DRAFT ENVIRONMENTAL ASSESSMENT

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

Dungeness Hatchery and Fish Collection Weir – Post-Flood, 1913
Source: University of Washington Library - Freshwater and Marine Image Bank

Prepared by the
National Marine Fisheries Service, West Coast Region

In Cooperation with the
Bureau of Indian Affairs, Northwest Region

February 2015 Draft

Cover Sheet
Draft Environmental Assessment

Title of Environmental Review:	Environmental Assessment to Analyze Impacts of a NOAA National Marine Fisheries Service Determination that Three Hatchery and Genetic Management Plans for Salmon Submitted by the Washington Department of Fish and Wildlife, with the Jamestown S'Klallam Tribe as the *U.S. v. Washington* fish resource co-manager, Satisfy Limit 6 of the ESA Section 4(d) Rule for Joint State/Tribal Resource Management Plans.
Distinct Population Segments:	Puget Sound Chinook Salmon and Puget Sound Steelhead
Responsible Agency and Official:	Barry Thom Deputy Regional Administrator National Marine Fisheries Service West Coast Region 7600 Sand Point Way N.E., Building 1 Seattle, WA 98115
Contacts:	Tim Tynan Sustainable Fisheries Division National Marine Fisheries Service West Coast Region 1201 NE Lloyd Blvd, Suite 1100 Portland, OR 97232
Legal Mandate:	Endangered Species Act of 1973, as amended and implemented – 50 CFR Part 223
Location of Proposed Activities:	Dungeness River Basin, Washington
Activity Considered:	ESA determination regarding the effects of one Hatchery and Genetic Management Plan (HGMP) for Chinook salmon, one HGMP for coho salmon, and one HGMP for pink salmon 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.

TABLE OF CONTENTS

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION 1

1.1. Background 1

1.2. Description of the Proposed Action 2

1.3. Purpose of and Need for the Action 5

1.4. Action Area 6

1.5. Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders 7

1.5.1. Clean Water Act 7

1.5.2. Bald Eagle and Golden Eagle Protection Act 7

1.5.3. Marine Mammal Protection Act 8

1.5.4. Executive Order 12898 8

1.5.5. Treaties of Point Elliot, Medicine Creek, and Point No Point 8

1.5.6. *U.S. v. Washington* 9

1.5.7. Secretarial Order 3206 9

1.5.8. The Federal Trust Responsibility 9

1.5.9. Washington State Endangered, Threatened, and Sensitive Species Act 10

1.5.10. Hatchery and Fishery Reform Policy 10

1.5.11. Recovery Plans for Puget Sound Salmon 10

1.5.12. Wilderness Act 11

1.5.13. Dungeness-Quilcene Water Resources Management Plan 11

1.5.14. Environmental Assessment of a NMFS Action to Consider WDFW and USFWS HGMPs Pursuant to the ESA 4(d) Rule 11

1.5.15. Environmental Assessment of NMFS Application of ESA 4(d) Options for Hood Canal Summer-Run And Columbia River ESUs of Chum Salmon 12

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION 12

2.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 12

2.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 12

2.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 13

2.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 14

2.5. Alternatives Considered but not Analyzed in Detail 14

2.5.1. Operate Hatchery Programs for Listed Species Only 14

2.5.2. Operate Hatchery Programs for Non-Listed Species Only 15

2.5.3. Approve Proposed Hatchery Programs under Section 10 of the Endangered Species Act 15
2.5.4. Approve Proposed Hatchery Programs under Section 10 of the Endangered Species Act with Additional Best Management Practices 15
2.5.5. Increase hatchery salmon release levels from programs in the Dungeness River watershed 15
3. AFFECTED ENVIRONMENT 16
3.1. Introduction 16
3.2. Water Quantity 17
3.3. Water Quality 20
3.4. Salmon and Steelhead 22
3.4.1. Puget Sound Chinook Salmon (ESA-listed) 29
3.4.2. Puget Sound Steelhead (ESA-listed) 33
3.4.3. Hood Canal Summer-Run Chum Salmon (ESA-Listed) 35
3.4.4. Puget Sound Fall Chum Salmon (Non-listed) 38
3.4.5. Puget Sound Pink Salmon (Non-listed) 38
3.4.6. Puget Sound Coho Salmon (Non-listed) 39
3.4.7. Sockeye Salmon 40
3.5. Other Fish Species 41
3.6. Wildlife 44
3.7. Socioeconomics 48
3.8. Cultural Resources 50
3.9. Human Health and Safety 50
3.10. Environmental Justice 52
4. ENVIRONMENTAL CONSEQUENCES 54
4.1. Introduction 54
4.1.1. Critical Habitat 55
4.2. Water Quantity 55
4.2.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 55
4.2.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 56
4.2.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 57
4.2.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 59
4.3. Water Quality 61

4.3.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 61
4.3.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 61
4.3.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 62
4.3.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 62
4.4. Salmon and Steelhead 63
4.4.1. Puget Sound Chinook Salmon (ESA-listed) 64
4.4.2. Puget Sound Steelhead (ESA-listed) 75
4.4.3. Hood Canal Summer-Run Chum Salmon (ESA-listed) 78
4.4.4. Puget Sound Fall Chum Salmon – not ESA-listed 82
4.4.5. Puget Sound Pink Salmon 85
4.4.6. Puget Sound Coho Salmon 92
4.4.7. Sockeye Salmon 101
4.5. Other Fish Species 103
4.5.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 103
4.5.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 105
4.5.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 106
4.5.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 107
4.6. Wildlife 109
4.6.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 109
4.6.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 110
4.6.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 112
4.6.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 113
4.7. Socioeconomics 115
4.7.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 115
4.7.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 116
4.7.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 117

4.7.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 117
4.8. Cultural Resources 118
4.8.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 118
4.8.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 119
4.8.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 120
4.8.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 120
4.9. Human Health and Safety 121
4.9.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 121
4.9.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 122
4.9.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 122
4.9.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 122
4.10. Environmental Justice 123
4.10.1. Alternative 1 (No-Action) – Do Not Make a Determination under the 4(d) Rule 123
4.10.2. Alternative 2 (Proposed Action) – Make a Determination that the Submitted HGMPs Meet the Requirements of the 4(d) Rule 123
4.10.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed 124
4.10.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed 125
5. CUMULATIVE IMPACTS 125
5.1. Introduction 125
5.2. Other Programs, Plans, and Policies 126
5.3. Climate Change 127
6. AGENCIES AND PERSONS CONSULTED 128
7. REFERENCES CITED 129

List of Tables

Table 1. Permit applications for Dungeness River salmon hatchery programs. 1
Table 2. Hatchery facilities associated with the proposed Dungeness River basin salmon harvest augmentation programs. 3
Table 3. Annual juvenile hatchery salmon release levels by location, species, and life stage under baseline conditions. 17
Table 4. Water source and use by Dungeness River salmon hatchery facilities..... 18
Table 5. Water source and use by hatchery facility and applicable "Category 5" 303(d) listings. 21
Table 6. Land use in the Dungeness River watershed (Haring 1999). 24
Table 7. General mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations. 28
Table 8. Average productivity for the Dungeness Chinook salmon population, and the entire ESU, for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S) for natural origin fish. "ESU" refers to the aggregate Puget Sound Chinook Evolutionarily Significant Unit. 32
Table 9. Range and status of other fish species that may interact with Dungeness River salmon and steelhead. 42
Table 10. Status and habitat associations of wildlife in the analysis area with direct or indirect relationships with hatchery-origin salmon and steelhead..... 45
Table 11. Percentage minority, per capita income, and percentage below poverty level in Clallam County and Washington State. 53
Table 12. Annual juvenile hatchery salmon production levels by alternative relative to baseline conditions for Dungeness River Hatchery programs. 56
Table 13. Water use by hatchery facility and alternative..... 56
Table 14. Total annual adult Chinook salmon return and naturally spawning fish contributions by alternative. 66
Table 15. Total annual adult fall-run pink salmon return and naturally spawning fish contributions by alternative. 86
Table 16. Total annual adult coho salmon return and contributions to natural and hatchery escapement by alternative. 94

List of Figures

Figure 1. Action area for the proposed continued operation of salmon hatcheries for conservation and fisheries harvest augmentation purposes in the Dungeness River watershed. 6
Figure 2. Mean daily discharge for the Dungeness River and average monthly precipitation near Sequim, Washington (Source - EDPU 2005, citing Simonds and Sinclair 2002). 19
Figure 3. Irrigation districts, water withdrawal locations, and water conveyance systems within the Dungeness River Basin. Source: Clallam Conservation District; July 2007. 25
Figure 4. Estimated annual naturally spawning Chinook salmon escapement abundance in the Dungeness River for 1986 – 2011 (Data sources: PSIT and WDFW 2010; WDFW 2013a). . 31

1. PURPOSE OF AND NEED FOR THE PROPOSED ACTION

1.1. Background

NOAA's National Marine Fisheries Service (NMFS) is the lead agency responsible for administering the Endangered Species Act (ESA) as it relates to listed salmon and steelhead. Actions that may affect listed species are reviewed by NMFS under section 7 or section 10 of the ESA or under section 4(d), which can limit the application of take prohibitions described in section 9. 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 Subsection 3.4, below, Puget Sound Chinook salmon and Puget Sound steelhead are listed as threatened under the ESA.

On January 18, 2013, NMFS received three HGMPs for Washington Department of Fish and Wildlife (WDFW) programs operating at the agency's Dungeness River Hatchery (Scott 2013). WDFW and the Jamestown S'Klallam Tribe requested processing of the HGMPs under limit 6 of the 4(d) Rule (B. Missildine, WDFW, February 7, 2013). The HGMPs describe programs for spring Chinook salmon, coho salmon and fall-run pink salmon (Table 1). The three programs would use the native salmon populations as broodstock, and release their progeny into the Dungeness River for the purposes of conserving the populations (Chinook and pink salmon), or increasing the abundance of adult returns for harvest augmentation purposes (coho salmon) (WDFW 2013a; WDFW 2013b; WDFW 2013c).

Table 1. Permit applications for Dungeness River salmon hatchery programs.

Hatchery Program	Operator
Dungeness River Hatchery Spring Chinook (Integrated)	WDFW
Dungeness River Coho Hatchery Program (Segregated)	WDFW
Dungeness River Hatchery Pink (Fall-Run) Salmon (Integrated)	WDFW

NMFS seeks to consider, through National Environmental Policy Act (NEPA) analysis, how its pending actions may affect the natural and physical environment and the relationship of people with that environment. The NEPA analysis provides an opportunity to consider, for example, how the action may affect conservation of non-listed species and socioeconomic objectives that seek to balance conservation with wise use of affected resources and other legal and policy mandates.

NMFS will evaluate the three HGMPs collectively in one Environmental Assessment because they overlap in geography, were submitted to NMFS at the same time, and were submitted by WDFW, with the Jamestown S'Klallam Tribe as the *U.S. v. Washington* fish resource co-manager, requesting consideration of the plans for coverage as joint tribal/state resource management plans under the ESA 4(d) Rule limit (limit 6). The final decisions on the hatchery plans are pursuant to separate authorities and will be made in separate ESA decision documents.

1.2. Description of the Proposed Action

WDFW has submitted to NMFS three plans for co-manager approved hatchery programs in the Dungeness River Basin. The plans were submitted pursuant to limit 6 of the 4(d) Rule for the ESA-listed Puget Sound Chinook salmon evolutionarily significant unit (ESU) and ESA-listed Puget Sound steelhead distinct population segment (DPS). One of the hatchery programs releases ESA-listed Chinook salmon, and the other two hatchery programs release non-ESA listed coho and fall-run pink salmon into the Dungeness River watershed. All of the programs are currently operating, and all propagated fish are derived from the native populations in the Dungeness River.

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 (see Table 2):

- Broodstock collection at WDFW's Dungeness River Hatchery through operation of weirs, fish traps, and collection ponds, and for pink salmon, through opportunistic seining, gaffing, dip netting, or hook and line collection in the lower 3.5 miles of the Dungeness River;

- Transport of Chinook salmon broodstock from Dungeness River Hatchery to Hurd Creek Hatchery;

- Holding, identification, and spawning of adult fish at Dungeness River Hatchery, Hurd Creek Hatchery, or on-site at the point of pink salmon capture in the lower Dungeness River collection location;

- Egg incubation at Dungeness River Hatchery and Hurd Creek Hatchery and fish rearing at Dungeness River Hatchery, Hurd Creek Hatchery, Gray Wolf Acclimation Pond, and the Upper Dungeness Acclimation Site;

- Release of up to 150,000 subyearling and 50,000 yearling Chinook salmon from Dungeness River Hatchery, Hurd Creek Hatchery, Gray Wolf Acclimation Pond, and the Upper Dungeness Acclimation Site; 500,000 yearling coho salmon from Dungeness River Hatchery; 2,000 coho salmon fry planted into Cooper Creek; up to 1,900 coho salmon eyed eggs transferred to local school projects; and 100,000 pink salmon fry released from Hurd Creek Hatchery;

- Monitoring and evaluation activities to assess the performance of the programs in meeting conservation, harvest augmentation, and listed fish risk minimization objectives.

Table 2. Hatchery facilities associated with the proposed Dungeness River basin salmon harvest augmentation programs.

