J. Lee-Waltermire. 2008. Increases in steelhead (Oncorhynchus mykiss) redd abundance resulting from two conservation hatchery strategies in the Hamma River, Washington. pp. 754-764(11) IN Canadian Journal of Fisheries and Aquatic Sciences, Volume 65, Number 4, April 2008.

Bergheim, A., and T. Åsgård. 1996. Chapter 3. Waste Production from Aquaculture. IN: Aquaculture and Water Resource Management, Donald J. Baird, et al. (eds). Blackwell Science, Ltd. Oxford, England. p.50-80.

Bortleson, G.C., M.J. Chrzastowski, and A.K. Helgerson. 1980. Historical changes of shoreline and wetlands at eleven major deltas in the Puget Sound region, Washington. Prepared in cooperation with the U.S. Department of Justice and the Bureau of Indian Affairs, Renton, Washington. U.S Geological Survey, Hydrologic Investigations Atlas HA-617, Washington, DC.

Bowhay, C. 2016. Policy Analyst, Northwest Indian Fisheries Commission. April 22, 2016. Letter to Mike Grayum (Director, Northwest Indian Fisheries Commission) regarding the 2016-2017 List of Agreed Fisheries (LOAF) for treaty salmon fisheries in the ocean north of Cape Falcon, Oregon and in Puget Sound. On file with NMFS West Coast Region, Sand Point office.

Boxall, A.B., L.A. Fogg, P.A. Blackwell, P. Kay, E.J. Pemberton, and A. Croxford. 2004. Veterinary medicines in the environment. Rev Environ Contam Toxicol. 2004: 1-91.

Carlson, D.L., and R.A. Hites. 2005. Polychlorinated biphenyls in salmon and salmon feed: global differences and bioaccumulation. Environmental Science and Technology 39:7389-7395.

Center for American Progress. 2016. The disappearing west. Available at: https://www.disappearingwest.org/#big_picture

CIG (Climate Impacts Group). 2004. Overview of climate change impacts in the U.S. Pacific Northwest (July 29, 2004, updated August 17, 2004). Climate Impacts Group, University of Washington, Seattle, Washington July 29, 2004.

CTC (Chinook Technical Committee). 2015. Pacific Salmon Commission joint Chinook technical committee report. Annual report of catch and escapement for 2014. Report TCCHINOOK (15)-2. Pacific Salmon Commission, Vancouver, B.C. 244 p.

Conservation Science Partners. 2016. Description of the approach, data, and analytical methods used to estimate natural land loss in the western U.S. (13 May 2016). For the project entitled: 'The Disappearing West". Submitted to: The Center for American Progress. 11050 Pioneer Trail, Suite 202. Truckee, California.

Cripps, S.J. 1995. Serial particle size fractionation and characterization of an aquacultural effluent. Aquaculture 133: 323-339.

Easton, M.D.L., D. Luszniak, and E. Von der Geest. 2002. Preliminary examination of contaminant loadings in farmed salmon, wild salmon and commercial salmon feed. Chemosphere 46: 1053-1074.

EPA (Environmental Protection Agency). 1998. Reviewing for Environmental Justice: EIS and Permitting Resource Guide. EPA Review. Region 10 – Environmental Justice Office.

Ford MJ (ed.), Cooney T, McElhany P, Sands N, Weitkamp L, Hard J, McClure M, Kope R, Myers J, Albaugh A, Barnas K, Teel D, Moran P, Cowen J. 2011. Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Northwest. Draft U.S. Department of Commerce, NOAA Technical Memorandum NMFS-NWFSC-113. 281 p.

Ford MJ, Hempelmann J, Hanson MB, Ayres KL, Baird RW, Emmons CK, et al. (2016) Estimation of a Killer Whale (Orcinus orca) Population's Diet Using Sequencing Analysis of DNA from Feces. PLoS ONE 11(1): e0144956. doi:10.1371/journal.pone.0144956

Grayum. M. 2016. Director, Northwest Indian Fisheries Commission. May 25, 2016. Letter to Bob Turner (Regional Assistant Administrator, NMFS West Coast Region, Sustainable Fisheries Division) describing harvest management objectives for Puget Sound Chinook for the 2016-2017 season. On file with NMFS West Coast Region, Sand Point office.

Gustafson, R.G., T.C. Wainwright, G.A. Winans, F.W. Waknitz, L.T. Parker, and R.S.Waples. 1997. Status review of sockeye salmon from Washington and Oregon. U.S. Department of Commerce, NOAA Tech. Memo. NMFS-NWFSC-33. 282p.

Gustafson, R.G., M.J. Ford, D. Teel, and J.S. Drake. 2010. Status review of eulachon (Thaleichthys pacificus) in Washington, Oregon, and California. U.S. Dept. Commer., NOAA Tech. Memo. NMFS-NWFSC-105, 360 p.

Haas, A., and B. Collins. 2001. A Historical analysis of habitat alterations in the Snohomish River Valley, Washington, since the mid-19th century: Implications for Chinook and coho salmon. Prepared for the Tulalip Tribes and Snohomish County Department of Public Works, Everett, WA.

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

Hard, J.J., R. Kope, W. Grant, F.W. Waknitz, L. Parker, and R. Waples. 1996. Status review of pink salmon from Washington, Oregon, and California. U.S. Department of Commerce, NOAA Technical Memorandum. NMFS-NWFSC-25. 131 p.

Hard, J., and eight co-authors. 2012. Identifying historical populations of steelhead within the Puget Sound distinct population segment. Puget Sound Steelhead Technical Recovery Team Report. April 15, 2012 - Review Draft. Northwest Fisheries Science Center, NMFS. Seattle, Washington. 128 p.

Hardy, R. 2005. Contaminants in salmon - a follow-up. Fish Feeds and Nutrition. March/April 2005 - Aquaculture Magazine. 3 p.

Haring, D. 2002. Salmonid habitat limiting factors analysis Snohomish river watershed water resource inventory area 7 - final report. December, 2002. Washington State Conservation Commission. Lacey, WA. 331 p.

Heard, W.R. 1991. Life history of pink salmon (Oncorhynchus gorbuscha). Pages 119-230 in C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press, Univ. British Columbia, Vancouver, British Columbia.

Hess, M.A., C.D. Rabe, J.L. Vogel, J.J. Stevenson, D.D. Nelson, and S.R. Narum. 2012. Supportive breeding boosts natural population abundance with minimal negative impacts on fitness of a wild population of Chinook salmon. Molecular Ecology. 1-15.

Hilborn, R., S.P. Cox, F.M.D. Gulland, D.G. Hankin, N.T. Hobbs, D.E. Schindler, and A.W. Trites. 2012. The Effects of Salmon Fisheries on Southern Resident Killer Whales: Final Report of the Independent Science Panel. Prepared with the assistance of D.R. Marmorek and A.W. Hall, ESSA Technologies Ltd., Vancouver, B.C. for National Marine Fisheries Service (Seattle. WA) and Fisheries and Oceans Canada (Vancouver. BC). xv + 61 pp. + Appendices.

Hard, J. J., J. M. Myers, E. J. Connor, R. A. Hayman, R. G. Kope, G. Lucchetti, A. R. Marshall, G. R. Pess, and B. E. Thompson. 2015. Viability Criteria for Steelhead Within the Puget Sound Distinct Population Segment. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-NWFSC-129. 367 p.

Hites, R.A., J.A. Foran, D.O. Carpenter, M.C. Hamilton, B.A. Knuth, and S.J. Schwager. 2004. Global Assessment of Organic Contaminants in Farmed Salmon. Science. Volume 303:226-229.

HRSG (Hatchery Scientific Review Group). 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 1-23.

HSRG. 2009. Columbia River hatchery reform system wide report. Available from: http://www.hatcheryreform.us/hrp/reports/system/welcome_show.action

HSRG (Hatchery Scientific Review Group). 2015. Annual Report to Congress On the Science of Hatcheries: A report on the application of up-to-date science in the management of salmon and steelhead in the Pacific Northwest. A. Appleby, H.L. Blankenship, D. Campton, K. Currens, T. Evelyn, D. Fast, T. Flagg, J. Gislason, P. Kline, C. Mahnken, B. Missildine, L. Mobrand, G. Nandor, P. Paquet, S. Patterson, L. Seeb, S. Smith, and K. Warheit. July 2015.

HCCC (Hood Canal Coordinating Council). 2005. Hood Canal and Eastern Strait of Juan de Fuca Summer Chum Salmon Recovery Plan. Hood Canal Coordinating Council. 334p. plus eight appendices.

ISAB (Independent Scientific Advisory Board). 2007. Climate Change Impacts on Columbia River Basin Fish and Wildlife. Independent Scientific Advisory Board for the Northwest Power and Conservation Council; Portland, Oregon. Report ISAB 2007-2. May 11, 2007.

ICF International. 2010. Overview of the “All H Analyzer”. February. (ICF 00901.09.) Vashon, WA. Prepared for National Marine Fisheries Service, Portland, Oregon.

Jacobs, M.N., A. Covaci, and P. Schepens. 2002a. Investigation of Selected Persistent Organic Pollutants in Farmed Atlantic Salmon (Salmo salar), Salmon Aquaculture Feed, and Fish Oil Components of the Feed. Environmental Science and Technology 36: 2797-2805.

Jacobs, M., J. Ferrario, and C. Byrne. 2002b. Investigation of polychlorintated dibenzo-p-dioxins, dibenzo-p-furans and selected coplanar biphenyls in Scottish farmed Atlantic salmon (Salmo salar). Chemosphere 47(2):183-191.

Johnson, O.W., W.S. Grant, R.G. Cope, K. Neely, F.W. Waknitz, and R.S. Waples. 1997. Status review of chum salmon from Washington, Oregon, and California. U.S. Dept. Commerce, NOAA Tech. Memo. NMFS-NWFSC-32, 280 p.

Johnson, L.L., G.M. Ylitalo, C.A. Sloan, B.F. Anulacion, A.N. Kagley, M.R. Arkoosh, T.A. Lundrigan, K. Larson, M. Siipola, and T.K. Collier. 2007. Persistent organic pollutants in

outmigrant juvenile chinook salmon from the Lower Columbia Estuary, USA. Sci Total Environ. 374(2-3): 342-366.

Johnson, L.L. M.L. Willis, O.P. Olson, R.W. Peace, C.A. Sloan, and G.M. Ylitalo. 2009. Contaminant Concentrations in Juvenile Fall Chinook Salmon (Oncorhynchus tschawytscha) from Columbia River Hatcheries. North American Journal of Aquaculture.