Activity	Facility	Location	Does Facility Exist under Baseline Conditions ?	Is Facility Operated under Baseline Conditions ?
Broodstock collection	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Mainstem weir (Game Farm)	River mile 2.5 on the Dungeness River	Yes	Yes
	Opportunistic seining, gaffing, dip netting, or hook and line collection	Lower Dungeness River	N/A	N/A
Spawning	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Hurd Creek Hatchery	River Mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7	Yes	Yes
	Opportunistic seining, gaffing, dip netting, or hook and line collection	At site of collection in the lower Dungeness River	N/A	N/A
Incubation	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Hurd Creek Hatchery	River Mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7	Yes	Yes
Rearing	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Hurd Creek Hatchery	River Mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7	Yes	Yes
	Gray Wolf Acclimation Pond	River mile 1.0 on the Gray Wolf River, tributary to the Dungeness River at river mile 15.8	Yes	Yes
	Upper Dungeness Acclimation Site	River mile 15.8 on the Dungeness River	Yes	Yes

Activity	Facility	Location	Does Facility Exist under Baseline Conditions ?	Is Facility Operated under Baseline Conditions ?
Juvenile Fish Release	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Hurd Creek Hatchery	River Mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7	Yes	Yes
	Gray Wolf Acclimation Pond	River mile 1.0 on the Gray Wolf River, tributary to the Dungeness River at river mile 15.8	Yes	Yes
	Upper Dungeness Acclimation Site	River mile 15.8 on the Dungeness River	Yes	Yes
	Cooper Creek	River mile 0.1 on Cooper Creek, tributary to the Strait of Juan de Fuca, 1.2 miles east of the Dungeness River mouth	N/A	N/A
Monitoring and evaluation	Dungeness River Hatchery	River mile 10.5 on the Dungeness River	Yes	Yes
	Hurd Creek Hatchery	River Mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7	Yes	Yes
	Gray Wolf Acclimation Pond	River mile 1.0 on the Gray Wolf River, tributary to the Dungeness River at river mile 15.8	Yes	Yes
	Upper Dungeness Acclimation Site	River mile 15.8 on the Dungeness River	Yes	Yes
	Watershed areas accessible to natural salmon and steelhead migration, spawning and rearing	Dungeness River basin areas, including the Gray Wolf River and Hurd Creek, extending from the river mouth through the upstream extent of anadromous	N/A	N/A

Activity	Facility	Location	Does Facility Exist under Baseline Conditions ?	Is Facility Operated under Baseline Conditions ?
		fish access.		

1.3. Purpose of and Need for the Action

The purpose of the Proposed Action is to ensure that on-going hatchery programs operated by WDFW for the production of Chinook salmon, coho salmon, and fall-run pink salmon as described in the three Hatchery and Genetic Management Plans (HGMPs) comply with the requirements of the ESA, and are authorized through approval under limit 6 of the ESA 4(d) Rule.

NMFS's need for the Proposed Action is to ensure the proposed hatchery programs comply with the requirements of the ESA and meet NMFS's tribal treaty rights stewardship responsibilities.
The applicants' need for the Proposed Action is for the continuation of on-going and proposed hatchery production described in the three HGMPs that will conserve critically depressed, native Chinook and fall-run pink salmon leading to their eventual recovery to a viable status, and provide coho salmon fishing opportunities for the Jamestown S'Klallam Tribe and the citizens of Washington State.

In fulfilling the purpose and need, the Proposed Action would provide hatchery fish production to help meet fish loss mitigation responsibilities, preserve critically depressed native salmon populations, and partially off-set adverse impacts on natural-origin salmon and their habitat resulting from past and on-going human developmental activities in the Dungeness River basin (Haring 1999) and from climate change. The goals of the programs are to meet population recovery objectives and fisheries harvest augmentation responsibilities by providing hatchery fish for the purposes of: (1) conserving the native salmon resources, (2) supporting values associated with Treaty-reserved fishing rights to meet Jamestown S'Klallam tribal commercial, ceremonial, and subsistence needs, and (3) meeting regional recreational and commercial fisheries objectives. The programs would mitigate for lost natural-origin fish production by producing native Dungeness River basin salmon to preserve and help restore the populations (Chinook and fall-run pink salmon), and provide commercial, ceremonial, and subsistence fisheries, and recreational and commercial harvest, of coho salmon by the Jamestown S'Klallam Tribe and Washington state citizens, respectively. The proposed programs would also include monitoring of plan performance and effects in the Dungeness River and adjacent marine areas, while minimizing adverse genetic, demographic, or ecological effects on listed fish and other natural populations. In addition to conserving at-risk salmon populations, the programs would also help meet tribal fishery harvest allocations that are guaranteed through treaties, as affirmed in *U.S. v. Washington* (1974). The hatchery-origin salmon produced through the programs would also help meet Pacific Salmon Treaty harvest sharing agreements with Canada. The HGMPs were designed to be consistent with the strategies and actions specified in the Dungeness River watershed recovery plan, the salmon recovery strategy for the basin (SSPS 2005 – Volume II). The watershed plan describes how the hatchery programs would operate in conjunction with harvest management, habitat restoration (Beechie et al. 1996) and habitat

protection actions to achieve near- and long-term goals for natural and hatchery production of salmon in the Dungeness River basin.

1.4. Action Area

The action area includes hatchery facilities where Dungeness River watershed salmon are collected as broodstock, spawned, incubated, reared, acclimated, and released (Figure 1). The following facilities would be used by proposed hatchery programs:

- Dungeness River Hatchery (river mile 10.5 on the Dungeness River)
- Hurd Creek Hatchery (river mile 0.2 on Hurd Creek, tributary to the Dungeness River at river mile 2.7)
- Mainstem Dungeness River weir (river mile 2.5 on the Dungeness River)
- Gray Wolf Acclimation Pond (river mile 1.0 on the Gray Wolf River, tributary to the Dungeness River at river mile 15.8)
- Upper Dungeness Acclimation Site (river mile 15.8 on the Dungeness River)
- Cooper Creek (tributary to the Strait of Juan de Fuca 1.2 miles east of the Dungeness River mouth)

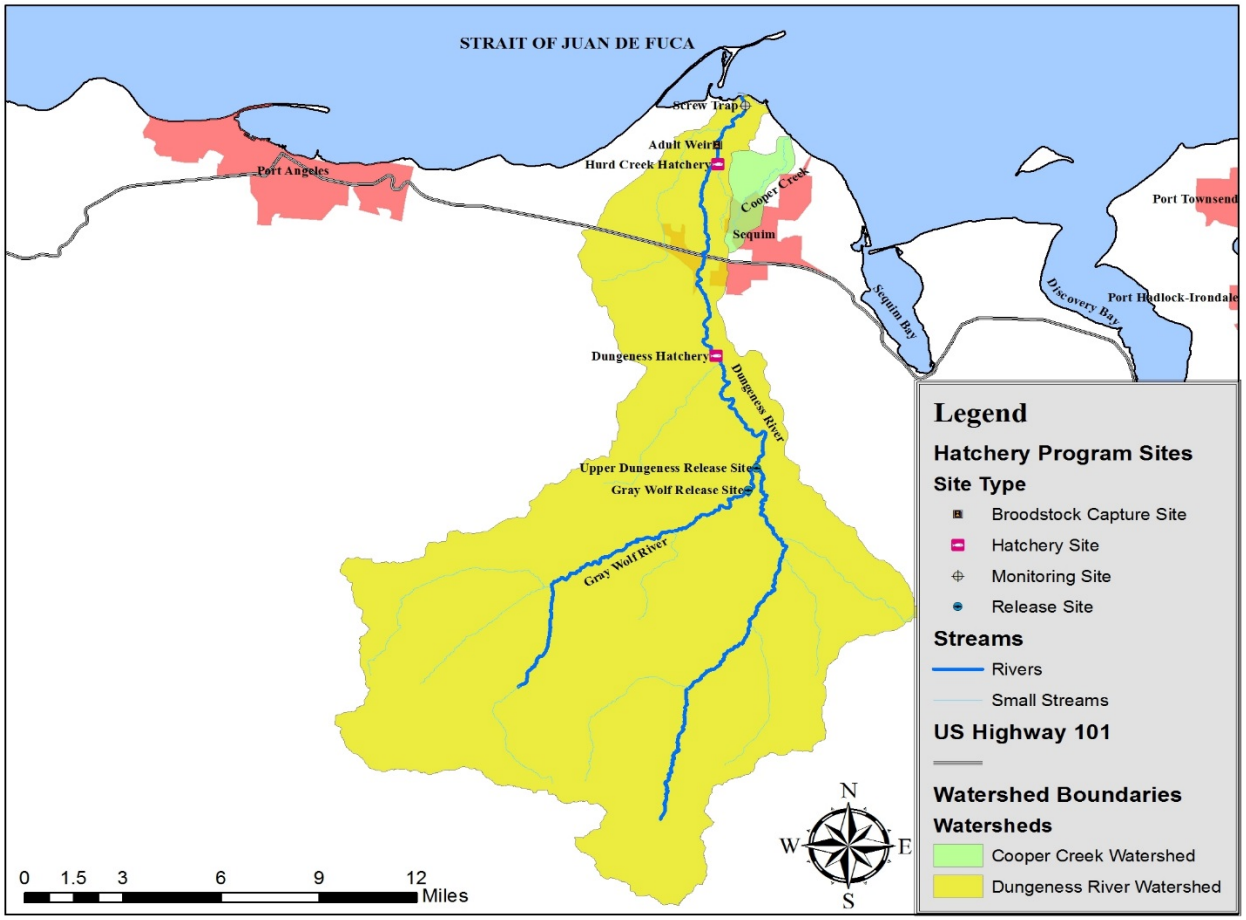

Figure 1. Action area for the proposed continued operation of salmon hatcheries for conservation and fisheries harvest augmentation purposes in the Dungeness River watershed.
Source: http://wdfw.wa.gov/conservation/research/projects/puget_sound_salmonids/dungeness/

In addition, adult salmon would be collected for use as broodstock in the lower Dungeness River, downstream of Dungeness Hatchery, through opportunistic seining, gaffing, dip netting, or hook and line collection. Monitoring and evaluation activities would occur at the hatcheries and in their immediate vicinities in Hurd Creek, Gray Wolf River, and extending from the mouth of the Dungeness River upstream to the limits of anadromous fish access.

The analysis area is the geographic extent that is being evaluated for a particular resource. For some resources, the analysis area may be larger than the action area, since some of the effects of the alternatives may occur outside the action area. The analysis area for each resource is described in Chapter 3, Affected Environment.

1.5. 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 Dungeness River watershed. They are summarized below to provide additional context for the Dungeness River salmon hatchery programs.

1.5.1. Clean Water Act

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

The 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.

1.5.2. Bald Eagle and Golden Eagle Protection Act

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

1.5.3. Marine Mammal Protection Act

The Marine Mammal Protection Act of 1972 (16 USC 1361) as amended, establishes a national policy designated to protect and conserve wild marine mammals and their habitats. This policy was established so as not to diminish such species or populations beyond the point at which they cease to be a 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, breathing, 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. Changes in fish production can indirectly affect marine mammals by altering the number of available prey (salmon and steelhead).

1.5.4. 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. Changes in hatchery production have the potential to affect the extent of harvest available for minority and low-income populations.

1.5.5. 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 Puget Sound. The treaties were completed to secure the rights of the tribes to land and the use of natural resources in their historically inhabited areas, in exchange for the ceding of land to the United States for settlement by its citizens. These treaties secured the rights of tribes for taking fish at usual and accustomed grounds and stations in common with all citizens of the United States. Marine and freshwater areas of Puget Sound were affirmed as the usual and accustomed fishing areas for treaty tribes under *U.S. v. Washington* (1974). The Jamestown S'Klallam Tribe is signatory to the Treaty of Point No Point, the lands settlement treaty between the United States government and the Native American tribes of the Strait of Juan de Fuca and Hood Canal regions (then, the S'Klallam, the Chimakum, and the Skokomish tribes) in the recently-formed Washington Territory. The Treaty of Point No Point was signed on January 26, 1855, at Hahdskus – the Salish dialect name for Point No Point – on the northern tip of the Kitsap Peninsula.

1.5.6. *U.S. v. Washington*

U.S. v. Washington (1974) is the Federal court proceeding that enforces and implements reserved treaty fishing rights with regards to salmon and steelhead returning to Puget Sound. Hatcheries in Puget Sound provide salmon and steelhead for these fisheries. Without many of these hatcheries, there would be few, if any, fish for the tribes to harvest. These fishing rights and attendant access were established by treaties that the Federal government signed with the tribes in the 1850s. In those treaties, the tribes agreed to allow the peaceful settlement of Indian lands in western Washington in exchange for their continued right to fish, gather shellfish, hunt, and exercise other sovereign rights. Under Phase II of *U.S. v. Washington*, the Federal District Court ensured tribes the rights to the protection of fish habitat subject to treaty catch and a right to the fish that are produced by hatcheries. In 1974, Judge George Boldt decided in *U.S. v. Washington* that the tribes' fair and equitable share was 50 percent of all of the harvestable fish destined for the tribes' traditional fishing places.

1.5.7. Secretarial Order 3206

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

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

- Work directly with Indian tribes on a government-to-government basis to promote healthy ecosystems (Sec. 5, Principle 1)
- Recognize that Indian lands are not subject to the same controls as Federal public lands (Sect. 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)
- Be sensitive to Indian culture, religion, and spirituality (Sec. 5, Principle 4)

1.5.8. The Federal Trust Responsibility

The United States government has a trust or special relationship with Indian tribes. The unique and distinctive political relationship between the United States and Indian Tribes is defined by statutes, executive orders, judicial decisions, and agreements and differentiates tribes from other entities that deal with, or are affected by the Federal government. Executive Order 13175, *Consultation and Coordination with Indian Tribal Governments*, states that the United States has recognized Indian tribes as domestic dependent nations under its protection. The Federal government has enacted numerous statutes and

promulgated numerous regulations that establish and define a trust relationship with Indian tribes. The relationship has been compared to one existing under common law trust, with the United States as trustee, the Indian tribes or individuals as beneficiaries, and the property and natural resources of the United States as the trust corpus (Cohen 2005; Newton et al. 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).

1.5.9. 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.

1.5.10. 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). It supersedes WDFW's Wild Salmonid Policy, which was adopted in 1997. 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 state hatcheries and its intent is to improve hatchery effectiveness, ensure compatibility between hatchery production and salmon recovery plans and rebuilding programs, and support sustainable fisheries.

1.5.11. Recovery Plans for Puget Sound Salmon

Federal recovery plans 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 completed salmon 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 Dungeness River watershed chapter presented in Volume II of the Shared Strategy for Puget Sound salmon recovery plan (SSPS 2005). Although listed in 2007, a recovery plan for the Puget Sound Steelhead DPS has not yet been completed but is currently in the process of assembly.

1.5.12. Wilderness Act

The 1964 Wilderness Act directs Federal agencies to manage wilderness so as to preserve its wilderness character. Lands classified as wilderness through the Wilderness Act may be under the jurisdiction of the U.S. Forest Service, National Park Service, U.S. Fish and Wildlife Service, or the U.S. Bureau of Land Management. With some exceptions, the Wilderness Act prohibits motorized and mechanized vehicles, timber harvest, new grazing and mining activity, or any kind of development. In 1988, Congress designated 95 percent of the Olympic National Park as wilderness under the Wilderness Act. The Olympic Wilderness Area is under the jurisdiction of the National Park Service.

1.5.13. Dungeness-Quilcene Water Resources Management Plan

In the late 1980s and early 1990s, discussions and planning by local residents in the Dungeness River watershed regarding flood control needs, floodplain and riparian development, logging practices, preservation of agricultural lands, and related natural resource issues resulted in the Dungeness-Quilcene Water Resources Management Plan (1994). Referred to as "the DQ Plan," it was part of a pilot regional water quantity project that used locally driven and consensus-based decision-making to provide recommendations about in-stream flow management, groundwater, water conservation, education and other issues. The DQ Plan development process included negotiations between the Jamestown S'Klallam Tribe and the Dungeness River Agricultural Water Users Association that resulted in an agreement between the users and Washington Department of Ecology that water users would not withdraw more than half of the flow in the Dungeness River during the irrigation season – essentially reserving half of the flow for salmon and steelhead production in the watershed. Other key recommendations from the DQ Plan were implemented, including a trust water rights agreement, improvements to the efficiency of the basin's irrigation system, the development of a habitat restoration plan by a technical team, and continuation of a watershed council to provide more coordinated and integrated natural resource planning for the Dungeness River Watershed area. The Dungeness River Management Team (DRMT) was activated in 1995 to help meet the latter recommendation through the exchange of information on technical studies, issues, and projects occurring in the Dungeness Watershed; assistance in implementation of flood control management, watershed management, and water resources management plans for the watershed; coordination of staff, funding and other resources among agencies and representatives; promotion of public education on watershed processes and activities; and review of salmon habitat restoration project proposals for the watershed.

1.5.14. Environmental Assessment of a NMFS Action to Consider WDFW and USFWS HGMPs Pursuant to the ESA 4(d) Rule

NMFS previously completed a review under NEPA of its ESA 4(d) Rule Limit 5 determination action for eight summer-run chum salmon HGMPs proposed by WDFW and USFWS within the geographic boundaries of the Hood Canal Summer-run Chum Salmon ESU. The analysis area for the EA included the Dungeness River. The results of the analysis indicated that no significant impacts on the human environment were expected to result from implementation of the preferred alternative actions, or from any combination of those alternatives. The final EA and Finding of No Significant Impact for the determination were completed in 2002 (NMFS 2002a).

1.5.15. Environmental Assessment of NMFS Application of ESA 4(d) Options for Hood Canal Summer-Run And Columbia River ESUs of Chum Salmon

This NMFS EA describes and evaluates five alternatives for protective regulations under the ESA 4(d) Rule for the two ESUs. Encompassed within the EA analyses area for the Hood Canal Summer-run Chum Salmon ESU is the Dungeness River. The results of the analysis indicated that no significant impacts on the human environment were expected to result from implementation of the preferred alternative actions, or from any combination of those alternatives. The final EA and FONSI were completed in 2001 (NMFS 2001b).

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

Three alternatives are considered in this EA: (1) NMFS would not make a determination under the 4(d) Rule; (2) NMFS would make a determination that the three submitted HGMPs meet the requirements of the 4(d) Rule; and, (3) NMFS would make a determination that the three submitted HGMPs do not meet the requirements of the 4(d) Rule, and the programs would be terminated. No other alternatives that would meet the purpose and need were identified that would be appreciably different from the three alternatives described below.

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

Under this alternative, NMFS would not make determinations under the 4(d) Rule. WDFW would continue to operate the Dungeness River watershed hatchery programs as under baseline conditions without NMFS's ESA determination. Because the HGMPs would not be approved, the hatchery actions proposed by WDFW would not be exempt from section 9 take prohibitions. No new environmental protection or enhancement measures would be implemented.

Other potential outcomes might occur under this No-action Alternative – WDFW, with the Jamestown S'Klallam Tribe, could pursue other mechanisms for ESA coverage, for example. However, NMFS's 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[1].

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 Secretary would approve the three proposed salmon hatchery programs under limit 6 of the 4(d) Rule, and the hatchery programs would be implemented as described in the three HGMPs (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-run pink salmon as proposed in the three HGMPs to:

- conserve the native Dungeness River Chinook and fall-run pink salmon populations
- produce coho salmon to support Jamestown S'Klallam tribal commercial and ceremonial and subsistence fisheries and WDFW-managed regional recreational and commercial fisheries.

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

The HGMP actions would continue until historical natural salmon population productivity and abundance are restored, and the ESA-listed Chinook salmon population and non-listed fall-run pink salmon population, are considered recovered in the Dungeness River Basin. The hatchery plans would be implemented consistent with the NMFS-approved recovery plan for the Dungeness River watershed (SSPS 2005).

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.

2.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under this alternative, the Secretary would determine that the three hatchery programs as described by the HGMPs do not meet the criteria under limit 6 of the 4(d) Rule and, therefore, not provide an approval letter. Because the HGMPs would not be approved, the hatchery actions proposed by WDFW would not be exempt from section 9 take prohibitions. With this lack of approval, the hatchery actions proposed by WDFW, with the Jamestown S'Klallam Tribe, could be withdrawn and the programs terminated. Were that to occur, all salmon currently being raised in hatchery facilities would be released or killed, and no additional broodstock would be collected.

This alternative would not be expected to meet the applicant's purpose and need for action because termination of the proposed hatchery actions would not produce juvenile hatchery fish of each species that would return as adult fish to meet conservation, tribal treaty fishing rights, and all-citizens sustainable fisheries objectives, as mitigation for depressed natural-origin salmon production. 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. This is particularly useful in the instant case, where the current conditions include hatchery effects as an ongoing feature. A no-hatchery alternative assists NMFS in comparing the proposed action to a hypothetical environment without hatcheries, which is important for gauging the extent of effects resulting from the proposed action.

2.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under this alternative, the Secretary would reduce the number of fish released from each of the three salmon hatchery programs. As the basis for analyzing a reduced production scenario, NMFS has applied an across-the-board 50 percent reduction in the annual maximum juvenile fish release goals described as Proposed Actions for the Chinook salmon, pink salmon, and coho salmon hatchery programs. Under Alternative 4, the annual maximum salmon release levels would be as follows:

- Chinook salmon: 75,000 subyearlings; 25,000 yearlings
- Pink salmon: 50,000 fry
- Coho salmon: 250,000 yearlings

This alternative would not be expected to meet the applicant's purpose and need for action, because the proposed hatchery actions would not release the number of juvenile salmon of each species identified by the tribal and State resource manager applicants as required to meet conservation, tribal treaty fishing rights, and all-citizens sustainable fisheries objectives, and to mitigate depressed natural-origin salmon production in the Dungeness River watershed. 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, and to potentially guide future decision-making by the hatchery operator.

2.5. Alternatives Considered but not Analyzed in Detail

2.5.1. Operate Hatchery Programs for Listed Species Only

Under this alternative, the Secretary would approve the proposed hatchery program for listed species (Chinook salmon) under limit 6 of the 4(d) Rule, and the hatchery program would be implemented as described in the Dungeness Hatchery spring Chinook salmon HGMP. For the purpose of this analysis, NMFS would treat this alternative as resulting in the hatchery production of only Chinook salmon as proposed in the HGMP for that species. The two HGMPs for the other species – coho and fall-run pink salmon – would propagate species that are not listed under the ESA and would not be approved under the 4(d) Rule to limit potential incidental take effects on listed Chinook salmon. With this lack of approval, the hatchery actions for coho and fall-run pink salmon proposed by WDFW, with the Jamestown S'Klallam Tribe, would not be implemented, and the programs would be terminated. Termination of the proposed hatchery actions for these two non-listed species would not meet the purpose and need for the proposed action, which is to produce a sufficient number of juvenile hatchery fish of each species to meet conservation objectives for pink salmon, and treaty fishing rights and all-citizens sustainable fisheries objectives for coho salmon, as mitigation for depressed natural-origin coho salmon and pink salmon production. Cessation of coho and fall-run pink salmon production would not meet either of these two objectives.

2.5.2. Operate Hatchery Programs for Non-Listed Species Only

Under this alternative, the Secretary would approve the proposed hatchery programs for non-listed species (coho and fall-run pink salmon) under limit 6 of the 4(d) Rule, and the two hatchery programs would be implemented as described in the HGMPs. For the purpose of this analysis, NMFS would treat this alternative as resulting in the hatchery production of only coho and fall-run pink salmon as proposed in the two HGMPs for those species. The HGMP 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 listed natural-origin Dungeness Chinook salmon population. With this lack of approval, the hatchery actions for Chinook salmon proposed by WDFW, with the Jamestown S'Klallam Tribe, would not be implemented, and the program would be terminated. Termination of the proposed hatchery actions for this listed species would not meet the purpose and need for the proposed action, which is to produce a sufficient number of juvenile hatchery fish to meet conservation needs for the critically depressed species in response to lost natural-origin Chinook salmon production in the watershed. Cessation of Chinook salmon production would not meet the listed fish conservation objective for the program.

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

The Secretary would determine that the three proposed hatchery programs, as described in the HGMPs, meet the criteria for either section 10(a)(1)(A) permits (the Chinook salmon program) or section 10(a)(1)(B) permits (the coho and fall-run pink salmon programs). Under this alternative, the only change from the Proposed Action Alternative would be a difference in ESA evaluation and determination pathways for these hatchery programs. The analysis of impacts under this alternative would not differ from the analysis that would occur under the Proposed Action Alternative (Subsection 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 three proposed hatchery programs under section 10(a)(1)(A) permits (the Chinook salmon program) or section 10(a)(1)(B) permits (the coho and fall-run pink salmon programs), but permits 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 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. Increase hatchery salmon release levels from programs in the Dungeness River watershed

Under this alternative, the programs would produce higher numbers of juvenile hatchery-origin salmon than those proposed, and NMFS would consider juvenile and adult fish production levels increased from those described in the three HGMPs. Like the reduced releases in Alternative 4, increased releases would provide this review with a greater understanding of effects of the action. However, an increased production level alternative would not influence the hatchery operator because it would exceed the production capacities for the hatcheries, and could not be implemented. Of particular concern would be

exceedance of 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 nine resources that may be affected by implementation of the EA alternatives:

- Water Quantity (Subsection 3.2)
- Water Quality(Subsection 3.3)
- Salmon and Steelhead (Subsection 3.4)
- Other Fish Species (Subsection 3.5)
- Wildlife (Subsection 3.6)
- Socioeconomics (Subsection 3.7)
- Cultural Resources (Subsection 3.8)
- Human Health and Safety (Subsection 3.9)
- Environmental Justice (Subsection 3.10)

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

Baseline conditions include the operation of the proposed Dungeness River Basin salmon hatchery programs (Table 3). The Dungeness River Hatchery spring Chinook and fall-run pink salmon hatchery programs were initiated for integrated recovery purposes to conserve and restore the indigenous Chinook and fall-run pink salmon populations in the Dungeness River. The coho salmon program at Dungeness River Hatchery operates for fisheries harvest augmentation purposes to partially mitigate for lost natural-origin coho salmon resulting from degradation and loss of habitat as a result of human developmental activities in the watershed. The Dungeness River Hatchery Chinook salmon program was initiated in its current form as a supplementation effort in 2004, after functioning as a captive broodstock-based program since 1992. The conservation program for fall-run pink salmon at the hatchery began in 2007. The Dungeness River Hatchery coho salmon program has operated for the longest duration, releasing smolts into the lower river since about 1902.

The action area (or project area) is the geographic area where the Proposed Action would take place. It includes the places where Dungeness River salmon would be spawned, incubated, reared, acclimated, released, or harvested under the proposed hatchery plans (Subsection 1.4, Action Area). Each resource's analysis area includes the action area as a minimum area but may include locations beyond the action area if some of the effects of the EA's alternatives on that resource would be expected to occur outside the action area (Subsection 1.4, Action Area).

Table 3. Annual juvenile hatchery salmon release levels by location, species, and life stage under baseline conditions.

Species	Hatchery Program & Year Initiated	Target Annual Juvenile Release Levels (2014)	Hatchery-Origin Adult Return Levels [1]
Chinook salmon	Dungeness River Hatchery Spring Chinook Salmon: 2004	150,000 subyearlings 50,000 yearlings	490 [3]
Coho salmon	Dungeness River Coho Salmon Hatchery: ~1902	500,000 yearlings 2,000 fry/1,900 eyed eggs [2]	4,350
Fall-Run Pink salmon	Dungeness River Pink (Fall-Run) Salmon Hatchery: 2007	100,000 fry	500

[1] Total adult production estimates derived assuming juvenile fish survival rates to adult return (escapement and total contribution to any marine area fisheries) of 0.23% for subyearling Chinook and 0.29% for yearling Chinook salmon; 0.87% for coho salmon, and 0.50% for pink (Source: observed and target rates reported for each species in the reported in the three WDFW HGMPs).

2 Coho salmon fry (2,000 per year) are proposed for release in Cooper Creek (in a partnership with North Olympic Salmon Coalition). Up to 1,900 eyed eggs are also proposed for transfer for educational purposes to local school projects (WDFW 2013c). Because fry and eyed egg survival rates to adult return for these very low numbers of fry and eggs under the Proposed Action would lead to the production of few (<20) adult fish each year, effects of this component of the Dungeness River Hatchery program are expected to be inconsequential under all alternatives, and are not analyzed.

3 Dungeness Chinook salmon may be harvested incidentally in marine area fisheries in Canada and Alaska targeting other salmon populations. Approximately 25% of the total annual return of Chinook salmon originating in the Dungeness River may be intercepted in those fisheries, reducing total annual escapement to approximately 368 fish.

3.2. Water Quantity

Hatchery programs can affect water quantity when they take water from a well (groundwater) or a neighboring river or tributary stream (surface water) to use in the hatchery facility for broodstock holding, egg incubation, juvenile rearing, and juvenile acclimation. All water, minus evaporation, that is diverted from a river or taken from a well is discharged into the water course adjacent to the hatchery rearing location, and for surface water from which the water was appropriated, after it circulates through the hatchery facility (non-consumptive use). When hatchery programs use groundwater, they may reduce the amount of water for other users in the same aquifer. When hatchery programs use surface water, they may lead to dewatering of the stream between the water intake and discharge structures, which may impact fish and wildlife if migration is impeded or dewatering leads to increased water temperatures. Generally, water intake and discharge structures are located as close together as possible to minimize the area of the stream that may be impacted by a water withdrawal.