Judge, Millie M. 2011. A qualitative assessment of implementation of the Puget Sound Chinook salmon recovery plan. NOAA Fisheries, Arlington, VA. http://treatyrightsatrisk.org/wp-content/uploads/2012/11/implement-rpt.pdf (accessed 15 Dec 2013).

Kassler T.W., D.K. Hawkins, and J.M. Tipping. 2007. Summer-run hatchery steelhead have naturalized in the South Fork Skykomish River, Washington. Molecular Genetics Laboratory, Washington Department of Fish and Wildlife. Olympia, WA. 31p.

Kelly, B. C., M. P. Fernandez, M. G. Ikonomou, and W. Knapp. 2008. Persistent organic pollutants in aquafeed and Pacific salmon smolts from fish hatcheries in British Columbia, Canada. Aquaculture 285: 224-233.

Kendra, W. 1991. Quality of salmonid hatchery effluents during a summer low-flow season. Transactions of the American Fisheries Society 120: 43-51.

Kolodziej, E.P., T. Harter, and D.L. Sedlak . 2004. Dairy wastewater, aquaculture, and spawning fish as sources of steroid hormones in the aquatic environment. Environ Sci Technol. 38:6377-6384.

Magnusson, A. and Hilborn, R. 2003. Estuarine influence on survival rates of coho (Oncorhynchus kisutch) and Chinook salmon (Oncorhynchus tshawytscha) released from hatcheries on the U.S. Pacific coast. Estuaries, 26: 1094–1103.

Mantua, N.J. Mantua and S.R. Hare. 2002. The Pacific decadal oscillation. Journal of Oceanography, Vol. 58, pp. 35-44.

Mantua, N., I. Tohver, and A. Hamlet. 2009. Impacts of climate change on key aspects of freshwater salmon habitat in Washington State. University of Washington. Seattle, Washington. 37 p.

Martínez Bueno, M.J., M.D. Hernando, A. Agüera, and A.R. Fernández-Alba. 2009. Application of passive sampling devices for screening of micro-pollutants in marine aquaculture using LC-MS/MS. Talanta. 77: 1518-1527.

Maule A.G, A.L. Gannam, and J.W. Davis. 2007. Chemical contaminants in fish feeds used in Federal salmonid hatcheries in the USA. Chemosphere 67: 1308-1315.

Mayo Clinic. 2010. Omega-3 fatty acids, fish oil, alpha-linolenic acid background information. Accessed through the Internet at: http://www.mayoclinic.com/health/fish-oil/ns_patient-fishoil. Web site accessed April 23, 2010.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. U.S. Dept. of Commerce, NOAA Tech. Memo, NMFS-NWFSC-42.

Michael, J.H., Jr. 2003. Nutrients in salmon hatchery wastewater and its removal through the use of wetland constructed to treat off-line settling pond effluent. Aquaculture 226: 213-225.

Missildine, B.R., R.J. Peters, G. Chin-Leo, and D. Houck. 2005. Polychlorinated biphenyl concentrations in adult Chinook salmon (Oncorhynchus tshawytscha) returning to coastal and Puget Sound hatcheries of Washington State. Environmental Science and Technology 39: 6944-6951

Moore, M.E., B.A. Berejikian, and E.P. Tezak. 2010. Early Marine Survival and Behavior of Steelhead Smolts through Hood Canal and the Strait of Juan de Fuca. Transactions of the American Fisheries Society 139:49–61, 2010.

Moore, M.E., B.A. Berejikian, F.A. Goetz, A.G. Berger, S.S. Hodgon, E.J. Conner, and T.P Quinn. 2015. Multi-population analysis of Puget Sound steelhead survival and migration behavior. Mar. Ecol. Prog. Ser. 537:217-232.

Myers, J. M., R. G. Kope, G. J. Bryant, D. Teel, L. J. Lierheimer, T. C. Wainwright, W. S. Grant, F. W. Waknitz, K. Neely, S. T. Lindley, and R. S. Waples. 1998. Status Review of Chinook Salmon from Washington, Idaho, Oregon, and California, U.S. Dept. Commer., NOAA Tech Memo. NMFS-NWFSC-35, 443p.

Myers, J.M., J.J. Hard, E.J. Connor, R.A. Hayman, R.G. Kope, G. Lucchetti, A.R. Marshall, G.R. Pess, and B.E. Thompson. 2015. Identifying historical populations of steelhead within the Puget Sound distinct population segment. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-128.

NMFS (National Marine Fisheries Service).1996. Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale. August, 1996. (Available at: http://www.oregon.gov/ODOT/HWY/GEOENVIRONMENTAL/docs/Biology/NMFS_Matrix.pdf accessed 2 Feb 2016).

NMFS (National Marine Fisheries Service). 2005. Puget Sound Chinook Harvest Resource Management Plan. Final EIS. NMFS Northwest Region with Assistance from the Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife.

NMFS. 2007. Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan. NMFS, Northwest Region, Portland, Oregon. 47 p.

NMFS. 2009. National Marine Fisheries Service Endangered Species Act (ESA) Section 7 Consultation Biological Opinion and Magnuson-Stevens Act (MSA) Essential Fish Habitat Consultation. Sunset Falls Fishway program. ESA Section 7 Consultation Number F/NWR/2009/00982. NMFS Northwest Region. Salmon Management Division. Portland, Oregon.

NMFS. 2014a. Draft Environmental Impact Statement on Two Joint State and Tribal Resource Management Plans for Puget Sound Salmon and Steelhead Hatchery Programs. NMFS West Coast Region, Sustainable Fisheries Division. Lacey, Washington.

NMFS. 2014b. Final Environmental Impact Statement to Inform Columbia River Basin Hatchery Operations and the Funding of Mitchell Act Hatchery Programs. September, 2014. NMFS West Coast Region Office, Sustainable Fisheries Division. Portland, Oregon.

NMFS. 2011. Evaluation of and recommended determination on a Resource Management Plan (RMP), pursuant to the salmon and steelhead 4(d) rule - comprehensive management plan for Puget Sound Chinook: harvest management component. NMFS Northwest Regional Office, Salmon Management Division. Seattle, Washington. 244p.

NMFS. 2012a. Final Environmental Assessment and Finding of No Significant Impact--Determination that the Hatchery and Genetic Management Plans for Sandy River Programs Submitted by the Oregon Department of Fish and Wildlife Satisfy the Endangered Species Act Section 4 (d) Rule under Limit 5. September 26, 2012.

NMFS. 2012b. Draft Environmental Assessment to Analyze Impacts of a NOAA's National Marine Fisheries Service Proposed Determination that the Tribal Resource Management Plan submitted by the Shoshone-Bannock Tribes satisfies the Tribal 4(d) Rule and Does Not Appreciably Reduce the Likelihood of Survival and Recovery of Snake River Spring/Summer-run Chinook Salmon Evolutionarily Significant Unit under the Endangered Species Act. May 2012.

NMFS. 2013. Fisheries Economics of the U.S. – 2011. Pacific region – California, Oregon, Washington. NOAA National Marine Fisheries Service, Office of Science and Technology. Available at:
http://www.st.nmfs.noaa.gov/economics/publications/feus/fisheries_economics_2011

NMFS. 2014. Draft Environmental Impact Statement on Two Joint State and Tribal Resource Management Plans for Puget Sound Salmon and Steelhead Hatchery Programs. NMFS West Coast Region, Sustainable Fisheries Division. Lacey, Washington.

NMFS. 2015. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation on Impacts of Programs Administered by the Bureau of Indian Affairs that Support Puget Sound Tribal Salmon Fisheries, Salmon Fishing Activities Authorized by the U.S. Fish and Wildlife Service, and Fisheries Authorized by the U.S. Fraser Panel in 2015. NMFS

Consultation Number: F/WCR-2015-2433. NMFS West Coast Region, Sustainable Fisheries Division. Seattle, Washington.

NMFS. 2016. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation on Impacts of Programs Administered by the Bureau of Indian Affairs that Support Puget Sound Tribal Salmon Fisheries, Salmon Fishing Activities Authorized by the U.S. Fish and Wildlife Service, and Fisheries Authorized by the U.S. Fraser Panel in 2016. NMFS Consultation Number: F/WCR-2016-4418. NMFS West Coast Region, Sustainable Fisheries Division. Seattle, Washington.

Newton, N.J., R.T. Anderson, C.E. Goldberg, J.P. La Velle, J.V. Royster, J.W. Singer, R. Strickland, and B.R. Berger. Cohen's Handbook of Federal Indian Law, 2005 edition. LexisNexis Matthew Bender Publications, San Francisco, California.

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

NWIFC (Northwest Indian Fisheries Commission). 2013. Tribal policy statement for salmon hatcheries in the face of treaty rights at risk. January 13, 2013. Northwest Indian Fisheries Commission. Olympia, Washington. 3p.

O'Neill, S., M. Ylitalo, G., J. West, J. Bolton, C. Sloan, and M. Krahn. 2006. Regional patterns of persistent organic pollutants in five Pacific salmon species (Oncorhynchus spp) and their contributions to contaminant levels in northern and southern resident killer whales (Orcinus orca). 2006 Southern Resident Killer Whale Symposium NOAA Fisheries Service Northwest Regional Office April 3-5, 2006, Seattle Washington.

O'Neill, S. and J. West. 2009. Marine distribution, life history traits, and the accumulation of polychlorinated biphenyls in Chinook Salmon from Puget Sound, Washington. Transactions of the American Fisheries Society 138:616–632, 2009.

PFMC (Pacific Fishery Management Council) 2011. SAFE document - Review of 2011 ocean salmon fisheries. Escapements to inland fisheries and spawning areas. Table B-41 - Puget Sound commercial net fishery catches and spawning escapements in numbers of fish for hatchery and natural Puget Sound Chinook stocks. Accessed March 14, 2013. Available at: http://www.pcouncil.org/salmon/background/document-library/historical-data-of-ocean-salmon-fisheries/

PNPTT (Point No Point Treaty Tribes) and WDFW (Washington Department of Fish and Wildlife. 2014. Summer chum salmon conservation initiative - an implementation plan to recover summer chum salmon in the Hood Canal and Strait of Juan de Fuca region. Supplemental report no. 8 five-year review of the Summer Chum Salmon Conservation Initiative for the period 2005 through 2013. Washington Department of Fish and Wildlife. Olympia, Washington. 249 p.