Four hatchery facilities are operated to support the three proposed salmon hatchery programs (Subsection 1.4, Action Area). The Dungeness River Hatchery facility uses surface water exclusively, withdrawn through three water intakes on the Dungeness River and one on Canyon Creek, an adjacent

tributary. The Hurd Creek Hatchery facility uses a combination of groundwater withdrawn from five wells, and surface water withdrawn from Hurd Creek for fish rearing and as an emergency back-up source. The Gray Wolf Acclimation Pond is supplied with surface water that is gravity fed from the Gray Wolf River. The Upper Dungeness Acclimation Ponds are supplied with pumped surface water from the Dungeness River (Table 4).

Table 4. Water source and use by Dungeness River salmon hatchery facilities.

Hatchery Facility	Surface Water Use Max (cfs) [1]	Surface Water Source	Ground-water Use Min/Max (cfs)	Annual Surface Water Flow (min/mean/max) (cfs) [2]	Maximum Percentage of Total Surface Water Withdrawn for Hatchery Program (%) [4]	Effluent Discharge Location	NPDES Permit Number
Dungeness River Hatchery	40 8.5	Dungeness R. Canyon Creek	0 0	55.5 / 397 / 3,310 2 / 8 / 25	72 / 10 / 1.2 100 / 100 / 34	Dungeness River RM 10.5	WAG 13-1037
Hurd Creek Hatchery	1.4	Hurd Creek	0.9 – 4.5	2 / 5/ 7	70	Hurd Creek RM 0.5	NA [3]
Gray Wolf Acclimation Pond	1.0	Gray Wolf R.	0	/ 189 /	0.5	Gray Wolf River RM 1.0	NA [3]
Upper Dungeness Acclimation Ponds	1.0	Dungeness R.	0	/ 358 /	0.3	Dungeness River RM 15.8	NA [3]

[1] Maximum allowable surface water withdrawal for hatchery use under Washington State water withdrawal permits #S2-06221 and #S2-21709 for Dungeness River and #S2-00568 for Canyon Creek. Hurd Creek Hatchery retains groundwater permit # G2-24026 (WDOE 2012b).

[2] October through September 5-year (2006-2011) mean, minimum, and maximum flow data for the lower Dungeness River from WDOE (2012a) Dungeness River Stream Flow Monitoring Station 18A050, accessible at: https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?wria=18#block2 Flow data collection reach is downstream of five irrigation withdrawal points on the river. Additional source of flow data is EDPU (2005) available at: http://www.clallam.net/environment/elwhadungenesswria.html. Flows presented for the Gray Wolf River and upper Dungeness River are the estimated incremental average annual flows from EDPU (2005). The Dungeness River Management Team recommended minimum instream flows for the lower Dungeness River at seasonal flow levels recommended by the Dungeness Instream Flow Group (Wampler and Hiss 1991; Hiss 1993): November through March: 575 cfs; April through July: 475 cfs; and August through October: 180 cfs. These minimum flows are not based on seasonal, historical Dungeness River flows, but represent flows required to maintain optimal potential fish habitat area (EDPU 2005).

[3] A NPDES Permit is not required for hatchery facilities producing less than 20,000 pounds of fish each year.

[4] Maximum percentage withdrawals derived assuming hatchery use of available surface water up to water maximum permitted surface 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 annual maximums. 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.

Surface flows in the Dungeness River fluctuate seasonally, based on rainfall levels and commensurate with spring-time snow melt (Figure 2). In addition, surface water withdrawal needs for the hatchery programs also fluctuate seasonally, with the highest hatchery water withdrawal needs occurring in the spring months, when fish are at their largest size and higher rearing flows are needed for fish health maintenance. Hatchery water withdrawal needs for fish rearing are lowest in the late summer months. Also, the Gray Wolf Acclimation Pond and Dungeness Acclimation Ponds only operate from April through June each year, and are disassembled, with no surface water withdrawals from July through March. Assuming hatchery water withdrawals at maximum permitted levels, up to 73 percent of the water during the lowest flows in the Dungeness River could be temporarily diverted into Dungeness River Hatchery to support the three salmon hatchery programs, and 10 percent of the water in the river could be withdrawn during average flows.

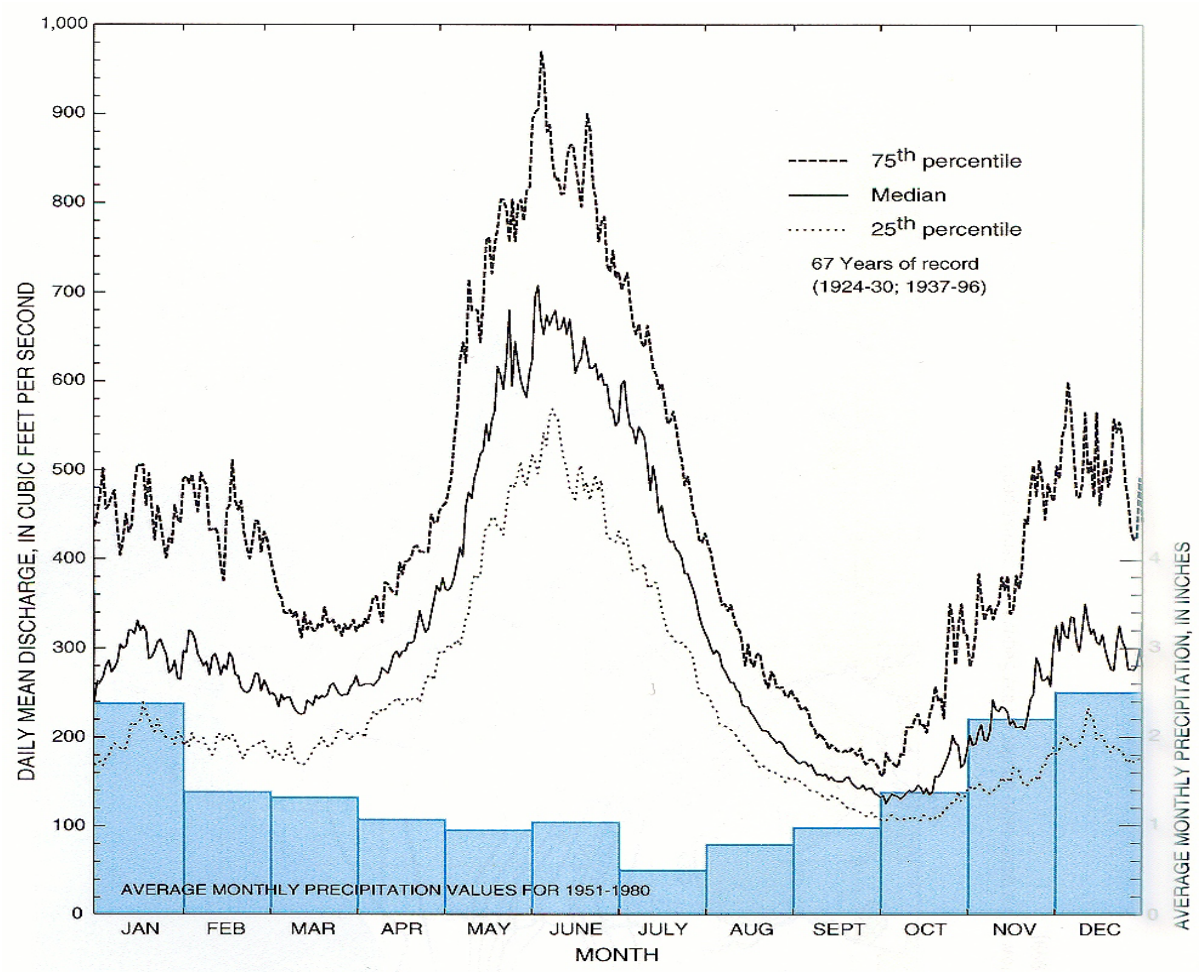

Figure 2. Mean daily discharge for the Dungeness River and average monthly precipitation near Sequim, Washington (Source - EDPU 2005, citing Simonds and Sinclair 2002).

The hatchery water intake structure on the Dungeness River supplying Dungeness River Hatchery does not meet current Federal fish passage criteria (WDFW 2013a). The Canyon Creek water intake is adjacent to a small dam that until recently completely blocked access to upstream salmon spawning habitat. WDFW is in the process of correcting fish passage problems at the location of the Dungeness River structure, with

plans to complete work by 2015. The current three structures used to withdraw water from the Dungeness River will be reduced to one structure, which will be passable to upstream and downstream migrating fish (WDFW 2013a). On Canyon Creek, a ladder was constructed in the dam that impounds water for the hatchery so that it is now passable to migrating fish (WDFW Fortress website, accessed June 12, 2013[2]). Through a separate NMFS ESA consultation on the effects of the construction of the fish ladder, minimum flow criteria for the reach of Canyon Creek downstream from the hatchery water intake are being developed to ensure unimpeded migration for salmon, steelhead, and bull trout. These construction and minimum flow criteria development actions are not part of this evaluation, which addresses operational effects of the proposed HGMPs.

3.3. Water Quality

Hatchery programs could affect several water quality parameters in the aquatic system. Concentrating large numbers of fish within hatcheries could 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). 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 hatchery operations are polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites (Missildine 2005; HSRG 2009a), fish disease pathogens (HSRG 2005; HSRG 2009a), steroid hormones (Kolodziej et al. 2004), anesthetics, pesticides, and herbicides.

The direct discharge of hatchery facility effluent is regulated by the Environmental Protection Agency under the Clean Water Act through National Pollutant Discharge Elimination System (NPDES) permits. For discharges from hatcheries not located on Federal or tribal lands within Washington, the Environmental Protection Agency has delegated its regulatory oversight to the State. 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 Environmental Protection Agency administers NPDES permits for all projects on Federal and tribal lands. NPDES permits are not needed for 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, Native American tribes may adopt their own water quality standards for permits on tribal lands (i.e., tribal wastewater plans).

All hatchery facilities used by the Dungeness River salmon hatchery programs are in compliance with NPDES permits issued by WDOE, or do not require a NPDES permit (Tables 4 and 5). Under its NPDES permit, Dungeness River Hatchery operates an off-line settling pond and artificial wetland to remove effluent before the water is discharged back into the river (WDFW 2013a). Although under the 20,000 pounds per year fish production criteria set by WDOE as the limit for concern regarding hatchery effluent discharge effects, WDFW has constructed a two-bay pollution abatement pond to treat water prior to its release into Hurd Creek. The fish rearing ponds on the Gray Wolf River and the Upper Dungeness River also have low annual fish production levels, below those for which a NPDES permit is required.

[2] https://fortress.wa.gov/dfw/score/score/hatcheries/hatchery_details.jsp?hatchery=Dungeness

As part of administering elements of the Clean Water Act, WDOE 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. A "category 5" assignment in the 303(d) list means that WDOE has data showing that the water quality standards have been violated for the pollutant, and there is no "Total Maximum Daily Load" (TMDL) or pollution control plan established it. For pollutants assigned as "category 5", a TMDL process is required to establish limits on pollutant levels that can be discharged to a water body that will ensure that state water quality standards are met.

Within the analysis area, bacteria in Hurd Creek are the only water quality parameter warranting inclusion under "category 5" on the 303(d) list (Table 5).

Table 5. Water source and use by hatchery facility and applicable "Category 5" 303(d) listings.

Hatchery Facility	NPDES Permit Compliant	Discharges Effluent into a 303(d) Listed Water Body	Impaired Parameters	Cause of Impairment
Dungeness River Hatchery	Yes	No	None	N/A
Hurd Creek Hatchery	N/A [1]	Yes	Bacteria	Agriculture and other human developmental activities
Gray Wolf Acclimation Pond	N/A [1]	No	None	N/A
Upper Dungeness River Ponds	N/A [1]	No	None	N/A

Source: Washington Department of Ecology Water Quality Assessments and TMDL data for the Dungeness River watershed (WDOE 2008), accessed March 25, 2013 at: http://www.ecy.wa.gov/programs/wq/303d/currentassessmt.html

1/ 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.

Although there are no "category 5" pollutants outside of Hurd Creek, bacteria in the Dungeness River and Dungeness Bay has a "category 4a" assignment, because an approved TMDL for instream flow to control the pollutant is in place and is actively being implemented. Instream flow is assigned a "category 4c" rating as a non-pollutant impairing the Dungeness River that cannot be addressed through a TMDL, requiring complex solutions to restore more natural conditions. "Fish and Shellfish Habitat" in Dungeness Bay also received a "category 4c" pollutant assignment as an impaired portion of the watershed.

3.4. Salmon and Steelhead

Resource management agencies estimate that, historically, 11 salmonid populations or population aggregations were native to the watershed (SSPS 2005). Current populations in the river basin include ESA-listed threatened spring Chinook salmon, summer-run chum salmon, steelhead, and bull trout. Non-listed salmonids currently present in the basin are coho salmon, summer and fall-run pink salmon, fall chum salmon, sockeye salmon, sea-run cutthroat trout, and resident rainbow trout. Natural-origin salmon and steelhead populations in the Dungeness River are severely diminished in their status relative to historical levels.

NMFS has identified two salmon ESUs (Puget Sound Chinook Salmon and Hood Canal Summer-Run Chum Salmon) and one steelhead DPS (Puget Sound Steelhead) in the analysis area that require protection under the ESA (70 FR 37160, June 28, 2005; 72 FR 26722, May 11, 2007). The Washington Coast/Puget Sound bull trout DPS listed as threatened by USFWS is also present in the analyses area (64 FR 58910, November 1, 1999). There are three additional non-listed anadromous salmon species in the analysis area (coho salmon, pink salmon, and fall chum salmon). Critical habitat was designated for Puget Sound Chinook salmon and Hood Canal Summer-Run Chum Salmon on September 2, 2005 (70 FR 52630). Critical habitat for the Puget Sound steelhead DPS was proposed for designation on January 14, 2013 (78 FR 2726). The USFWS issued a final rule, "Revised Designation of Critical Habitat for bull trout in the Conterminous United States" on October 18, 2010 (75 FR 63897). Because ESA-listing was not warranted for coho, pink, and fall chum salmon in the Puget Sound region action area, no critical habitat designations have been made for these species.