Pouliquen, H., C. Thorin, J. Haury, M. Larhantec-Verdier, M.L. Morvan, R. Delépée, and H. LeBris. 2008. Comparison of water, sediment and plants for the monitoring of antibiotics: a case study on a river dedicated to fish farming. Environ. Toxicol. Chem. 2008 Nov 3:1

PSIT (Puget Sound Indian Tribes) and WDFW (Washington Department of Fish and Wildlife). 2010. Draft Puget Sound Steelhead Harvest Management Plan. Available from Washington Department of Fish and Wildlife, Olympia, WA. January 7, 2010. 224p.

PSIT and WDFW. 2015. Puget Sound Chinook Harvest Management Plan Update. Available from Washington Department of Fish and Wildlife, Olympia, WA. April 28, 2015. 43p.

Puget Sound Technical Recovery Team (PSTRT) and Shared Strategy Staff Group. 2003. Integrated Recovery Planning for Listed Salmon: Technical Guidance for Watershed Groups in Puget Sound. Draft Feb 3, 2003, 68 p. (available at http://www.nwfsc.noaa.gov/trt/puget_docs/pstrtwatershedguidance.pdf accessed 3 Feb 2016).

Rawson, K., C. Kraemer, and E. Volk. 2001. Estimating the abundance and distribution of locally hatchery-produced Chinook salmon throughout a large river system using thermal mass-marking of otoliths. Pages 31-34 in Hagen, P. and five others, editors. 2001 International Workshop on Salmonid Otolith Marking; March 21, 2001, Seattle, WA. Technical report no. 3. North Pacific Anadromous Fish Commission. Vancouver, BC.

Rawson, K., and M. Crewson. 2016. Snohomish Chinook recovery plan: phases of recovery and integrated adaptive management strategy. Draft - March 7, 2016. Tulalip Tribes Natural Resources Department. Tulalip Tribes, Marysville, Washington.

Ruckelshaus, M. H., K. Currens, R. Fuerstenberg, W. Graeber, K. Rawson, N. Sands, and J. Scott. 2002. Planning ranges and preliminary guidelines for the delisting and recovery of the Puget Sound Chinook salmon Evolutionarily Significant Unit. 19. April 30, 2002 Available at: http://www.nwfsc.noaa.gov/trt/puget_docs/trtpopesu.pdf.

Ruggerone, G.T. and F.A. Goetz. 2004. Survival of Puget Sound chinook salmon (Oncorhynchus tshawytscha) in response to climate-induced competition with pink salmon (Oncorhynchus gorbuscha). Can. J. Fish. Aquat. Sci. 61: 1756–1770.

Salo, E.O. 1991. Life history of chum salmon (Oncorhynchus keta). Pages 231-310 in C. Groot and L. Margolis, editors. Pacific salmon life histories. UBC Press, Univ. British Columbia, Vancouver, British Columbia.

Scheuerell, M. D., and J. G. Williams. 2005. Forecasting climate-induced changes in the survival of Snake River spring/summer Chinook salmon (Oncorhynchus tshawytscha). Fisheries Oceanography. 14(6): 448-457. http://dx.doi.org/10.1111/j.1365-2419.2005.00346.x.

Selecky, M.C., J. Hardy, and G. Palcisko. 2006. Human Health Evaluation of Contaminants in Puget Sound Fish. Division of Environmental Health Office of Environmental Health

Assessments. P.O. Box 47825, Olympia, Washington 98504-7825. Available at: http://www.doh.wa.gov/fish

SSPS (Shared Strategy for Puget Sound). 2005. Snohomish Watershed Profile. WRIA 17. June 2005. In Volume II of the Shared Strategy for Puget Sound. Plan adopted by the National Marine Fisheries Service (NMFS) January 19, 2007. Submitted by the Shared Strategy Development Committee. Shared Strategy for Puget Sound. Seattle, Washington. 12 p.

(SRBSRTC) Snohomish Basin Salmonid Recovery Technical Committee. 1999. Initial Snohomish River basin Chinook salmon conservation/recovery technical work plan. Committee included 31 members and contributing authors. Snohomish County Public Works, Surface Water Management Division. Everett, Washington. 151 p.

SRBSRTC (Snohomish River Basin Salmonid Recovery Technical Committee). 2002. Snohomish River basin Salmonid Habitat Conditions Review. Snohomish County Department of Public Works, Surface Water Management Division. Everett, WA. 174 p.

Snohomish County. 2005. Habitat limiting factors by sub-watershed - WRIA 7 salmonid habitat limiting factors analysis. Snohomish County, Everett, Washington. 288 p.

Snohomish County. 2011. Snohomish County Smith Island restoration project draft environmental impact statement. June 2011. Snohomish County Department of Public Works, Everett, Washington. 112 p.

Sparrow, R.A.H. 1981. Hatchery Effluent Water Quality in British Columbia. Bio-Engineering Symposium for Fish Culture (FCS Publ. 1): pages 162 to 166.

Salmon and Steelhead Habitat Inventory and Assessment Process (SSHIAP) 2012. State of our watersheds report. Northwest Indian Fisheries Commission. Olympia, Washington. Available at: http://nwifc.org/publications/sow/

Stay, A.C. 2012. Treaty tribes and hatcheries. The Water Report – Water Rights, Water Quality and Water Solutions in the West. May 15, 2012. Issue #99: Pages 1-9. Envirotech Publications, Inc. Eugene, Oregon.

Toy, K.A., N.L. Polissar, S. Liao, G.D. Mittelstaedt. 1996. A fish consumption survey of the Tulalip and Squaxin Island tribes of Puget Sound. Tulalip Tribes Department of the Environment, 7615 Totem Bay Road, Marysville, Washington.

Treaty Indian Tribes of Western Washington. 2011. Treaty rights at risk: Ongoing habitat loss, the decline of the salmon resource, and recommendations for change. July 14, 2011. http://nwifc.org/downloads/whitepaper628finalpdf.pdf (accessed 1 Oct 2012)

Tulalip. 2012. Bernie Kai-Kai Gobin Salmon Hatchery "Tulalip Hatchery" Subyearling Summer Chinook Salmon. Hatchery and Genetic Management Plan. December 20, 2012. Tulalip Tribes. Marysville, Washington.

Tulalip. 2013a. Tulalip Bay Hatchery Coho Salmon. Hatchery and Genetic Management Plan. May 29, 2013. Tulalip Tribes. Marysville, Washington. Tulalip Tribes. Marysville, Washington.

Tulalip. 2013b. Tulalip Bay Hatchery Chum Salmon. Hatchery and Genetic Management Plan. April 10, 2013. Tulalip Tribes. Marysville, Washington. Tulalip Tribes. Marysville, Washington.

USCB (United States Census Bureau). 2000. Profile of General Demographic Characteristics: 2000. Census 2000 American Indian and Alaska Native Summary File (AIANSF). Available at: http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk (accessed May 31, 2016).

USCB (United States Census Bureau). 2012. Online State and County QuickFacts. 2011 Census Data. Available at http://quickfacts.census.gov/qfd/index.html (accessed March 11, 2013)

United States v. Washington. 1974. 384 F. Supp 312 (W.D. Wash.), aff'd, 500F.2nd 676 (9thCr. 1975, cert. denied), 423 U.S. 1086 (1976), Seattle, Washington.

USGCRP (U.S. Global Change Research Program). 2009. U.S. Department of Interior (DOI), National Marine Fisheries Service, and Lower Elwha Klallam Tribe. Global Climate Change Impacts in the United States. Cambridge University Press, New York. globalchange.gov/publications/reports/scientific-assessments/us-impacts

USFWS (U.S Fish and Wildlife Service). 2012. Listed and Proposed Endangered and Threatened Species and Critical Habitat; Candidate Species; and Species of Concern in Snohomish County. March 15, 2012.

WDOE (Washington Department of Ecology). 1989. Quality and Fate of Fish Hatchery Effluents during the Summer Low Flow Season. Publication No. 89-17. Prepared by Will Kendra, Washington Department of Ecology, Environmental Investigations and Laboratory Services Program, Surface Water Investigations Section, Mail Stop PV-11, Olympia, Washington 98504. May 1989.

WDOE (Washington Department of Ecology). 2008. Water Quality Assessment 305(b) Report and 303(d) List. Available at http://www.ecy.wa.gov/programs/wq/303d/2008/index.html (accessed March 4, 2012).

WDOE (Washington Department of Ecology). 2012a. Accessed on March 4, 2012 on WDOE website at https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?wria=20.

WDOE (Washington Department of Ecology). 2012b. Online well log viewer. Available at http://apps.ecy.wa.gov/welllog/ (accessed August 14, 2012).

WDOE (Washington Department of Ecology). 2013. Fish consumption rates - Technical support document. A review of data and information about fish consumption in Washington. Version 2.0 Final, January 2013. Publication No. 12-09-058. Available on WDOE website at:

www.ecy.wa.gov/biblio/1209058.html

WDFW (Washington Department of Fish and Wildlife). 2013a. Wallace River Hatchery Summer Chinook Salmon. Hatchery and Genetic Management Plan. February 11, 2013. Fish Program. Washington Department of Fish and Wildlife. Olympia, WA.

WDFW (Washington Department of Fish and Wildlife). 2013b. Wallace River Hatchery Coho Salmon. Hatchery and Genetic Management Plan. Updated September 16, 2016. Fish Program. Washington Department of Fish and Wildlife. Olympia, WA.

WDFW (Washington Department of Fish and Wildlife). 2013c. Everett Bay Net-Pen Coho Salmon. June 27, 2013. Fish Program. Washington Department of Fish and Wildlife. Olympia, WA.

WDFW (Washington Dept. Fish and Wildlife) and WWTIT (Western Washington Treaty Indian Tribes). 1993. 1992 Washington State Salmon and Steelhead Stock Inventory. Appendices. Olympia, Washington.

WDFW (Washington Dept. Fish and Wildlife) and WWTT (Western Washington Treaty Tribes). 1997. Wild Salmonid Policy. Adopted by Washington Fish and Wildlife Commission, Olympia, Washington.

Washington Department of Fish and Wildlife (SaSI). 2002. 2002 Washington State Salmon and Steelhead Stock Inventory (SASSI). Wash. Dept. Fish and Wildlife. Available on-line at: http://wdfw.wa.gov/fish/sasi/index.htm. Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, Washington 98501- 1091.

WDFW (Washington Dept. Fish and Wildlife) and PSIT (Puget Sound Indian Tribes). 2016. 2014/2015 Puget Sound Steelhead Harvest Management Plan Report. Chris James (Northwest Indian Fisheries Commission) and Robert Leland (Washington Department of Fish and Wildlife (Eds). March 2016. 10p.