In the Dungeness River watershed, Puget Sound Chinook salmon critical habitat extends from the outlet of the Dungeness River upstream to the limits of Chinook salmon access in the Dungeness River mainstem, Gray Wolf River, Matriotti Creek, and an unnamed tributary (located at latitude N48.1514°, longitude W123.1216°). Critical habitat for Hood Canal summer-run chum salmon is designated to include all reaches within the Dungeness River watershed accessible to listed chum salmon draining into Dungeness Bay. Proposed critical habitat for Puget Sound steelhead in the Dungeness River watershed extends from the mouth of the Dungeness River upstream to the limits of steelhead access in the mainstem Dungeness River, Cassalery Creek, Gierin Creek, Bear Creek, Canyon Creek, Cassalery Creek, Gold Creek, the Gray Wolf River, and Matriotti Creek. Critical habitat for both species includes adjacent marine areas, including Dungeness Bay. Also included as critical habitat for the listed species are adjacent riparian zones and estuarine/marine areas in Dungeness Bay. Within these critical habitat areas, NMFS identifies primary constituent elements (PCEs), which are sites and habitat components that support one or more life stages and are considered essential for the conservation of the ESUs (70 FR 52630) and DPS (78 FR 2726). In the Puget Sound areas designated as critical habitat, major management activities affecting PCEs for salmon and steelhead habitat are forestry, grazing, agriculture, channel/bank modifications, road building/maintenance, urbanization, sand and gravel mining, dams, irrigation impoundments and withdrawals, river, estuary, and ocean traffic, wetland loss, and forage fish/species harvest (NMFS 2005).

The abundance of Chinook salmon returning to the watershed in the 1850s numbered approximately 8,000 fish (SSPS 2005). The recent five-year (2005-2009) average naturally spawning Chinook salmon escapement to the Dungeness River is 417 fish, of which 59% were hatchery-origin fish from the WDFW supportive breeding program considered in this document (Ford 2011). Assessments of current habitat availability and conditions indicate that the Dungeness River in its degraded state is able to

support production of 699 returning adult Chinook salmon, and that the Gray Wolf River, historically an important spawning area, is under-seeded with spawning fish (SSPS 2005). Although the species has access to its historical geographic range of habitat, spatial structure for the Chinook salmon population has been adversely affected through degradation in the quality of mainstem Dungeness River spawning and rearing habitat, and loss of historically used lower river side-channel habitat as a result of diking and other channel changes. Regarding diversity, the Chinook salmon in the river are part of a single spring-summer-run timed population of native origin fish. Migration timing appears to be unchanged over time; however, an estimated 30% of historical life-history strategies for the species have been lost due to the loss of side-channel and estuarine habitat. With regards to productivity for the Dungeness Chinook population, short-term (1995-2009) and long-term (1986-2009) population trend and growth rate estimates are 1.209 (range 1.093-1.336) and 1.096 (range 1.039-1.156), respectively (Ford 2011). Positive recruit per spawner and spawner per spawner trends for the population over the longer term (0.11 and 0.08, respectively; Ford 2011) also indicate the population is replacing itself. The other ESA-listed salmonid species – summer chum salmon, steelhead, and bull trout – have exhibited similar declines in population viability parameters from historical levels, with abundances falling such that "their low numbers allow no room for further downward cycles" (SSPS 2005, citing McNulty 2001). Status information for these listed and the other non-listed anadromous salmon populations in the watershed is described in the following sections.

The primary factors for decline of salmon and steelhead in the Dungeness River watershed result from the combined impact of past and on-going land and water use activities on fish habitat and the processes sustaining that habitat (Table 6). During the 1890s, settlers moving into the area began irrigating their agricultural lands with Dungeness River water (this and following generally from Haring 1999 and SSPS 2005). The settlers constructed dikes and wetland drainage systems near the river mouth, converting tidal and estuarine areas into farmland. Beginning with this initial development, the Dungeness River estuary has been completely modified from historical condition by extensive diking and conversion of historical estuary to agriculture and development lots. The marine nearshore habitat in Dungeness Bay has been affected by the alteration of sediment transport from the Dungeness River, by shoreline armoring, and by loss of eelgrass habitat (Haring 1999). Fish habitat in the lower 11 miles of the Dungeness River was further impacted by bank hardening to protect adjacent settled lands from erosion and flooding; clearing of riparian vegetation; gravel extractions; and operation of water diversions for irrigation purposes (EDPU 2005; Haring 1999). Dikes, levees and other actions to control the lower reaches of the river degraded rearing and migration areas for juvenile salmon. Tributaries truncated by these developmental activities harmed over-wintering habitat for coho salmon and steelhead, and contributed to scouring of redds (SSPS 2005). Diking along the river constricted the natural process of stream channel formation and the transport of sediment. Major dikes are currently located on the east bank from RM 0 - 2.6 (the "Corps" dike) as well as RM 7.6 - 8.4 (the Dungeness Meadows dike) (SSPS 2005). Other dikes and embankments constructed by private property owners are located throughout the lower ten miles of the mainstem river.

Both the upper and lower watersheds have been logged over multiple generations. Headwater areas were protected from logging through the formation of Olympic National Park, and subsequent designation of most of the Park as wilderness, but other sections of the upper watershed in the Olympic National Forest remain in commercial timber production. In these upstream areas, sediment input from unstable soils on steep slopes and forestry practices (particularly forest road management) have produced excessive sediments loads in the river (Haring 1999). Forest practice-related mass failures in

Table 6. Land use in the Dungeness River watershed (Haring 1999).

Land Use	Acres	Percent of Area Watershed
Commercial Forestland	74,624	43.26
Residential High Density	1,364	0.79
Residential Low Density	5,940	3.44
Cropland	420	0.24
Pasture/Hayland	9,899	5.74
Grass/Scrub/Shrub	7,103	4.12
Private Woodlots	8,735	5.06
Conversions	2,377	1.38
Urban Lands	410	0.24
Ponds/River Channels	808	0.47
Quarries	167	0.10
Olympic National Park	51,308	29.74
Unclassified	9,362	5.43
Grand Total	**172,517**	

some areas resulted in delivery of sediments at unnatural levels and rates to the river system. These habitat impacts have led to river channel braiding and aggradation; disconnection of the river from its floodplain; blocking of access to productive side channel habitat; scouring of redds; and seasonal low flows that can severely impair salmonid stocks (EDPU 2005). Revised National Forest policies for timber management implemented in the upper watershed have become more protective of fish and wildlife species. The National Forest Service has targeted road remediation in the Dungeness River watershed to reduce the erosional and slope destabilization effects of logging road construction. Five bridges currently span the Dungeness River, constricting the mainstem river to a narrower channel, and increasing water velocities and erosion potential to the detriment of salmon spawning, rearing and migration conditions downstream.

The Dungeness River is the river system most affected by irrigation withdrawals in western Washington, and resultant adverse impacts on salmonids were identified in the early 1900s (Haring 1999). Water rights were severely over-appropriated in a 1924 adjudication, and biologists measuring irrigation withdrawals in September of 1987 found that 82% of the total flow was being withdrawn (Jamestown S'Klallam 2007). The historical and on-going source for this water is the Dungeness River, and groundwater in its associated aquifer. Most of the water is diverted from the watershed for agricultural use through multiple water diversions (Figure 3). These withdrawals occur mainly between mid-April and September, the same time that Chinook return to the river and begin to spawn (Haring 1999). In past years, Chinook spawning success may have been impaired by these agricultural water diversions, particularly in late summer when flows are at seasonal lows. Water withdrawals continue to affect salmon spawning and rearing habitat, although measures have been implemented in recent years to reduce withdrawals during critical periods for salmon (Jamestown S'Klallam Tribe 2007). Following numerous instream flow studies, irrigation ditch efficiency analyses, construction projects to line ditches and "plug leaks" in the system, instream flows have improved dramatically relative to initial post-development conditions. However, with the increasing human population in and around the city of Sequim, Washington, the demand for water for irrigation, domestic, and business use has markedly

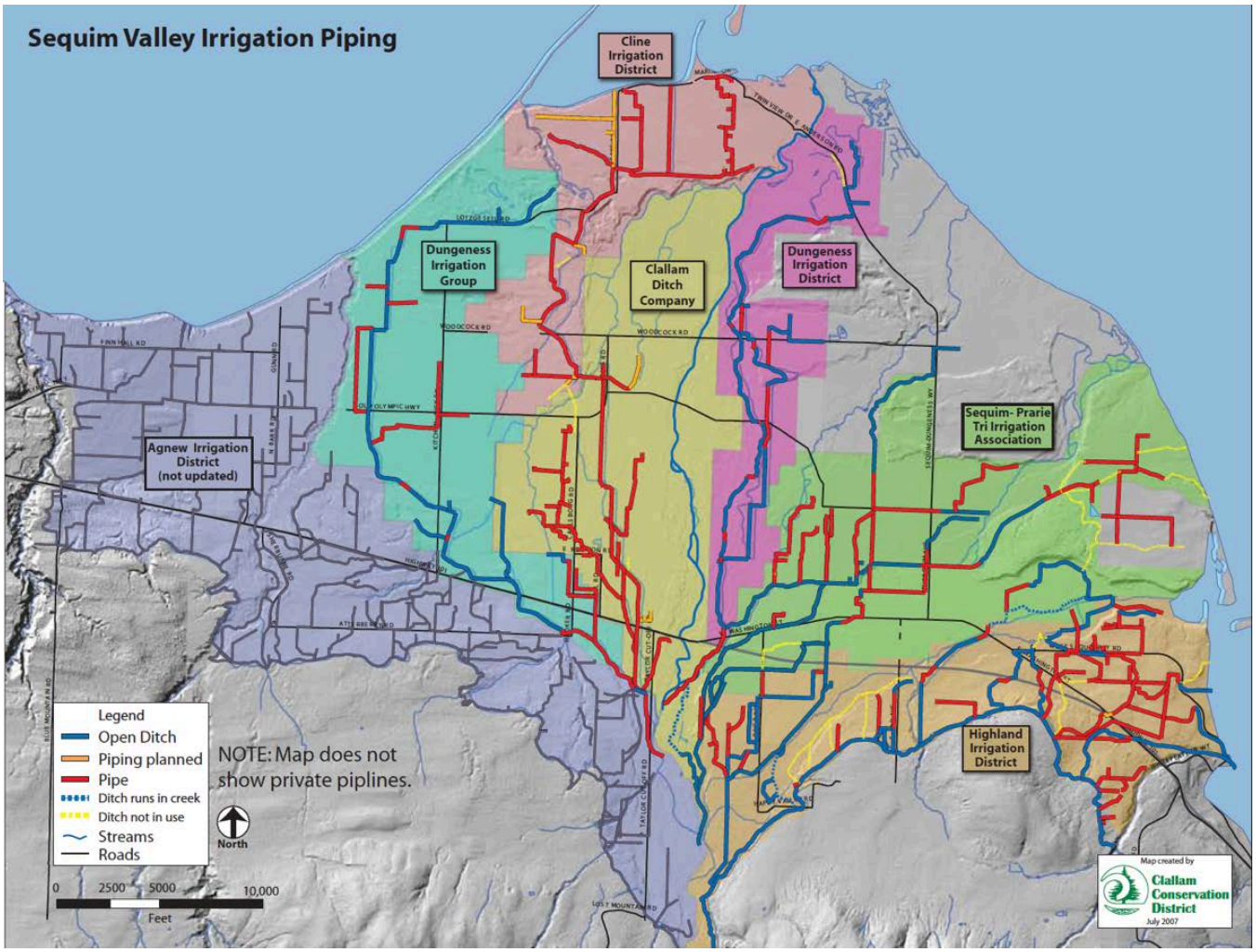

Figure 3. Irrigation districts, water withdrawal locations, and water conveyance systems within the Dungeness River Basin. Source: Clallam Conservation District; July 2007.

increased (SSPS 2005). In addition to the increasing demand for fresh water, burgeoning human development in the watershed has added contaminated run-off from lawns, driveways, parking lots, and other urban landscape features, and from farm animals, decaying irrigation ditches, leaky septic systems and other sources. The Jamestown S'Klallam Tribe was forced to abandon their commercial oyster farm in Dungeness Bay last decade due to excessive bacteria levels from these sources (SSPS 2005). The Clallam Conservation District has implemented major improvements in irrigation ditch systems to reduce or eliminate the addition of pollutants into the Dungeness River, tributaries and Dungeness Bay. Additionally, water temperatures in the Dungeness mainstem and side channels have been improved by the reduction of diversions by the agricultural community (Jamestown S'Klallam 2007).

A non-habitat related potential factor for decline was operation of a full river spanning weir at Dungeness River Hatchery at RM 10 beginning in the 1930s. The weir blocked Chinook salmon access to upstream spawning areas for approximately 50 years (SSPS 2005). Although the weir was abandoned in the 1980s (since that time, returning adults are collected primarily as volunteers to an off-channel

hatchery trap), its operation in prior years likely harmed the abundance and spatial structure of the natural-origin Dungeness Chinook population.

The above-described habitat degradation and loss factors have adversely affected the viability status of salmon and steelhead in the watershed. Haring (1999) identified major alterations of fish and river-basin habitat as the primary limiting factors to the recovery of abundant and productive salmon populations in the Dungeness River watershed. These factors are summarized as follows:

- Road construction and logging in upper watershed forested areas that increased the rate of mass wasting and sedimentation to streams;
- Removal of timber and conversion of forestland to rural development in the rain-on-snow zone in the upper portions of the watershed that substantially increased run-off during storm events;
- Agricultural and urban development in the lower watershed that resulted in floodplain constriction and channelization, increased sedimentation of stream gravels, loss of large woody debris (LWD) and instream pools, and elimination or substantial reduction in the presence of functional riparian buffers;
- Water withdrawals for agricultural irrigation and domestic use that substantially reduce the availability of instream flow during the adult salmon upstream migration and spawning periods, and result in spawning redds being constructed in channel areas that are extremely susceptible to sediment scour and deposition;
- Increases in impervious surfaces associated with various land uses that increase the frequency and magnitude of storm-water runoff, and decreases the infiltration of precipitation to groundwater;
- The severe decline in numbers of adult salmonids that return to spawn, decreasing carcasses that provide the marine-derived nutrient base that serves as the foundation of the food web, and diminishing modifications of channel substrate and channel shape afforded by naturally spawning salmon that are beneficial to salmonid productivity;
- Alteration of the estuary, substantially affecting its habitat and physical functions to the detriment of juvenile fish rearing and migration and adult fish transition to freshwater; and,
- Degradation of nearshore habitat through extensive armoring of the shoreline, alteration of the long-shore littoral drift process (resulting from shoreline armoring and alteration of the sediment supply from streams), and loss of eelgrass habitats critical to juvenile salmonid survival.