WFWC (Washington Fish and Wildlife Commission). 2009. Hatchery and Fishery Reform Policy (POL C3619). Effective November 6, 2009.

WHO (World Health Organization). 1999. Food Safety Issues Associated with Products from Aquaculture. Report of a Joint FAO/NACA/WHO Study Group. World Health Organization (WHO) Technical Report Series 883. 55.

Williams, R. W., R.M. Laramie, and J. J. Ames. 1975. A catalog of Washington streams and salmon utilization. Volume 1. Puget Sound Region. . Wash. Dept. Fish. (Available from Washington Dept. of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501-1091).

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

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## Appendix A

## Puget Sound Hatchery Programs and Facilities

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Table A-1. Chinook salmon hatchery programs and facilities.

| Salmon species | Chinook salmon major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chinook salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chinook | Georgia Strait | Nooksack | **Skookum Creek Hatchery (January 2006)** | SF Nooksack | Spring | Integrated Recovery | Conservation | Lummi Indian Nation | Subyearling/May | 200,000 | 200,000 | 200,000 | Skookum Creek Hatchery | SF Nooksack RM 14.3 |
| Chinook | Georgia Strait | Nooksack | **Kendall Creek Hatchery spring Chinook (2005) (August 2005)** | NF Nooksack | Spring | Integrated Recovery | Conservation | WDFW | Subyearling/May | 750,000 | 750,000 | 750,000 | Kendall Creek Hatchery | NF Nooksack RM 46; NF Nooksack at confluence with Deadhorse Creek RM 63.5; NF Nooksack at Excelsior Campground RM 65; NF Nooksack RM 55 on Canyon |
| Chinook | Georgia Strait | Nooksack | Lummi Bay Hatchery summer/fall Chinook (November 2000) | Green R. lineage (out-of-ESU) | Summer/fall | Isolated harvest | Harvest augmentation | Lummi Indian Nation | Subyearling/May | 2,000,000 | 1,500,000 | 2,000,000 | Lummi Bay Hatchery | Lummi Bay; Nooksack River RM 1.5 |
| Chinook | Georgia Strait | Nooksack | Samish Hatchery fall Chinook subyearling (August 2005) | Green R. lineage (out-of-ESU) | Summer/fall | Isolated harvest | Harvest augmentation | WDFW | Subyearling/May-June | 4,000,000 | 4,000,000 | 4,000,000 | Samish Hatchery | Samish River RM 10.5 |
| Chinook | Georgia Strait | Nooksack | Samish Hatchery fall Chinook yearling (August 2005) | Green R. lineage (out-of-ESU) | Summer/fall | Isolated harvest | Harvest augmentation | WDFW | Yearling/March | 100,000 | 100,000 | 100,000 | Samish Hatchery | Samish River RM 10.5 |
| Chinook | Georgia Strait | San Juan Islands (Orcas) | Glenwood Springs Hatchery (August 2005) | Green R. lineage (out-of-ESU) | Summer/fall | Isolated harvest | Harvest augmentation | Long Live The Kings | Subyearling/July | 300,000 | 300,000 | 300,000 | Glenwood Springs Hatchery | Eastsound, Orcas Island (One HGMP) |
| | | | | Green R. lineage (out-of-ESU) | Summer/fall | Isolated harvest | Harvest augmentation | Long Live The Kings | Yearling - April | 250,000 | 250,000 | 250,000 | Glenwood Springs Hatchery | Eastsound, Orcas Island |
| Chinook | Whidbey Basin | Skagit | **Marblemount fall chinook (August 2005)** | Lower Skagit | Fall | Integrated research | Indicator stock | WDFW | Subyearling/June | 222,000 | 222,000 | 222,000 | Marblemount Hatchery | Baker River RM 1 |
| Chinook | Whidbey Basin | Skagit | **Marblemount spring chinook subyearling (August 2005)** | Cascade | Spring | Isolated harvest | Indicator stock/Harvest augmentation | WDFW | Subyearling/June | 250,000 | 250,000 | 250,000 | Marblemount Hatchery | Cascade River, tributary to the Skagit River at RM 78.5 |
| Chinook | Whidbey Basin | Skagit | **Marblemount spring chinook yearling (August 2005)** | Cascade | Spring | Isolated harvest | Indicator stock/Harvest augmentation | WDFW | Yearling/April | 150,000 | 150,000 | 150,000 | Marblemount Hatchery | Cascade River, tributary to the Skagit River at RM 78.5 |
| Chinook | Whidbey Basin | Skagit | **Marblemount summer chinook (August 2005)** | Upper Skagit | Summer | Integrated research | Indiactor stock | WDFW | Subyearling/May | 200,000 | 200,000 | 200,000 | Marblemount Hatchery | Skagit River mainstem RM 91 |
| Chinook | Whidbey Basin | Stillaguamish | **Harvey Creek Hatchery NF Stillaguamish summer Chinook (March 2003)** | NF Stillaguamish | Summer | Integrated Recovery | Conservation | Stillaguamish Tribe | Subyearling/May | 45,000 | 45,000 | 45,000 | Harvey Creek Hatchery | Transferred to Whitehorse Springs Hatchery - Joint program w/WDFW. Captive brood |
| Chinook | Whidbey Basin | Stillaguamish | **Whitehorse Pond summer Chinook (August 2005)** | NF Stillaguamish | Summer | Integrated Recovery | Conservation | WDFW | Subyearling/May | 200,000 | 200,000 | 420,000 | Whitehorse Pond | Whitehorse Spring Ck (RM 1.5); trib to NF Stilly at RM 28 |
| Chinook | Whidbey Basin | Stillaguamish | **South Fork Stillaguamish Chinook natural stock restoration program (August 2007)** | SF Stillaguamish | Fall | Integrated Recovery | Conservation | Stillaguamish Tribe | Subyearling/May | 45,000 | 45,000 | 45,000 | Harvey Creek Hatchery | Brenner Hatchery, SF Stillaguamish River RM 31.0 |

Table A-1. Chinook salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chinook salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chinook | Whidbey Basin | Snohomish | Bernie Kai-Kai Gobin Salmon Hatchery, Tulalip spring Chinook program (March 2004) | Cascade | Spring | Isolated harvest | Harvest augmentation | Tulalip Tribes | Yearling/March | 0 | 0 | 0 | Bernie Kai-Kai Gobin Salmon Hatchery | Tulalip Bay, Port Susan |
| Chinook | Whidbey Basin | Snohomish | **Bernie Kai-Kai Gobin Salmon Hatchery, Tulalip summer/fall Chinook program (July 2005)** | Skykomish | Summer/ Fall | Integrated harvest | Harvest augmentation | Tulalip Tribes | Subyearling/May | 1,700,000 | 1,700,000 | 1,700,000 | Bernie Kai-Kai Gobin Salmon Hatchery | Tulalip Bay, Port Susan |
| Chinook | Whidbey Basin | Snohomish | **Wallace River fingerling summer Chinook salmon (August 2005)** | Skykomish | Summer | Integrated harvest | Harvest augmentation | WDFW | Subyearling/June | 1,000,000 | 500,000 | 1,000,000 | Wallace River Hatchery | Wallace River RM 4.0, tributary to Skykomish River at RM 36 |
| Chinook | Whidbey Basin | Snohomish | **Wallace River yearling Summer Chinook salmon (August 2005)** | Skykomish | Summer | Integrated harvest | Harvest augmentation | WDFW | Yearling/April | 250,000 | 125,000 | 500,000 | Wallace River Hatchery | Wallace River RM 4.0, tributary to Skykomish River at RM 36 |
| Chinook | Central/South Sound | Lake Washington | **Issaquah Fall Chinook Salmon (August 2005)** | Sammamish | Fall | Integrated harvest | Harvest augmentation | WDFW | Subyearling/May | 2,000,000 | 2,000,000 | 2,000,000 | Issaquah Hatchery | Issaquah Creek RM 3.0, tributary to Lake Sammamish |
| Chinook | Central/South Sound | Lake Washington | Portage Bay Hatchery Chinook salmon (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated research | Research | University of Washington | Subyearling/May | 180,000 | 180,000 | 180,000 | Portage Bay Hatchery | Portage Bay, Ship Canal, Lake Washington/Union |
| Chinook | Central/South Sound | Kitsap Peninsula | Grovers Creek Hatchery and satellite rearing ponds (July 2000) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest augmentation | Suquamish Tribe | Subyearling/May-June | 2,800,000 | 2,800,000 | 2,800,000 | Grovers Creek Hatchery/Gorst Creek Rearing Ponds | Grovers Creek (500K); Websters Creek (150K); Clear Creek Rearing pond (50K); Gorst Creek Rearing Ponds (2,100K) |
| | | | | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest augmentation | Suquamish Tribe | Yearling/March | 150,000 | 150,000 | 150,000 | Gorst Creek Rearing Ponds, Websters Pond | Websters Creek (50k/yr) and Gorst Creek Rearing Ponds (150K/yr) (Sinclair Inlet) |
| Chinook | Central/South Sound | Duwamish/Green | **Soos Creek fall Chinook fingerling program (August 2005)** | Green | Fall | Integrated harvest | Harvest augmentation | WDFW | Subyearling/June | 3,200,000 | 1,600,000 | 3,200,000 | Soos Creek Hatchery | Soos Creek RM 0.8, tributary to the Green River at RM 33 |
| Chinook | Central/South Sound | Duwamish/Green | **Soos Creek/Icy Creek fall Chinook yearling program (August 2005)** | Green | Fall | Integrated harvest | Harvest augmentation | WDFW | Yearling/April | 300,000 | 150,000 | 300,000 | Soos Creek Hatchery/Icy Creek Hatchery | Icy Creek, tributary to the Green River at RM 48.3 |
| Chinook | Central/South Sound | Duwamish/Green | **Keta Creek fall Chinook (May 2003)** | Green | Fall | Integrated harvest | Harvest augmentation/research | Muckleshoot Tribe | Subyearling/March | 600,000 | 300,000 | 600,000 | Keta Creek Hatchery | Upper Green River tribs above Howard Hanson Dam (RM 60.5) |
| Chinook | Central/South Sound | Puyallup | **Voights Creek fall Chinook fingerling program (August 2005)** | Puyallup | Fall | Integrated harvest | Harvest augmentation | WDFW | Subyearling/June | 1,600,000 | 800,000 | 1,600,000 | Voights Creek Hatchery | Voights Creek (RM .5), trib to Carbon River at RM 4.0, trib to Puyallup River at RM 17.8 |
| Chinook | Central/South Sound | Puyallup | **Clarks Creek (Diru) fall Chinook (December 2005)** | Puyallup | Fall | Integrated harvest | Harvest augmentation | Puyallup Tribe | Subyearling/late April-June | 400,000 | 200,000 | 1,000,000 | Clarks Creek Hatchery | Upper Puyallup River watershed (RM 31-49 - includes Mowich R., Meadow, Deer, Rushingwater Creeks); Diru Creek (trib to Puyallup RM 5.7) acclimation sites |

Table A-1. Chinook salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chinook salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chinook | Central/South Sound | White | **White River spring Chinook (May 2003)** | White | Spring | Integrated Recovery | Conservation | Muckleshoot Tribe | Subyearling/June | 260,000 | 260,000 | 260,000 | White River Hatchery | White River RM 23.4 |
| | | | | White | Spring | Integrated Recovery | Conservation | Muckleshoot Tribe | Yearling/April | 90,000 | 90,000 | 90,000 | White River Hatchery | White River RM 23.4 |
| Chinook | Central/South Sound | White | **Puyallup White River acclimation sites (August 2002)** | White | Spring | Integrated Recovery | Conservation | Puyalup Tribe | Subyearling/June | 840,000 | 840,000 | 840,000 | White River Acclimation Ponds | Clearwater R (trib to White River at RM 35.3), Huckleberry Creek (trib at RM 53.1), Cripple Creek (trib to W Fork White at RM 2) |
| Chinook | Central/South Sound | Carr Inlet/South Sound | **White River spring Chinook - Hupp Springs Hatchery (August 2002)** | White | Spring | Isolated Recovery | Conservation | WDFW | Subyearling/May | 250,000 | 250,000 | 250,000 | Hupp Springs Hatchery | Hupp Springs Hatchery on Minter Creek RM 3.0, tributary to Carr Inlet, South Puget Sound |
| | | | | White | Spring | Isolated Recovery | Conservation | WDFW | Yearling/April | 85,000 | 85,000 | 85,000 | Hupp Springs Hatchery | Hupp Springs Hatchery on Minter Creek RM 3.0, tributary to Carr Inlet, South Puget Sound |
| Chinook | Central/South Sound | Carr Inlet/South Sound | Minter Creek fall Chinook fingerling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Subyearling/May | 1,800,000 | 1,800,000 | 1,800,000 | Minter Creek Hatchery | Minter Creek RM 0.5, tributary to Carr Inlet, South Puget Sound |
| Chinook | Central/South Sound | Chambers Creek, South Puget Sound | Garrison Springs fall Chinook Fingerling Program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Subyearling/April-May | 850,000 | 850,000 | 850,000 | Garrison Springs Hatchery | Chambers Creek RM 0.5 and Lake Steilacoom at RM 5.5 |
| Chinook | Central/South Sound | Chambers Creek, South Puget Sound | Chambers Creek fall Chinook yearling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Yearling/April-May | 200,000 | 200,000 | 2,820,000 | Chambers Creek Hatchery | Chambers Creek RM 0.5 |
| Chinook | Central/South Sound | Nisqually | **Nisqually Hatchery at Clear Creek (July 2000)** | Nisqually | Fall | Isolated harvest | Harvest Augmentation | Nisqually Tribe | Subyearling/May-June | 3,400,000 | 1,700,000 | 3,700,000 | Clear Creek Hatchery | Clear Creek, tributary to Nisqually River at RM 6.3 |
| Chinook | Central/South Sound | Nisqually | **Nisqually Hatchery at Kalama Creek (July 2000)** | Nisqually | Fall | Isolated harvest | Harvest Augmentation | Nisqually Tribe | Subyearling/May-June | 600,000 | 300,000 | 600,000 | Kalama Creek Hatchery | Kalama Creek, tributary to Nisqually River at RM 9.2 |
| Chinook | Central/South Sound | Deschutes | Tumwater Falls Fall Chinook fingerling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Subyearling/April-June | 3,800,000 | 3,800,000 | 5,800,000 | Tumwater Falls Hatchery | Deschutes River RM 0.2 |
| Chinook | Central/South Sound | Deschutes | Tumwater Falls fall Chinook yearling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Yearling/April | 200,000 | 200,000 | 200,000 | Tumwater Falls Hatchery | Percival Cove, mouth of Percival Creek, trib to Capital Lake, Budd Inlet, S Puget Sound |
| Chinook | Hood Canal | Skokomish | **George Adams fall Chinook fingerling program (August 2005)** | Skokomish | Fall | Integrated harvest | Harvest Augmentation | WDFW | Subyearling/May-June | 3,800,000 | 1,900,000 | 3,800,000 | George Adams Hatchery | Purdy Creek RM 1.8, tributary to the Skokomish River ay RM 4.0 |
| Chinook | Hood Canal | Skokomish | **Rick's Pond fall Chinook program (August 2005)** | Skokomish | Fall | Integrated harvest | Harvest Augmentation | WDFW | Yearling/April | 120,000 | 60,000 | 120,000 | George Adams Hatchery | Rick's Pond, spring tributary to the Skokomish River at RM 2.9 |
| Chinook | Hood Canal | Finch Creek, west Hood Canal | Hoodsport fall Chinook fingerling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Subyearling/June | 2,800,000 | 2,800,000 | 2,800,000 | Hoodsport Hatchery | Finch Creek RM 0.0, tributary to west Hood Canal |
| Chinook | Hood Canal | Finch Creek, west Hood Canal | Hoodsport fall Chinook yearling program (August 2005) | Green R. lineage (out-of-ESU) | Fall | Isolated harvest | Harvest Augmentation | WDFW | Yearling/May | 120,000 | 120,000 | 120,000 | Hoodsport Hatchery | Finch Creek RM 0.0, tributary to west Hood Canal |

Table A-1. Chinook salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chinook salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chinook | Hood Canal | Hamma Hamma | **Hamma Hamma fall Chinook fingerling program (August 2005)** | Mid Hood Canal | Fall | Integrated Recovery | Conservation | Long Live The Kings | Subyearling/May-June | 110,000 | 110,000 | 110,000 | Hamma Hamma Hatchery/George Adams Hatchery | John Creek, tributary to the Hamma Hamma River at RM 2.0 |
| Chinook | Strait of Juan de Fuca | Dungeness | **Dungeness Spring Chinook program (August 2005)** | Dungeness | Spring | Integrated Recovery | Conservation | WDFW | Subyearling/May-June | 100,000 | 100,000 | 100,000 | Dungeness and Hurd Creek Hatcheries | Upper Dungeness River & Gray Wolf Acclimation Pond (RM 1.0); Dungeness River RM 10.5 |
| | | | | Dungeness | Spring | Integrated Recovery | Conservation | WDFW | Yearling/April | 100,000 | 100,000 | 100,000 | Dungeness and Hurd Creek Hatcheries | Dungeness River RM 10.5 |
| Chinook | Strait of Juan de Fuca | Elwha | **Elwha River fummer/fall Chinook program (November 2012)** | Elwha | Summer/ Fall | Integrated Recovery | Conservation | WDFW | Subyearling/June | 2,500,000 | 2,500,000 | 2,500,000 | Elwha Channel Hatchery | Elwha River RM 2.9 |
| | | | | Elwha | Summer/ Fall | Integrated Recovery | Conservation | WDFW | Yearling/April | 400,000 | 400,000 | 400,000 | Morse Creek Hatchery | Elwha River RM 2.9 (200K) and Morse Creek (RM 1.0) tributary to eastern SJF |

| | | | |
|---|---|---|---|
| **Totals** | **45,317,000** | **37,182,000** | **51,307,000** |
| Subyearlings | 42,802,000 | 35,002,000 | 45,922,000 |
| Yearlings | 2,515,000 | 2,180,000 | 5,385,000 |

Table A-2. Steelhead hatchery programs and facilities.

| Species | Steelhead major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Steelhead population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Steelhead | Northern Cascades | Nooksack | Kendall Creek Hatchery Winter Steelhead (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augment | WDFW | Yearling/May | 150,000 | 75,000 | 150,000 | Kendall Creek Hatchery | NF Nooksack RM 46. |
| Steelhead | Northern Cascades | Nooksack | Whatcom Creek Hatchery (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 35,000 | 35,000 | 35,000 | Whatcom Creek Hatchery | Samish River RM 10.5 |
| | | | | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | Bellingham Technical College/WDFW | Yearling/May | 5,000 | 5,000 | 10,000 | Whatcom Creek Hatchery | Whatcom Creek RM 0.5 |
| Steelhead | Northern Cascades | Skagit | Barnaby Slough Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 200,000 | 100,000 | 200,000 | Barnaby Slough | Skagit River RM 70.2. |
| Steelhead | Northern Cascades | Skagit | Marblemount Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 334,000 | 167,000 | 364,000 | Marblemount Hatchery | Cascade River, tributary to the Skagit River at RM 78.5 |
| Steelhead | Northern Cascades | Stillaguamish | Whitehorse Pond Summer Steelhead Program (August 2005) | Skamania Hatchery-lineage (out of DPS) | Summer | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 70,000 | 35,000 | 70,000 | Whitehorse Pond | Whitehorse Spring Ck (RM 1.5); trib to NF Stilly at RM 28; Canyon Creek; Red Bridge (RM 55); Silverton (RM 60). |
| Steelhead | Northern Cascades | Stillaguamish | Whitehorse Pond Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 150,000 | 75,000 | 150,000 | Whitehorse Pond | Whitehorse Spring Ck (RM 1.5); trib to NF Stilly at RM 28; Pilchuck Creek; Canyon Creek |
| Steelhead | North Cascades | Snohomish | Reiter Pond Summer Steelhead Program (August 2005) | Skamania Hatchery-lineage (out of DPS) | Summer | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 250,000 | 125,000 | 250,000 | Reiter Ponds | Reiter Pond 140K (RM 45); NF Skykomish @ Index 10K; Sultan R. 20K; Raging R. 50K. |
| Steelhead | Northern Cascades | Snohomish | Reiter Pond Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 250,000 | 125,000 | 250,000 | Reiter Ponds | Reiter Pond at Skykomish River RM 45; NF Skykomish @ Index 10K; Sultan R. 20K; Monroe 20K; Howard Ck.15K; Barr Ck. 15K; Tolt R. 5K; Pilchuck R. 15K. |
| Steelhead | Northern Cascades | Snohomish | Tokul Creek Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 185,000 | 92,500 | 185,000 | Tokul Creek Hatchery | Tokul Creek (RM 0.5), tributary of the Snoqualmie River at RM 39, which is tributary to the Snohomish River at RM 20.5; and Snoqualmie River watershed sites (Duvall, mouth and upriver of Tolt R., Raging River) |
| Steelhead | Northern Cascades | Snohomish | Wallace River Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 20,000 | 10,000 | 20,000 | Wallace Hatchery | Wallace River RM 4.0, tributary to Skykomish at RM 36 |
| Steelhead | Northern Cascades | Green | Palmer Ponds Winter Steelhead Program (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 150,000 | 75,000 | 208,000 | Palmer Ponds | Palmer Ponds at Green River RM at 56.1 |
| | | | | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 20,000 | 10,000 | 20,000 | Icy Creek Hatchery | Icy Creek, tributary to the Green River at RM 48.3 |
| | | | | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 35,000 | 17,500 | 35,000 | Soos Creek Hatchery | Soos Creek RM 0.8, tributary to the Green River at RM 33.5 |
| | | | | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 15,000 | 7,500 | 15,000 | Flaming Geyser (Pond) | Flaming Geyser Park (Green River) at RM 44.3 |