Primary bottlenecks to the recovery of salmon and steelhead populations to a viable level resulting from the above factors are: insufficient egg/alevin incubation and juvenile rearing conditions and capacity in the watershed; inadequate adult migration, holding, and spawning conditions and capacity in the lower mainstem river; and egg and fry mortality during incubation (NMFS 2006).

Haring (1999) identified the following actions required in combination for salmonid recovery in the watershed:

- revision, implementation, and enforcement of land use ordinances that provide protection for natural ecological processes in the marine, instream, and riparian corridors, including measures to maintain impervious surfaces to levels, and in a manner, that will maintain natural hydrology;
- protection of marine, instream, and riparian habitat that is currently functioning, particularly key habitat areas; and

- restoration of natural marine, instream, and riparian ecological processes where they have been impaired.

Measures to address these and other limiting factors and threats to salmon recovery in the watershed are in the process of implementation, consistent with approaches specified in the Dungeness Watershed chapter of the Shared Strategy for Puget Sound salmon recovery plan (SSPS 2005).

Hatchery programs can adversely affect natural-origin salmon and steelhead and their habitat through genetic risks, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer (Table 7). Hatchery programs can benefit natural-origin salmon and steelhead through marine-derived nutrient cycling effects, by preserving and increasing abundance and spatial structure, retaining genetic diversity, and potentially increasing productivity of a natural-origin population if natural-origin abundance is low enough that a population is at risk of extinction or fish are having difficulty finding mates. Table 7 lists the various effects through which the hatchery programs could affect natural-origin salmon and steelhead populations in the Dungeness River.

The extent of adverse hatchery-related effects depends on the design of the hatchery programs, the condition of the habitat, and the current status of the species, among other factors. Available information suggests that hatchery rearing can have a substantial adverse genetic effect on the fitness of associated natural-origin populations. However, this current understanding of the genetic effects of hatchery fish spawning with their natural-origin counterparts relies heavily on one study of steelhead in the Hood River, Oregon, and the data and theory are insufficient to predict the magnitude and duration of 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). In an assessment of Columbia River Basin hatchery program effects, the Hatchery Scientific Review Group (HSRG) acknowledged that, in watersheds with lost or severely degraded habitats, some hatchery programs may be required to perform a “life support” function to prevent functional extirpation of a naturally spawning population (HSRG 2009a). They also concluded that “the abundance of fish representing a natural population must be sufficiently high to allow selection in the natural environment to be an effective deterministic force towards maximizing mean population fitness in view of stochastic forces.” Their view was that under exceptional circumstances, maintaining a naturally-spawning component for a hatchery-sustained population may be desirable for both genetic and demographic reasons (HSRG 2009a). These recent studies, and review findings by the HSRG, suggest that, 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 supplementation also has the potential to increase competition with and predation on wild fish. However, hatchery programs may be designed to limit opportunities for co-occurrence and interaction between hatchery-origin fish and migrating natural-origin fish, reducing potential adverse effects from competition and predation. Although poorly managed hatchery programs can increase fish pathogen and fish disease transfer risks, compliance with applicable fish health management protocols can effectively minimize these risks (NMFS 2012a).

Turning to the potential benefits of hatchery programs, as mentioned above, conservation hatchery programs may accelerate recovery of a target population by increasing abundance faster than may occur

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. • 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. • 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. • Weirs for broodstock collection or to control the number of hatchery-origin fish on the spawning grounds can have the following unintentional consequences: o Isolation of formerly connected populations o Limiting or slowing movement of migrating fish species, which may enable poaching or increase predation o Alteration of stream flow o Alteration of streambed and riparian habitat o Alteration of the distribution of spawning within a population o Increased mortality or stress due to capture and handling o Impingement of downstream migrating fish o Forced downstream spawning by fish that do not pass through the weir o Increased straying due to either trapping adults that were o 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 carrying 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. • Spatial Structure: Preservation or expansion of the spatial structure of a natural-origin fish population resulting from implementation of a hatchery program. • Genetic diversity: Retention of within-population genetic diversity of a natural-origin fish population resulting from implementation of a hatchery program. • 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).
Nutrient cycling	• Returning hatchery-origin adults can increase the amount of marine-derived nutrients in freshwater systems.

naturally (Waples 1999). Hatchery programs can also be used to create genetic reserves for a population to prevent the loss of its unique traits due to catastrophes (Ford 2011). Hatchery programs, simply by virtue of creating more fish, can increase effective breeding population sizes. In very small populations, this can be a benefit, making selection more effective and reducing other small-population size risks (e.g., Lacy 1987; Whitlock 2000; Willi et al. 2005). Conservation hatchery programs can thus serve to protect genetic diversity; several, such as the supportive breeding programs for Elwha River salmon and steelhead (NMFS 2012b), Lake Ozette sockeye salmon (NMFS 2004), and Snake River sockeye salmon (Flagg et al. 2004), are important genetic reserves for unique, at-risk salmon populations.

A more detailed discussion of the general effects of hatchery programs on salmon, steelhead, and their habitat can be found in the Draft Environmental Impact Statement on Two Joint State and Tribal Resource Management Plans for Puget Sound Salmon and Steelhead Hatchery Programs (NMFS 2014).

3.4.1. Puget Sound Chinook Salmon (ESA-listed)

The Dungeness Chinook salmon population is among the 22 populations of Chinook salmon delineated by NMFS in the Puget Sound region (Ruckelshaus et al. 2006). The Dungeness Chinook salmon population is grouped with one other population – the Elwha – in the Strait of Juan de Fuca 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, in combination with requirements elsewhere in the ESU, recovered and delisted (NMFS 2007) – therefore, the Dungeness Chinook salmon population must be brought to a low extinction risk status.

The extant Dungeness Chinook salmon population is considered a spring/summer-run timed (or "early") population, based on spawn timing. Adult weir operations in 1997 and 2001 indicate that most of the

adult Chinook return has entered the river by early August (PSIT and WDFW 2010). The population spawns in the watershed from mid-August to mid-October (WDFW and WWTIT 1994). Spawning begins about two weeks earlier in the upper Dungeness River main stem and in the Gray Wolf River, than in the main stem below its confluence with the Gray Wolf River (WDFW and WWTIT 1994; Ruckelshaus et al 2006). The area of spawning extends to the impassable falls on the Dungeness River mainstem at RM 18.7 where falls, just above the mouth of Gold Creek, block further access. Chinook salmon also spawn at least into the lower 6.1 miles of the Gray Wolf River, although the river is accessible to migrating anadromous fish to RM 8.0 (WDFW and WWTIT 1994; Haring 1999). Chinook salmon also spawn in the lower Dungeness River downstream of Dungeness River Hatchery, and in lower Canyon Creek below the existing hatchery water intake dam at RM 0.08 (Haring 1999).

Adults mature primarily at age four (63%), with age 3 and age 5 adults comprising 10% and 25%, of the annual returns, respectively (Myers et al.1998). Dungeness Chinook salmon predominantly exhibit an ocean-type life history trajectory (95 to 98 percent of the total emigrating population – Myers et al. 1998), with juveniles emigrating seaward from mid-February through the end of July as fry, fingerlings, or sub-yearlings smolts after just a few months of rearing in the watershed. A small portion of the population may rear in the river for a year and emigrate seaward as yearlings (Marlowe et al. 2001; SSPS 2005). Through juvenile outmigrant trapping at RM 0.5 just above the point of tidal influence, Topping et al. (2006) found two distinct peaks in natural-origin Chinook salmon seaward emigration, indicating newly emerged fry and subyearling smolt migration trends. Emigration abundance peaks occurred on March 16 for fry (average individual size of 39 mm fl) and June 8 for subyearling smolts (average size of 74 mm fl). Fry accounted for an estimated 24% of the emigrating juvenile population and 76% emigrated seaward as subyearling smolts (Topping et al. 2006).

The current abundance of Dungeness Chinook salmon is substantially reduced from historical levels (SSPS 2005). The historical equilibrium abundance level[3] for the Dungeness population is 8,100 fish (Ruckelshaus et al. 2002). From 1986 through 2000, the average total escapement in the watershed was 153 fish. Between 2000 and 2011, the estimated average total annual naturally spawning Chinook salmon escapement was 559 fish (Figure 4; WDFW 2013a). The recent year Chinook salmon abundance measured as natural spawning escapement to the river is 6.9% of the historical equilibrium abundance for the population. Assessments of current habitat productivity in the watershed suggest that the Dungeness River can theoretically support 699 Chinook salmon spawners, and that the Gray Wolf River is underutilized (SSPS 2005).

Chinook salmon produced in the Dungeness River Hatchery are included as part of the Dungeness population, and listed with natural-origin fish as threatened. Hatchery-origin Chinook salmon make up a sizeable fraction of the annual naturally spawning adult abundance, averaging 77% for the basin in recent years (2000-2011), and ranging from 39% to 96% (WDFW 2013a). The highest observed hatchery-origin escapements (2001-2006) reflect years when adult fish progeny of captive broodstock program Chinook salmon returned to spawn (PSIT and WDFW 2010). The captive broodstock program, by design, was terminated after the 2003 brood (2006 return year), and escapements correspondingly decreased in return years 2007 through 2009. A reinitiated supplementation hatchery program based on

[3] "Historical equilibrium abundance" is the estimated maximum (upper level) number of naturally spawning Chinook salmon under properly functioning habitat conditions in the Dungeness River watershed. The lower level of the planning range for equilibrium spawner abundance is 4,700 fish.

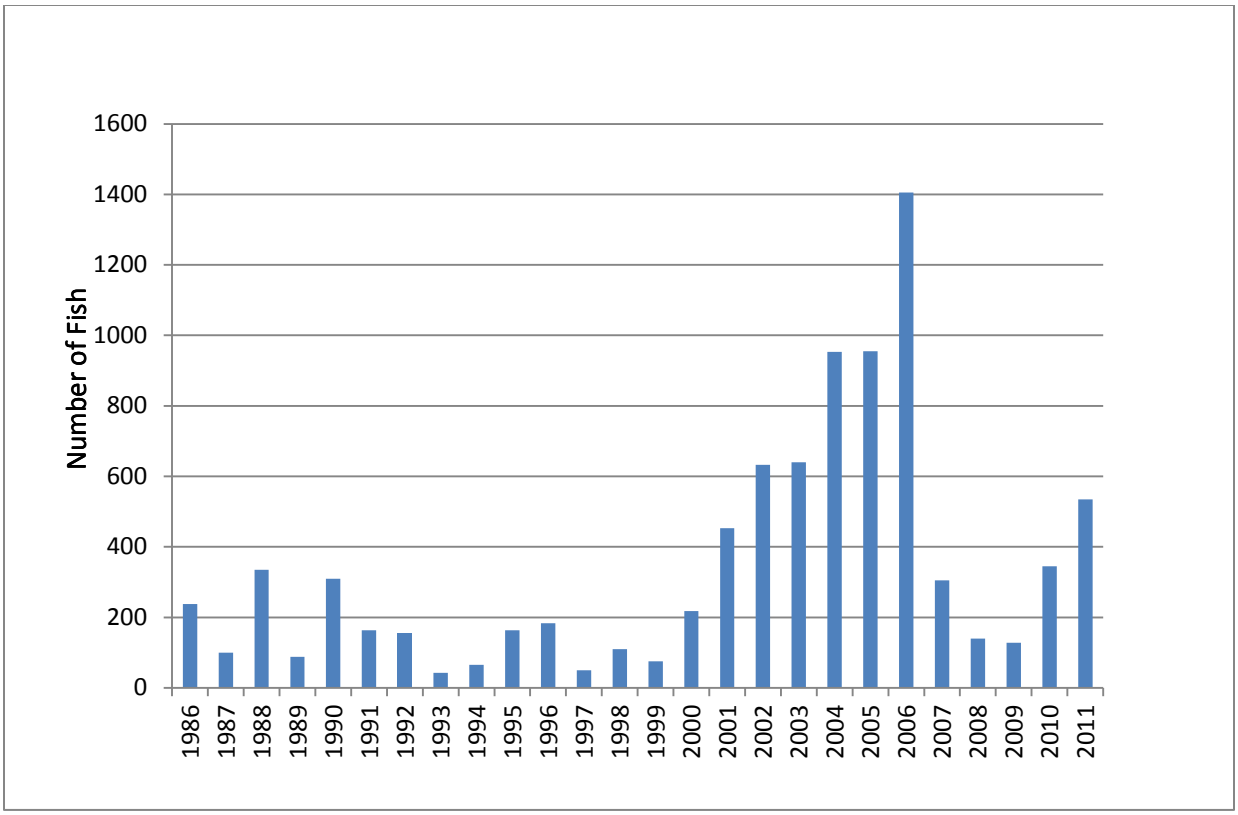

Figure 4. Estimated annual naturally spawning Chinook salmon escapement abundance in the Dungeness River for 1986 – 2011 (Data sources: PSIT and WDFW 2010; WDFW 2013a).

subyearling fish releases is increasing adult returns and natural spawning levels (return years 2010 and 2011).