Table A-2. Steelhead hatchery programs and facilities, continued.

| Species | Steelhead major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Steelhead population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Steelhead | Northern Cascades | Green | Palmer Ponds Summer Steelhead Program (August 2005) | Skamania Hatchery-lineage (out of DPS) | Summer | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 30,000 | 15,000 | 30,000 | Palmer Ponds | Palmer Ponds at Green River RM at 56.1 |
| | | | | Skamania Hatchery-lineage (out of DPS) | Summer | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 30,000 | 15,000 | 30,000 | Soos Creek Hatchery | Soos Creek RM 0.8, tributary to the Green River at RM 33.5 |
| | | | | Skamania Hatchery-lineage (out of DPS) | Summer | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 20,000 | 10,000 | 20,000 | Icy Creek Hatchery | Icy Creek, tributary to the Green River at RM 48.3 |
| Steelhead | Northern Cascades | Green | **Green River Wild Stock Winter Steelhead Program (February 2010)** | Green River | Winter | Integrated Recovery | Conservation | WDFW | Yearling/May | 50,000 | 50,000 | 50,000 | Soos Creek Hatchery | Soos Creek RM 0.8, tributary to the Green River at RM 33.5 |
| Steelhead | Central and South Puget Sound | White | **White River Winter Steelhead Supplementation Program (September 2006)** | White River | Winter | Integrated Recovery | Conservation | WDFW, Puyallup Indian Tribe and Muckleshoot Indian Tribe | Yearling/May | 35,000 | 35,000 | 35,000 | Diru Creek Hatchery and White River Hatchery | White River RM 24.3, which is tributary to the Puyallup River at RM 10.1. |
| Steelhead | Central and South Puget Sound | Puyallup | Voights Creek Winter Steelhead (August 2005) | Chambers Ck lineage (out of DPS) | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 200,000 | 100,000 | 200,000 | Voights Creek Hatchery | Voights Creek (RM .5), trib to Carbon River at RM 4.0, trib to Puyallup River at RM 17.8 |
| Steelhead | Hood Canal and Strait of Juan de Fuca | Skokomish | **Hood Canal Steelhead Supplementation Project (October 2009)** | Skokomish River | Winter | Integrated Recovery | Conservation | WDFW and Long Live the Kings | Yearlings - April-May; Adults - March 1 | 34,900 | 34,900 | 34,900 | McKernan Hatchery | South Fork Skokomish River |
| | | Dewatto | | Eastside Hood Canal Tributaries | Winter | Integrated Recovery | Conservation | WDFW and Long Live the Kings | Yearlings - April-May; Adults - March 1 | 7,653 | 7,653 | 7,653 | LLTK Lilliwaup Hatchery | Dewatto River |
| | | Duckabush | | Westside Hood Canal Tributaries | Winter | Integrated Recovery | Conservation | WDFW and Long Live the Kings | Yearlings - April-May; Adults - March 1 | 6,897 | 6,897 | 6,897 | LLTK Lilliwaup Hatchery | Duckabush River |
| Steelhead | Hood Canal and Strait of Juan de Fuca | Dungeness | Dungeness Winter Steelhead Program (August 2005) | Dungeness River | Winter | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 10,000 | 5,000 | 10,000 | Dungeness Hatchery | Dungeness River RM 10.5 |
| Steelhead | Hood Canal and Strait of Juan de Fuca | Elwha | **Lower Elwha Fish Hatchery (August 2012)** | Elwha River | Winter | Integrated Recovery | Conservation | Lower Elwha Klallam Tribe | Yearling/May | 175,000 | 175,000 | 175,000 | Lower Elwha Hatchery | Elwha River RM 0.3 |
| | | | | | | | | | **Totals** | **2,468,450** | **1,408,950** | **2,561,450** | | |

Table A-3. Coho salmon hatchery programs and facilities.

| Salmon species | Chinook salmon major population group (Coho salmon MPGs have not been determined) | Watershed | Hatchery program name and HGMP date (in parenthesis) | Coho salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Coho | Strait of Georgia | Nooksack | Kendall Creek Coho Program (March 2003) | Nooksack | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 300,000 | 150,000 | 300,000 | Kendall Creek Hatchery | NF Nooksack RM 46. |
| Coho | Strait of Georgia | Nooksack | Lummi Nation Coho Salmon (March 2003) | Nooksack | Normal-timed | Isolated harvest | Harvest augmentation | Lummi Indian Nation | Yearling/May | 1,000,000 | 500,000 | 2,000,000 | Skookum Creek Hatchery | SF Nooksack RM 14.3 |
| | | | | Nooksack | Normal-timed | Isolated harvest | Harvest augmentation | Lummi Indian Nation | Yearling/May | 1,000,000 | 500,000 | 2,000,000 | Lummi Bay Hatchery | Lummi Bay, north Puget Sound |
| Coho | Strait of Georgia | Nooksack | Squalicum Harbor Coho Net Pen (March 2003) | Nooksack | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/April | 5,000 | 5,000 | 5,000 | Kendall Creek Hatchery | Bellingham Bay, north Puget Sound |
| Coho | Strait of Georgia | San Juan Islands | San Juan (Roche Harbor) Net Pen Coho Program (March 2003) | Skagit (Cascade) River | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/June | 15,000 | 15,000 | 15,000 | Marblemount Hatchery | Roche Harbor, northern San Juan Island |
| Coho | Strait of Georgia | San Juan Islands | Glenwood Springs Coho (March 2003) | Nooksack-lineage | Normal-timed | Isolated harvest | Harvest augmentation | Long Live the Kings | Fry/April | 10,000 | 10,000 | 10,000 | Glenwood Springs Hatchery | Westsound, Orcas island |
| | | | | Nooksack-lineage | Normal-timed | Isolated harvest | Harvest augmentation | LLTK | Yearling/April | 100,000 | 100,000 | 100,000 | Glenwood Springs Hatchery | Eastsound, Orcas island |
| Coho | Whidbey Basin | Skagit | Marblemount Coho Program (March 2003) | Skagit (Cascade) River | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/June | 250,000 | 125,000 | 250,000 | Marblemount Hatchery | Cascade River Rm 1.0, tributary to the Skagit River at RM 78.5 |
| | | | | Skagit (Cascade) River | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 100,000 | 50,000 | 100,000 | Marblemount Hatchery | Indian Slough, Padilla Bay, northern Puget Sound |
| Coho | Whidbey Basin | Skagit | Baker Lake Coho (March 2003) | Skagit (Baker) | Normal-timed | Integrated Harvest | Harvest augmentation | WDFW | Fry/April-May | 120,000 | 60,000 | 310,000 | Baker Trout Pond complex | Sulphur Creek Facility, trib to Lake Shannon at Baker River RM 9.0 |
| | | | | Skagit (Baker) | Normal-timed | Isolated Harvest | Harvest augmentation | WDFW | Yearling/May-June | 60,000 | 30,000 | 60,000 | Baker Trout Pond complex | Baker Lake, Lake Shannon and mouth of Baker River (RM 1.0), tributary to the Skagit River |
| Coho | Whidbey Basin | Skagit | Oak Harbor Net Pen Coho Program (March 2003) | Skagit | Normal-timed | Isolated Harvest | Harvest augmentation | WDFW | Yearling/June | 30,000 | 30,000 | 30,000 | Marblemount Hatchery | Oak Harbor Marine, Oak Harbor, Saratoga Passage |
| Coho | Whidbey Basin | Stillaguamish | Stillaguamish Coho Program (March 2004) | Stillaguamish | Normal-timed | Integrated harvest/recovery | Harvest augmentation/conservation | Stillaguamish Tribe | Yearling/May-June | 54,000 | 27,000 | 54,000 | Harvey Creek Hatchery/North Fork/Johnson Creek Hatchery | Harvey Creek Hatchery RM 2.0 on Harvey/Armstrong Creek, trib to the Stillaguamish River at RM 15.3 |
| Coho | Whidbey Basin | Snohomish | Tulalip Coho Program (March 2004) | Skykomish | Normal-timed | Integrated Harvest | Harvest augmentation | Tulalip Tribes | Yearling/May-June | 1,000,000 | 1,000,000 | 1,000,000 | Tulalip Salmon Hatchery, Bernie Kai-Kai Gobin Salmon Hatchery, Wallace River Hatchery | Tulalip Creek and Tulalip Bay, Port Susan |
| Coho | Whidbey Basin | Snohomish | Wallace River Coho Program (March 2003) | Skykomish | Normal-timed | Integrated Harvest | Harvest augmentation | WDFW | Yearling/May | 150,000 | 75,000 | 300,000 | Wallace River Hatchery | Wallace River RM 4.0, tributary to Skykomish River at RM 36 |
| Coho | Whidbey Basin | Snohomish | Mukilteo Net Pen Coho Program (March 2003) | Skykomish | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/June | 20,000 | 20,000 | 20,000 | Wallace River Hatchery | Mouth of the Snohomish River (RM 0, Port Gardner Bay) |

Table A-3. Coho salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group (Coho salmon MPGs have not been determined) | Watershed | Hatchery program name and HGMP date (in parenthesis) | Coho salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Coho | Whidbey Basin | Snohomish | Possession Point Coho Program (March 2003) | Skykomish | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/May | 50,000 | 50,000 | 50,000 | Wallace River Hatchery | Possession Point, mouth of Everett Bay, Puget Sound |
| Coho | Central/South Sound | Lake Washington | Laebugton Net Pen Coho Program (March 2003) | Issaquah Creek (x Green River) | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/June | 25,000 | 25,000 | 25,000 | Issaquah Creek Hatchery | Port of Edmonds, Public Fishing Pier |
| Coho | Central/South Sound | Lake Washington | Issaquah Coho Program (March 2003) | Issaquah Creek (x Green River) | Normal-timed | Integrated Harvest | Harvest augmentation | WDFW | Yearling/April | 450,000 | 450,000 | 450,000 | Issaquah Creek Hatchery | Issaquah Creek RM 3.0, tributary to Lake Sammamish |
| Coho | Central/South Sound | Lake Washington | Portage Bay (UW) Coho Program (March 2003) | Lake Washington | Selected | Isolated harvest/research | Harvest augmentation/ Research | UW | Yearling (accelerated subyearling) | 90,000 | 90,000 | 90,000 | Portage Bay Hatchery | Portage Bay, Ship Canal, Lake Union |
| Coho | Central/South Sound | Lake Washington | Ballard Net Pen Coho Program (August 2005) | Issaquah Creek (x Green River) | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearlings/June | 30,000 | 30,000 | 30,000 | Issaquah Creek Hatchery | Ray's Boathouse Restaurant (Ballard), central Puget Sound |
| Coho | Central/South Sound | Green | Soos Creek Coho Program (March 2003) | Green | Normal-timed | Integrated Harvest | Harvest augmentation | WDFW | Yearling/May | 600,000 | 300,000 | 600,000 | Soos Creek Hatchery | Soos Creek RM 0.8, tributary to the Green River at RM 33.5 |
| Coho | Central/South Sound | Green | Crisp Creek Ponds - On-station (October 2004) | Green | Normal-timed | Integrated Harvest | Harvest augmentation | Muckleshoot Indian Tribe | Yearling/May | 200,000 | 100,000 | 300,000 | Crisp Creek Rearing Ponds | Crisp Creek RM 1.1, tributary to the Green River at RM 40.1 |
| Coho | Central/South Sound | Green | Elliot Bay Netpens (October 2004) | Green | Normal-timed | Integrated Harvest | Harvest augmentation | Muckleshoot Indian Tribe/Suquamish Tribe | Yearling/June | 395,000 | 395,000 | 395,000 | Soos Creek Hatchery | northeastern Elliot Bay, central Puget Sound |
| Coho | Central/South Sound | Green | Marine Technology Center Coho Program (March 2003) | Green | Normal-timed | Isolated harvest | Education | WDFW | Fry/April | 15,000 | 15,000 | 15,000 | Soos Creek Hatchery | Sehurst Park (on Puget Sound) in Burien, Washington |
| | | | | Green | Normal-timed | Isolated harvest | Education | WDFW | Yearling/May | 10,000 | 10,000 | 10,000 | Soos Creek Hatchery | Sehurst Park (on Puget Sound) in Burien, Washington |
| Coho | Central/South Sound | Green | Des Moines Net Pen Coho Program (March 2003) | Green | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearlings/June | 30,000 | 30,000 | 30,000 | Soos Creek Hatchery | Des Moines Marina, central Puget Sound |
| Coho | Central/South Sound | Green | Agate Pass Seapens (March 2003) | Minter Creek | Normal-timed | Isolated harvest | Harvest augmentation | Suquamish Tribe | Yearlings/June | 600,000 | 600,000 | 600,000 | Agate Pass Netpens, Minter Creek Hatchery | Agate pass, Port Madison, central Puget Sound |
| Coho | Central/South Sound | Puyallup | Voights Creek Coho Program (March 2003) | Puyallup (Voights Creek Hatchery) | Normal-timed | Integrated harvest | Harvest augmentation | WDFW | Yearlings/April, May | 780,000 | 390,000 | 1,180,000 | Voights Creek Hatchery | Voights Creek (RM .5), trib to Carbon River at RM 4.0, trib to Puyallup River at RM 17.8 |
| Coho | Central/South Sound | Puyallup | Puyallup Tribes' Puyallup Acclimation Sites (March 2003) | Puyallup (Voights Creek Hatchery) | Normal-timed | Integrated recovery | Restoration | Puyallup Tribe | Yearlings/April-May | 200,000 | 200,000 | 200,000 | Voights Creek Hatchery and 3 acclimation ponds above Electron Dam | Rushingwater Acclimation Pond, RM 0.5 on Rushingwater Creek, trib to Mowich River at RM 1.1; Mowich River Acclimation Pond, RM 0.2 on Mowich River; Cowskull Creek Acclimation Pond, |
| Coho | Central/South Sound | Carr Inlet | Minter Creek Coho (March 2003) | Minter Creek | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearlings/May-July | 1,044,000 | 1,040,000 | 1,040,000 | Minter Creek Hatchery | Minter Creek RM 0.5, tributary to northern Carr Inlet in south Puget Sound |
| Coho | Central/South Sound | Nisqually | Kalama Creek Hatchery Fall Coho (April 2003) | Central/South Sound mix | Normal-timed | Isolated harvest | Harvest augmentation | Nisqually Tribe | Yearling/April | 350,000 | 175,000 | 350,000 | Kalama Creek Hatchery | Kalama Creek, tributary to Nisqually River at RM 9.2 |

Table A-3. Coho salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group (Coho salmon MPGs have not been determined) | Watershed | Hatchery program name and HGMP date (in parenthesis) | Coho salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Coho | Central/South Sound | Nisqually | Clear Creek Hatchery Fall Coho (April 2003) | Central/South Sound mix | Normal-timed | Isolated harvest | Harvest augmentation | Nisqually Tribe | Yearlings/April | 630,000 | 315,000 | 630,000 | Clear Creek Hatchery | Clear Creek, tributary to Nisqually River at RM 6.3 |
| Coho | Central/South Sound | South Puget Sound | Squaxin Island / South Sound Net Pens (March 2003) | Central/South Sound mix | Normal-timed | Isolated harvest | Harvest augmentation | Squaxin Island Tribes and WDFW | Yearlings/May-June | 2,600,000 | 2,600,000 | 3,200,000 | South Sound Net-pens, | Peale Passage, deep South Puget Sound |
| Coho | Hood Canal | Skokomish | George Adams Coho Yearling Program (March 2003) | Mixed Puget Sound, localized to Skokomish River | Normal-timed | Isolated harvest | Harvest augmentation | WDFW | Yearlings/post April-15 | 300,000 | 150,000 | 300,000 | George Adams Hatchery | |
| Coho | Hood Canal | Port Gamble Bay/Little Boston Creek | Port Gamble Coho Net Pens (March 2003) | Big Quilcene River | Early-timed | Isolated harvest | Harvest augmentation | Port Gamble S'Klallam Tribe/USFWS | Yearlings/April-May | 400,000 | 400,000 | 600,000 | Quilcene NFH, Port Gamble Net pens | Port Gamble Bay, northern Hood Canal |
| Coho | Hood Canal | Quilcene | Quilcene Coho Net Pen (March 2003) | Big Quilcene River | Early-timed | Isolated harvest | Harvest augmentation | Skokomish Tribe and USFWS | Yearlings/April-May | 200,000 | 200,000 | 450,000 | Quilcene NFH, Quilcene Bay Net pens | Quilcene Bay, northwestern Hood Canal |
| Coho | Hood Canal | Big Quilcene River | Quilcene National Fish Hatchery Coho Salmon Production Program (June 2010) | Big Quilcene River | Early-timed | Isolated harvest | Harvest augmentation | USFWS | Yearlings/April-May | 400,000 | 400,000 | 400,000 | Quilcene NFH | Big Quilcene River RM 2.8 |
| Coho | Strait of Juan de Fuca | Discovery Bay | Snow Creek Coho - Supplementation (August 2005) | Snow Creek | Normal-timed | Integrated recovery | Restoration | WDFW | Unfed fry/March-May | 36,000 | 36,000 | 36,000 | Snow/Andrews Creek remote incubator sites; Hurd Creek Hatchery | Snow Creek RM 4.0; Andrews Creek RM 1.5, trib to Snow Creek |
| | | | | Snow Creek | Normal-timed | Integrated recovery | Restoration | WDFW | Subyearling/November | 9,000 | 9,000 | 9,000 | Hurd Creek Hatchery | Crocker Lake, Snow Creek watershed |
| | | | | Snow Creek | Normal-timed | Integrated recovery | Restoration | WDFW | Yearlings/February | 9,000 | 9,000 | 9,000 | Hurd Creek Hatchery | Crocker Lake, Snow Creek watershed |
| Coho | Strait of Juan de Fuca | Dungeness | Dungeness River Coho (March 2003) | Dungeness-mixed origin | Early-timed | Isolated harvest | Harvest augmentation | WDFW | Yearling/June | 500,000 | 250,000 | 500,000 | Dungeness Hatchery and Hurd Creek Hatchery | Dungeness River RM 10.5 |
| Coho | Strait of Juan de Fuca | Elwha | Lower Elwha Fish Hatchery (August 2012) | Elwha | Normal-timed | Integrated Harvest | Harvest augmentation | Lower Elwha Klallam Tribe | Yearling/May | 425,000 | 425,000 | 425,000 | Lower Elwha Hatchery | Elwha River RM 0.3 |

Table A-3. Coho salmon hatchery programs and facilities, continued.

| Salmon species | Chinook salmon major population group (Coho salmon MPGs have not been determined) | Watershed | Hatchery program name and HGMP date (in parenthesis) | Coho salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| | | | | | | | | | **Totals** | **14,592,000** | **11,391,000** | **18,478,000** | | |
| | | | | | | | | | Yearling | 14,102,000 | 11,111,000 | 17,798,000 | | |
| | | | | | | | | | Subyearling | 9,000 | 9,000 | 9,000 | | |
| | | | | | | | | | Fry | 181,000 | 121,000 | 371,000 | | |

Table A-4. Fall-run chum salmon and summer-run chum salmon hatchery programs and facilities.