Spatial structure for the Dungeness Chinook population has also been affected over time relative to historical levels. A full spanning weir operated beginning in the 1930s in association with the Dungeness Hatchery program to collect broodstock at RM 10.8 precluded unrestricted upstream access and spawning in the upper Dungeness River watershed for 50 years, although some Chinook salmon were known to have regularly escaped upstream during that period (Haring 1999; SSPS 2005). The rack was removed in the 1980s. Although Chinook salmon continue to have access to their historical geographic range of habitat, and now spawn throughout the entire river, recent year low adult return levels have led to underutilization of accessible areas, especially in the Gray Wolf River (SSPS 2005). Side channel habitat in the lower river, once available for spawning and rearing, has been lost due to diking and other land and water-use activities described above. Spatial structure for the population has been adversely affected through dikes, levees and other actions to control the lower reaches of the river and tributaries. These actions have degraded available spawning and migration areas for adult fish and refugia for rearing juvenile salmon. Finally, as noted above, water withdrawals have substantially reduced flows needed during the adult salmon upstream migration and spawning periods, result in spawning redds being constructed in channel areas that are extremely susceptible to sediment scour and deposition.

Genetic diversity of the Dungeness Chinook salmon population has been substantially reduced by anthropogenic activities over the last century. Extensive human disruptions in the watershed, including

sporadic releases of non-native hatchery fall Chinook salmon in the last century, may have severely impacted a late-returning life history of Chinook salmon that existed in the watershed (Ruckelshaus et al. 2006, citing Williams et al. 1975; Jamestown S'Klallam Tribe 2003). Recent assessments indicate that only one Chinook salmon stock with no discontinuity in spawning distribution through time or space exists in the basin (Ruckelshaus et al. 2006, citing Marlowe et al. 2001). The Puget Sound Chinook salmon TRT concluded that the late-returning life history in the Dungeness River was an important part of the historical diversity of the Chinook salmon population (Ruckelshaus et al. 2006). 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 represents a particularly important loss of the evolutionary legacy of the historical ESU. As a now rare race in the region, the substantially reduced abundance of the Dungeness spring/summer-run population relative to historical levels represents a risk to remaining ESU diversity.

Productivity for Dungeness Chinook salmon has remained relatively stable since the Puget Sound Chinook ESU was listed in 1999. The most recent NMFS status review for the listed ESU found that productivity trends for the population, as measured by recruit per spawner and spawner to spawner rates, are slightly positive, and at the replacement level (Table 8).

Table 8. Average productivity for the Dungeness Chinook salmon population, and the entire ESU, for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S) for natural origin fish. "ESU" refers to the aggregate Puget Sound Chinook Evolutionarily Significant Unit.

Brood Years	**1982-1986**		**1987-1991**		**1992-1996**		**1997-2001**		**2002-2006**		**Trend**	
Population	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**	**R/S**	**S/S**
Dungeness	*0.58*	*0.21*	*0.31*	*0.11*	*0.25*	*0.20*	*1.67*	*0.93*	*0.44*	*0.18*	*0.11*	*0.08*
ESU	*9.57*	*2.19*	*5.05*	*0.96*	*3.01*	*1.24*	*2.70*	*1.19*	*1.67*	*0.67*	*-1.81*	*-0.28*

Source: Ford (2011). R/S, S/S, and trend findings based on assumptions for years where escapements were not sampled to determine actual hatchery: natural-origin escapement ratios.

Although the Dungeness Chinook salmon population appears to be replacing itself, low egg-to-juvenile outmigrant survival rates reflect a general low productivity for the population. WDFW has operated screw traps in the lower Dungeness each year since 2005 to estimate the number of juvenile salmon produced in the basin. Estimates for Chinook salmon production ranged from a high of 136,571 in 2007 to a low of 14,239 smolts in 2008 (PSIT and WDFW 2010a - data from WDFW juvenile outmigrant monitoring annual report series, including Topping et al. 2006; Topping et al. 2008). Estimated egg to smolt survival has averaged around 4% over that period. For comparison, in the Skagit River, where natural habitat is in better condition for Chinook salmon productivity, egg to smolt survival estimates average approximately 8% for the same period, and over 10% since 1990.

Chinook salmon produced through the Dungeness River Hatchery program are not the focus of any directed harvest in fisheries within the analysis area. Mark recovery data using tagged Elwha hatchery subyearlings as the surrogate indicate that Dungeness hatchery-origin Chinook salmon are harvested

incidentally at very low levels in southern U.S. mixed stock marine area fisheries targeting more abundant Chinook stocks and other species (PSIT and WDFW 2010a). Fishery mortality in U.S. fisheries in the analyses area are expected to remain very low, because Chinook salmon-directed commercial and recreational fisheries are not expected to occur, and coho and pink salmon fisheries will continue to be regulated to limit incidental Chinook mortality (PSIT and WDFW 2010a). Incidental harvest of Dungeness River Chinook salmon occurs predominantly in Canadian troll, sport and net fisheries, which account for an estimated 35.4% of total recoveries (all fisheries plus escapement) of coded wire-tagged subyearling fish for the brood years for which Dungeness Chinook tag recovery data are available (WDFW 2013a). Canadian fishery impacts on U.S. Chinook salmon populations are managed and limited in accordance with U.S./Canada Pacific Salmon Treaty harvest sharing agreements.

Review of estimated average total exploitation rates for Strait of Juan de Fuca Chinook for the periods 1983-1987 (76%), 1998-2000 (38%), and 2001-2003(18%) indicate that harvest rates for Chinook salmon in the region declined by 76% (PSIT and WDFW 2004). Incidental harvests in current U.S. marine area fisheries are managed to further limit impacts on Dungeness Chinook salmon. When projected total (hatchery and natural-origin fish) escapement to the Dungeness River exceeds 500 fish, U.S. fisheries are managed to not exceed a 10.0% exploitation rate on the population. If escapement is projected to be below 500 fish, U.S. fisheries will be managed to further reduce incidental mortality to an exploitation rate on adult and sub-adult Dungeness Chinook salmon of less than 6.0% (PSIT and WDFW 2010a; NMFS 2011).

3.4.2. Puget Sound Steelhead (ESA-listed)

The Puget Sound Steelhead Technical Recovery Team (PSTRT) delineated one extant steelhead population that is native to the Dungeness River watershed and part of the listed Puget Sound steelhead DPS: Dungeness River Winter-Run (Hard et al. 2012). A summer-run component of the steelhead return to the Dungeness River is thought to have existed historically in the upper accessible reaches of the mainstem Dungeness River and Gray Wolf River (Haring 1999), but it is uncertain whether the race still persists in the watershed. In a recent evaluation of Washington steelhead populations, WDFW listed the summer-run race in the Dungeness River as still extant (Scott and Gill 2008). Although, the population delineated by the PSTRT includes only winter-run steelhead, the group concluded that further monitoring is needed to establish whether native summer-run fish are still present and if they are part of a combined summer/winter population or represent an independent population. Under draft DPS viability criteria under development and consideration by NMFS (Hard et al., pending), at least one winter-run and one summer-run population of the six populations in the Olympic Major Population Grouping will be identified as key populations needing to be restored to a low extinction risk status for recovery and delisting of the DPS. Hatchery-origin steelhead released from Dungeness River Hatchery (not part of the proposed actions considered in this document) are not included as part of the listed DPS.

The Dungeness River winter-run steelhead population includes fish spawning in the mainstem Dungeness and Gray Wolf Rivers (this and following from Hard et al. 2012). The extent of spawning is confined to areas downstream of naturally impassable barriers to migration on the Dungeness River and the Gray Wolf River, which prevent upstream access. Steelhead in the watershed enter the river on their spawning migration from mid-September to early June. Spawning occurs from March through June, with peak spawning in May. Although data are lacking for the Dungeness population, most natural-origin winter-run steelhead in Puget Sound return to spawn as four year-old fish, with five year-olds

comprising a significant proportion of total returns (Hard et al. 2012, citing WDFW 1994). Dungeness winter steelhead spawning distribution extends from the Dungeness River mainstem at RM 18.7, downstream to the upper extent of tidewater (Haring 1999). Winter steelhead distribution is assumed to include the Bell, Gierin, Cassalery, Cooper, Meadowbrook, Matriotti, Beebe, Lotsgazell, Woodcock, Mud, Bear, Hurd, Bear, Canyon, and Gold Creek watersheds, and the Gray Wolf River. Juvenile out-migrant trapping data for the 2005 migration year indicate that natural-origin Dungeness River steelhead juveniles emigrate seaward as smolts between February and early July, with peak migration during the first two weeks of May (Topping et al. 2006). Steelhead smolt individual sizes in the trapping study ranged from 130-mm to 290-mm (fl), and averaged 175.2 mm (fl).

Harvest data from the 1940s indicate that the total winter-run steelhead adult return to the Dungeness River could have exceeded 4,400 fish (Hard et al. 2012). As a surrogate indicator of relative abundance, catch estimates based on adjusted catch recording card returns from sport harvest averaged 348 steelhead from 1946 to 1953 prior to the introduction of “large numbers of hatchery fish” (Hard et al. 2012). Due to the turbid character of the Dungeness River during peak spawning activity, the ability to conduct spawner surveys to assess annual abundance levels is limited. The last escapement estimate for Dungeness winter steelhead was in the 2000/2001 season with an estimated escapement of 183 fish based on index areas. Since 2001, only partial surveys have been conducted in the watershed system and data were insufficient to generate steelhead escapement estimates (WDFW 2013a). An estimate of the intrinsic potential based spawner capacity indicates that the Dungeness River watershed could support the production of 2,039 natural-origin steelhead (Hard et al. 2012).

In the most recent status review for the Puget Sound Steelhead DPS, NMFS found that, since 1995, natural-origin Puget Sound steelhead abundance has shown a widespread declining trend over much of the DPS (Ford 2011). Similarly, winter-run steelhead counts made opportunistically in selected areas in the Dungeness River watershed have been very low and have steadily declined since the early 1990s (WDFW 2013a). The estimated probability that the Dungeness River winter-run steelhead population would decline to 10% of its current fish abundance (~100 fish) within 100 years is high but cannot be calculated because of the lack of sufficient abundance data (Ford 2011). The co-managers identify a critical threshold for winter-run steelhead of 125 fish, reflecting the estimated escapement level needed so that the annual effective size, or number of successful breeders, would not be lower than 50 if a ratio of the annual number of effective breeders to spawner census of at least 0.40 was achieved. The viable threshold for the population, reflecting a level of population abundance associated with a very high probability of persistence, or conversely, a very low risk of extinction, for a period of 100 years, ranges from 500 to 750 fish (PSIT and WDFW 2010b).

Spatial structure of the winter-run steelhead population has likely been adversely affected by habitat loss and degradation to the same degree, and for the same reasons mentioned above for Dungeness Chinook salmon. However, due to their later run timing, spatial structure for the winter-run steelhead population was not likely affected by seasonal operation of the Dungeness River Hatchery weir to collect Chinook salmon adults as broodstock from the 1930s through the 1980s. Summer-run steelhead distribution in the watershed may have been adversely affected by the weir when it was in operation over that period.

Available data indicate that steelhead diversity in the Dungeness River watershed has declined relative to historical levels. It is likely that the historically extant summer-run component of the steelhead return has declined to very low levels or has become extirpated. As with Chinook salmon in the watershed,

degradation and loss of habitat in the watershed, and past harvest practices, have reduced the diversity of the species in general relative to historical levels. Genetic diversity for the native winter-run population may have been adversely affected by releases of non-native Chambers Creek steelhead from Dungeness River Hatchery, although there are no genetic data indicating that introgression associated with planting of the non-native stock has occurred.

With an estimated mean population growth rate of -0.096 ($\lambda = 0.908$) and process variance of < 0.001, Ford (2011) reported high confidence ($P < 0.05$) that a 90% decline in the Dungeness River winter-run steelhead population will not occur within the next 20 years (but will occur within 30 years), and that a 99% decline will not occur within the next 40 years (but will occur within 55-60 years). However, for other years and values of decline, they were less certain about the precise level of risk (Ford 2011). WDFW juvenile outmigrant trapping at the Dungeness River mouth from 2005 to 2011 showed an average annual production of natural-origin winter-run steelhead smolts of 11,729 smolts (range 6,125 to 19,600 fish) (WDFW 2013a). Annual steelhead smolt productivity appears to be trending upwards based on the short term annual observations.

Steelhead were historically harvested in the Dungeness River from December through February, using fish traps or lines, although Dungeness Bay and in-river conditions may not have been amenable for harvesting fish during the summer months (Hard et al. 2012, citing Gunter 1927). Current fisheries for winter-run steelhead returning to the Dungeness River target non-listed hatchery-origin fish produced through the Dungeness River Hatchery program (this and following from PSIT and WDFW 2010b). Tribal steelhead fisheries, for commercial, subsistence and ceremonial purposes, are normally open for up to four and a half days per week from the second week of December through February in Area 6D (Dungeness Bay) and in the Dungeness River. Tribal regulations permit use of nets and hook-and-line gear. Tribal fishing is excluded within a 1500-foot radius at the mouth of the Dungeness River as a measure to reduce impacts on milling/staging adult fish. The tribal hook-and-line subsistence fishery in the river is open from December through mid-March, under a daily bag limit of 2 fish. The recreational fishery in the Dungeness River is open from mid-October through February, from the mouth upstream to the Dungeness Forks Campground. Game fish regulations state the daily bag limit of two fish over 14 inches, composed of marked (hatchery-origin) steelhead, sea run cutthroat, or resident trout. The Gray Wolf River is closed to recreational fishing from November through early June. Annual tribal and recreational fisheries harvests of mainly hatchery-origin winter-run steelhead in the analyses area from 1998 through 2008 averaged 15 fish (range 0 to 67 fish) and 54 fish (range 23 to 200 fish), respectively (PSIT and WDFW 2010b). Recreational regulations require the release of unmarked (wild) steelhead, and both recreational and treaty fisheries close at the end of February, in advance of the peak of wild steelhead entry. Mortalities of the earliest returning natural-origin steelhead likely occur in these hatchery steelhead-directed fisheries, but available data indicate that incidental harvests of natural steelhead are unsubstantial. From 2003 through 2008, the estimated annual harvest of natural-origin steelhead in recreational fisheries was 0 (PSIT and WDFW 2010b). The harvest of wild fish in tribal fisheries for the year 2003 through 2008 was unknown, but likely very low given low total steelhead harvests over the period, averaging 20 fish per year (PSIT and WDFW 2010b).