| Salmon species | Major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chum salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Strait of Georgia | Nooksack | Whatcom Creek Chum Program (August 2005) | Nooksack | Fall | Isolated Harvest | Education/Harvest Augmenetation | Bellingham Technical College/WDFW | Fed fry/May | 2,000,000 | 2,000,000 | 4,000,000 | Whatcom Creek Hatchery, Kendall Creek Hatchery | Whatcom Creek RM 0.5, tributary to Bellingham Bay |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Whidbey Basin | Skagit | Upper Skagit Hatchery (November 2003) | Skagit | Fall | Integrated harvest/education | Harvest augmentation/education | Upper Skagit Indian Tribe | Fed fry/May | 400,000 | 400,000 | 400,000 | Upper Skagit Hatchery | Red Creek tributary to Skagit River at RM 22.9 |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Whidbey Basin | Stillaguamish | Stillaguamish (Harvey Creek) Chum Program (March 2003) | Stillaguamish | Fall | Integrated education | Education/Harvest Augmenetation | Stillaguamish Tribe | Unfed and fed fry/April-May | 250,000 | 250,000 | 250,000 | Harvey Creek Hatchery | Harvey Creek Hatchery RM 2.0 on Harvey/Armstrong Creek, trib to the Stillaguamish River at RM 15.3 |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Whidbey Basin | Snohomish | Bernie Kai-Kai Gobin Salmon Hatchery Tulalip Chum (March 2004) | Walcott Slough (localized to release site) | Fall | Isolated Harvest | Harvest augmentation | Tulalip Tribes | Fed fry/May | 8,000,000 | 8,000,000 | 12,000,000 | Bernie Kai-Kai Gobin Salmon Hatchery | Battle Creek RM 0.3, Tulalip Bay, Port Susan |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Central/South Sound | Green | Keta Creek Hatchery (October 2004) | East Kitsap (localized) | Fall | Integrated Harvest | Harvest augmentation | Muckleshoot Indian Tribe | Fed fry/April-May | 2,000,000 | 2,000,000 | 2,000,000 | Keta Creek Hatchery | Crisp Creek RM 1.1, tributary to the Green River at RM 40.1 |

Table A-4. Fall-run chum salmon and summer-run chum salmon hatchery programs and facilities, continued.

| Salmon species | Major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chum salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Central/South Sound | East Kitsap | Cowling Creek Hatchery and Satellite Incubation and Rearing Facilities (March 2003) | Chico Creek (East Kitsap) | Fall | Integrated Harvest | Harvest augmentation | Suquamish Tribe | Unfed fry/April | 600,000 | 600,000 | 600,000 | Cowling Creek Hatchery | Dogfish Creek (Liberty Bay), Clear and Barker Creeks (Dyes Inlet), and Steele Creek (Burke Bay); all are East Kitsap tribs |
| Chum | Fall chum MPGs have not been designated. Chinook MPG is Central/South Sound | East Kitsap | | Chico Creek (East Kitsap) | Fall | Integrated Harvest | Harvest augmentation | Suquamish Tribe | Fed fry/May | 1,200,000 | 1,200,000 | 1,200,000 | Cowling Creek Hatchery | Cowling Creek, tributary to Miller bay, East Kitsap |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Central/South Sound | Puyallup | Diru Creek Late Fall Chum (March 2003) | Chambers Creek (localized) | Late Fall | Integrated Harvest | Harvest augmentation | Puyallup Indian Tribe | Fed fry/April-May | 2,000,000 | 2,000,000 | 2,000,000 | Diru Creek Hatchery | Diru Creek RM 0.25, tributary to Clarks Creek, trib to Puyallup River at RM 5.8 |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook salmon MPG is Central/South Sound | Carr Inlet | Minter Creek Chum Program (April 2004) | Elson Creek (Skookum Inlet), localized | Fall | Integrated Harvest | Harvest augmentation | WDFW | Fed fry/April | 2,000,000 | 2,000,000 | 2,000,000 | Minter Creek Hatchery | Minter Creek RM 0.5, tributary to northern Carr Inlet in south Puget Sound |
| Chum | Fall-run chum salmon MPGs have not been designated. Listed summer-run chum salmon population is Hood Canal. Chinook salmon MPG is Hood Canal. | Skokomish | McKernan Fall Chum Program (March 2003) | Finch Creek | Fall | Isolated Harvest | Harvest augmentation | WDFW | Fed fry/April | 10,000,000 | 10,000,000 | 15,000,000 | McKernan Hatchery | Weaver Creek RM 1.0, tributary to the Skokomish River at RM |

Table A-4. Fall-run chum salmon and summer-run chum salmon hatchery programs and facilities, continued.

| Salmon species | Major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chum salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chum | Fall chum MPGs have not been designated. Listed summer chum population is Hood Canal. Chinook salmon MPG is Hood Canal. | Enetai Creek (south Hood Canal) | Skokomish Hatchery Fall Chum (March 2003) | Walcott Slough/Quilcene (localized to release site) | Fall | Isolated Harvest | Harvest augmentation | Skokomish Tribe | Fed fry/April | 2,500,000 | 2,500,000 | 2,500,000 | Enetai Hatchery | Enetai Creek, tributary to south Hood Canal north of the Skokomish River |
| Chum | Fall chum MPGs have not been designated. Area includes listed Hood Canal summer chum population, and the Hood Canal Chinook MPG. | Finch Creek (west Hood Canal) | Hoodsport Fall Chum (March 2003) | Finch Creek | Fall | Isolated Harvest | Harvest augmentation | WDFW | Fed fry/April | 12,000,000 | 12,000,000 | 15,000,000 | Hoodsport Hatchery | Finch Creek, westside tributary to Hood Canal |
| Chum | Hood Canal. No MPGs for summer-run chum salmon | Tahuya River | **Union/Tahuya Summer Chum (June 2000)** | Hood Canal | Summer | Integrated Recovery | Conservation | WDFW and Long Live the Kings | Fry | 352,000 | | | George Adams Hatchery | Tahuya River RM 1.0 |
| Chum | Hood Canal. No MPGs for summer-run chum salmon | Lilliwaup Creek | **Lilliwaup Creek Summer Chum (October 1999)** | Hood Canal | Summer | Integrated Recovery | Conservation | WDFW and LLTK | Fry | 168,000 | | | Lilliwaup Hatchery | Lilliwaup Creek RM 0.5 |
| Chum | Fall-run chum salmon MPGs have not been designated. Area includes the listed Hood Canal summer-run chum salmon population, and the Hood Canal Chinook salmon MPG. | Port Gamble Bay (north Hood Canal) | Port Gamble Hatchery Fall Chum (March 2003) | Walcott Slough (localized to release site) | Fall | Isolated Harvest | Harvest augmentation | Port Gamble S'Klallam Tribe | Fed fry/April-May | 500,000 | 500,000 | 500,000 | Little Boston Hatchery | Little Boston Creek, Port Gamble Bay, north Hood Canal. |

Table A-4. Fall-run chum salmon and summer-run chum salmon hatchery programs and facilities, continued.

| Salmon species | Major population group | Watershed | Hatchery program name, HGMP date (in parenthesis), and listing status (listed or proposed for listing shown in bold) | Chum salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Chum | Fall-run chum salmon MPGs have not been designated. Chinook MPG is Strait of Juan de Fuca | Elwha | Lower Elwha Fish Hatchery (August 2012) | Elwha | Fall | Integrated Recovery | Conservation | Lower Elwha Klallam Tribe | Fed fry/March-April | 1,025,000 | 1,025,000 | 1,025,000 | Lower Elwha Hatchery | Elwha River RM 0.3 |
| | | | | | | | | | **Totals** | **44,995,000** | **44,475,000** | **58,475,000** | | |

Table A-5. Pink salmon hatchery programs and facilities.

| Salmon species | Major population group | Watershed | Hatchery program name and HGMP date (in parenthesis) | Pink salmon population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Pink | Pink salmon MPGs have not been designated. Chinook salmon MPG is Strait of Georgia | Nooksack | Whatcom Creek Pink Program (August 2005) | Nooksack (localized to release site) | Normal | Isolated Harvest | Education/Harvest Augmentation | Bellingham Technical College/WDFW | Fed fry/April | 1,000,000 | 1,000,000 | 1,000,000 | Whatcom Creek Hatchery | Whatcom Creek RM 0.5, tributary to Bellingham Bay |
| Pink | Pink salmon MPGs have not been designated. Chinook salmon MPG is Hood Canal | Finch Creek (western Hood Canal) | Hoodsport Pink Salmon Program (March 2003) | Dungeness/Dosewallips (localized to the release site) | Normal | Isolated Harvest | Harvest Augmentation | WDFW | Fed fry/April | 500,000 | 500,000 | 1,000,000 | Hoodsport Hatchery | Finch Creek, western Hood Canal |
| Pink | Pink salmon MPGs have not been designated. Chinook salmon MPG is Strait of Juan de Fuca | Elwha | Elwha River Pink Salmon Preservation and Restoration Program (August 2012) | Elwha | Normal | Integrated Recovery | Conservation | Lower Elwha Klallam Tribe (and WDFW) | Fed fry/March | 3,000,000 | 3,000,000 | 3,000,000 | Lower Elwha Hatchery | Elwha River, RM 1.3 |
| | | | | | | | | | **Totals** | **4,500,000** | **4,500,000** | **5,000,000** | | |

Table A-6. Sockeye salmon hatchery programs and facilities.

| Watershed | Hatchery program name and HGMP date (in parenthesis) | Population | Species race or run | Hatchery program type | Hatchery program purpose | Hatchery operator | Life stage, time, and number of fish by alternative | | | | Primary facility | Release location(s) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Life stage and time | Alternative 1 and 2 | Alternative 3 | Alternative 4 | | |
| Skagit/Baker | Baker Lake Sockeye Program (March 2003) | Baker River (ESU) | Early Summer | Integrated Harvest | Conservation | WDFW | Fry/February-May | 1,000,000 | 1,000,000 | 1,000,000 | Baker Lake Sockeye Spawning Beach facilities | Baker Lake at various boat launches (from beach #4) and ChannelCreek (from beach #3), a Baker Lake tributary. |
| | | Baker River (ESU) | Early Summer | Integrated Harvest | Conservation | WDFW | Fingerling/June and September | 120,000 | 120,000 | 120,000 | Baker Lake Sockeye Spawning Beach facilities | Baker Lake at various boat launches (from beach #4) and ChannelCreek (from beach #3), a Baker Lake tributary. |
| | | Baker River (ESU) | Early Summer | Integrated Harvest | Conservation | WDFW | Yearling/April | 5,000 | 5,000 | 5,000 | Baker Lake Sockeye Spawning Beach facilities | Baker Lake at various boat launches (from beach #4) and ChannelCreek (from beach #3), a Baker Lake tributary. |
| Lake Washington | Cedar River Sockeye Program (August 2005) | Lake Washington (localized Baker river stock) | Early Summer | Intgrated Harvest | Conservation/Harvest | WDFW | Fry/January-April | 34,000,000 | 34,000,000 | 34,000,000 | Cedar River Hatchery | Cedar River RM 21.7, 2.3, and 0.5 |
| | | | | | | | **Totals** | **35,125,000** | **35,125,000** | **35,125,000** | | |