3.4.3. Hood Canal Summer-Run Chum Salmon (ESA-Listed)

The Hood Canal Summer-run Chum Salmon ESU was listed as a threatened species under the ESA in 1999 (64 FR 14508, March 25, 1999) and reconfirmed in 2005 (70 FR 37160, June 28, 2005). The ESU

includes all natural-origin summer-run chum salmon in the eastern Strait of Juan de Fuca and Hood Canal of western Washington. Based on genetic analysis, historical and present geographic distribution, straying patterns, and life history variation, Sands et al. (2009) identified two independent populations of natural-origin summer-run chum salmon. One population (Strait of Juan de Fuca population) occurs in eastern Strait of Juan de Fuca watersheds (including Chimacum Creek), and the second (Hood Canal population) occurs in Hood Canal watersheds. NMFS designated critical habitat for the Hood Canal summer-run chum salmon ESU to include the portions of the Dungeness River watershed accessible to summer chum salmon, Dungeness Bay, and adjacent nearshore marine waters (70 FR 52630, September 2, 2005).

The Strait of Juan de Fuca population includes as a component a very small summer chum salmon aggregation that spawns in the Dungeness River. The Dungeness River is not included in the 1993 Puget Sound salmon stock inventory as currently supporting a summer chum population (WDF et al. 1993). Summer chum have been periodically observed during the months of September and October in the Dungeness River in the course of monitoring and collecting Chinook and pink salmon escapement data. These data indicated that a modest-sized, self-sustaining run is present in the system. The Summer Chum Salmon Conservation Initiative (SCSCI) (WDFW AND PNPTT 2000) rated Dungeness River summer chum salmon as “of special concern” in status because of the lack of historical or current stock assessment information. Summer chum salmon have been infrequently observed in small numbers in the Dungeness River, and the historical size of this spawning aggregation is unknown (WDFW and PNPTT 2000). There is uncertainty about whether the Dungeness River represents a subpopulation or a minor spawning aggregation within the Strait of Juan de Fuca population (Sands et al. 2009). Under the SCSCI, the Dungeness River was not recommended for initiation of a hatchery-based supplementation program to recover the species in the watershed. No project was recommended until sufficient knowledge about the summer chum population is collected to make an adequate assessment of the risks and potential for successful implementation of a supportive breeding program (WDFW and PNPTT 2000). There is therefore no associated, listed hatchery-origin summer chum salmon group.

Summer chum adults observed in the watershed migrate into the mainstem river beginning in late August. Spawning occurs from late August through early October, generally in the lowest 1 to 2 miles of the mainstem portion of the river, but adults have been recovered in some years at Dungeness River Hatchery (RM 10.8) (WDFW and PNPTT 2000; NMFS 2002b). Age class at return data are lacking for summer chum salmon in the Dungeness River. Most natural-origin summer-run chum salmon in the ESU return to spawn as either three or four year-old fish, with five year-olds comprising a smaller proportion (~5%) of total annual returns (WDFW and PNPTT 2000). Juvenile life history data for summer chum salmon in the Dungeness River is also lacking, but natural-origin summer-run chum salmon fry in other watersheds within the Strait of Juan de Fuca portion of the ESU emerge from stream gravels predominantly in late March and April (Tynan 1997; WDFW and PNPTT 2000), and out-migrate at an individual size of 39-40 mm (fl) immediately, without delay in freshwater, to marine waters (Schreiner 1977; Koski 1981; Salo 1991).

Although escapement estimates for summer chum are lacking, extensive monitoring of adult salmon spawning in the Dungeness River has occurred during August through October since at least 1986 through spawner surveys focused on Chinook and pink salmon. Surveys of salmon on the Dungeness River from 1974 through 1978 suggest that the watershed had few to no summer chum spawners in most years, but in 1976, 199 summer chum salmon were observed (WDFW and PNPTT 2000). Subsequent

surveys confirmed very low annual abundances of the species, with estimated Dungeness River escapement representing 1.5% of the total spawning for the Strait of Juan de Fuca population in 2004 and 0.02% in 2005 (Sands et al. 2009). But spawner survey emphasis on other species, such as Chinook salmon, sometimes results in incomplete coverage of potential summer chum holding and spawning areas (WDFW and PNPTT 2000). Since 1987, however, summer-timed chum salmon have been observed in the Dungeness River every year, with partial peak counts ranging between 1 and 60 fish. For the most recent five years for which data are available (2007-2011), 0 to 3 summer chum salmon were observed annually during Chinook and/or pink salmon-directed spawning ground surveys. The potential contribution of summer chum spawning to abundance of the Strait of Juan de Fuca population under recovered habitat conditions is unknown. However, the NMFS Biological Review Team estimated that the Dungeness River could potentially support a summer chum salmon spawning aggregation of about 6,000 to 20,000 fish considering the extent of accessible habitat and assuming its recovery to properly functioning conditions for the species (Sands et al. 2009).

Primary factors that contributed to summer chum salmon population abundance declines across the ESU were habitat degradation, logging, over-harvest in fisheries, and climate effects (NMFS 2005). The specific factors responsible for the poor status of summer chum salmon in the Dungeness River are unknown, but likely similar to those habitat-related factors identified above for Chinook salmon and steelhead. A recovery plan for the species prepared by the Hood Canal Coordinating Council (Summer Chum Salmon Plan (SCSP) HCCC 2005) was authorized by NMFS for the implementation of habitat restoration actions to address these limiting factors. Actions have been implemented in the Dungeness River watershed consistent with the SCSP that are expected to benefit the survival and productivity of summer chum salmon as the proposed salmon hatchery programs for other salmon species continue under the baseline.

There are no population viability data available for summer chum salmon in the Dungeness River, due to the species' sporadic and low level of occurrence in the watershed (Sands et al. 2009).

Fisheries harvest impacts on summer chum salmon in the Dungeness River are unknown, but likely have been very low due to the low and infrequent observations of the species. The seasonal timing of commercial coho salmon fisheries is specifically designed to avoid summer chum impacts, and the late start of the fisheries relative to summer chum spawn timing has been effective in eliminating encounters with listed summer chum salmon originating from the Dungeness River and other watersheds in Dungeness Bay (marine area) gillnets. NMFS' ESA authorization for the co-managers' harvest management plan for Hood Canal summer chum salmon recognized that the status of the summer chum salmon population in the Dungeness River is unknown (NMFS 2001a). No critical thresholds are therefore required or applied in the river to manage harvest impacts on the species. As an implementation term, NMFS required initiation by the co-managers of escapement surveys sufficient to monitor the status of Dungeness River summer chum salmon population (NMFS 2001a). In response, spawning ground surveys conducted by the co-managers for Chinook salmon also record observations of summer-run chum salmon spawners and carcasses within areas used by Chinook salmon (WDFW 2013a). It is likely that surveys in the Dungeness River downstream of Dungeness River Hatchery substantially cover areas used by summer chum salmon, given the propensity of summer chum salmon to spawn in the lowest portion (lowest one-half mile) of watersheds within their range (WDFW and PNPTT 2000).

3.4.4. Puget Sound Fall Chum Salmon (Non-listed)

Fall chum salmon in the Dungeness River watershed, aggregated with other fall chum spawning in other eastern Strait of Juan de Fuca tributaries as the "Dungeness/East Strait Tribs" population (WDFW and WTIT 1994), 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 is one fall chum salmon aggregation in the Dungeness River watershed that is considered a native, natural-origin stock (WDFW and WTIT 1994). No genetic analysis has been done on Dungeness/East Strait Tribs fall chum salmon to ascertain it's standing as a unique independent population. There is no associated hatchery population of fall chum salmon in the watershed. The native Dungeness River fall chum stock is considered unknown in status due to the lack of historical abundance trend information (WDFW and WTIT 1994). Spawning occurs from mid-November through December in the lower Dungeness River and in a small channel, locally known as Beebe Creek, that drains into Matriotti Creek (a lower Dungeness River tributary) (WDFW and WTIT 1994). Haring (1999) reported spawning distribution to include the Dungeness River upstream to RM 11.8, Bear Creek, Matriotti Creek to RM 0.9, and to the upper end of Beebe Creek.

Juvenile chum emigrate seaward soon after emerging from the gravel as unfed fry from February through the end of May, with peak migration in late March and early April (Topping et al. 2008). The historical (pre-development period) abundance of fall chum salmon in the watershed is unknown. Annual run sizes to the Dungeness River watershed from 1968 through 1999 ranged from under 10 fish to 1,700 fish. Spawning levels recorded in more recent years remain relatively low, ranging from 79 fish to 799 fish (WDFW Run Reconstruction for 2000 to 2004). Fall chum salmon population abundance, spatial structure, productivity, and genetic diversity have likely been adversely affected in the same manner and for the same reasons 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.

Dungeness River fall chum salmon may be harvested incidentally in Jamestown S'Klallam tribal and all-citizen's recreational coho salmon fisheries in the lower river and Dungeness Bay, and in tribal chum salmon fisheries in the Strait of Juan de Fuca directed at the harvest of fall chum salmon and coho salmon destined for other Puget Sound watersheds.

3.4.5. Puget Sound Pink Salmon (Non-listed)

There are two odd-year pink salmon populations in the Dungeness River Basin that are included as part of the Washington Odd-Year Pink Salmon ESU: Upper (early-run) Dungeness and Lower (late-run) Dungeness (WDFW and WWIT 1994; Hard et al. 1996). After reviewing the viability status of pink salmon populations within the Puget Sound region, NMFS determined that ESA listing for the ESU and its component populations, including the Dungeness River populations, was not warranted (60 FR 192, October 4, 1995).

The two pink salmon populations are native to the river. There is no hatchery production of the early-run (or summer-run) population, but the late-run (or fall-run) population is the subject of a supportive breeding program to recover the stock to a healthy level (WDFW 2013c). The summer-run population is considered depressed in status, and the status of the fall-run population is critical (WDFW and WWIT 1994). The summer-run pink salmon population spawns in odd-numbered years only in the upper Dungeness River mainstem above RM 9.2, in lower Gold Creek, and in the lower Gray Wolf River up to RM 6.0 (WDFW and WWIT 1994). The fall-run population spawns in odd-numbered years only in the lower six miles of the Dungeness River. The summer-run population spawns from August to mid-September, and the fall-run population spawns from mid-September to late October. Juvenile pink salmon in the Dungeness River emigrate seaward after little to no rearing in freshwater as fry averaging 34 mm (fl) (range 32 mm to 43 mm fl). Pink salmon fry emigration peaks in mid-April, and extends from mid-February through the third week in May (Topping et al. 2008).

Although pre-development era data are lacking, average run size data available since the late 1950s indicate that the pink salmon populations were healthy and abundant. Prior to the 1980s, summer-run and fall-run Dungeness pink salmon population escapements usually exceeded 20,000 and 10,000 spawners respectively (WDFW and WWIT 1994). In 1963, fall-run pink salmon escapement exceeded 100,000 spawners (Haring 1999). Escapements for both populations declined abruptly in 1981 and have remained low in subsequent years, with the exception of 2001 (69,272 fish and 11,072 fish escapements, respectively) (WDFW 2013b). Recent year (2003-2011) fall-run pink salmon escapements to the Dungeness River averaged 8,402 fish, and ranged from 3,479 to 17,919 fish per year (WDFW 2013b). The same habitat-related threats identified above for other salmon species in the Dungeness River watershed likely apply as limiting factors to the consistent achievement of high, stable annual adult return levels for the two pink salmon populations, although variable marine survival conditions in the ocean are also likely contributors.

There are no fisheries directed at pink salmon harvest within the action area. Dungeness River pink salmon may be harvested incidentally in Puget Sound tribal commercial and WDFW recreational fisheries in the Strait of Juan de Fuca targeting more abundant pink salmon stocks, and coho salmon. Harvest of Dungeness River pink salmon in those marine area fisheries are expected to be very low and fewer than 100 fish for each stock, based on harvest impact evaluations of adult returns in past years (A. Dufault, WDFW, pers. comm., February, 2013). The late annual start date of September 21 for the Dungeness River coho salmon fishery implemented to protect summer chum and Chinook salmon from incidental harvest has been shown to be effective in protecting returning early and late-timed Dungeness pink salmon from harvest (S. Chitwood, Jamestown S'Klallam Tribe, pers. comm., August 5, 2013).

3.4.6. Puget Sound Coho Salmon (Non-listed)

The single coho salmon population in the Dungeness River watershed is part of the Puget Sound/Strait of Georgia coho salmon ESU (Weitkamp 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 Dungeness River coho population was considered unknown in status in an assessment by WDFW in 2002 because of the lack of abundance trend data (WDFW and WTIT 1994), however, in a later review (Haring 1999) the population was classified as depressed. The Dungeness River coho population is likely a mixture of the native stock and non-native coho salmon stocks introduced through hatchery transplanting between 1952 and 1981. Broodstock sustaining the WDFW hatchery program are localized returns to the hatchery trap of adult hatchery-origin, native Dungeness River stock coho

salmon. Because of poor habitat conditions which limit the number of natural-origin coho salmon available for use as broodstock, the hatchery program is managed as segregated (isolated), with the intent to keep hatchery-origin and natural-origin fish reproductively separate (WDFW 2013b). No natural-origin coho salmon are therefore used as broodstock. The natural- and hatchery-origin aggregations are considered part of the extant Dungeness River coho salmon population. Spawning occurs from November through early January. Coho salmon spawn naturally mainly in accessible portions of the Dungeness and Gray Wolf rivers and their tributaries (Haring 1999). Juvenile coho salmon in the Dungeness River emigrate seaward as yearling smolts, ranging in size from 69 mm to 180 mm (fl), and averaging 108 mm (fl) from early April through the end of May, with peak migration in the mid-May (Topping et al. 2008).

The total abundance of coho salmon in the watershed is dominated by hatchery-origin fish produced through the Dungeness River Hatchery program (Haring 1999). From 1965 through 1997, total coho salmon escapement levels to the watershed ranged from about 2,000 fish to over 22,000 fish (Haring 1999). Natural-origin coho salmon made up a small fraction (averaging less than 10%) of total annual returns in that period. For more recent years (2007 through 2011), the total coho salmon run size to the Dungeness River averaged 8,977 fish (range 1,210 fish to 19,318 fish). For this period, the estimated average natural-origin Dungeness River coho salmon run size was 2,052 fish (range 260 fish to 4,747 fish), and the average hatchery-origin fish run size was 6,921 fish (range 950 fish to 14,571 fish) (J. Haymes, WDFW unpublished data, January 7, 2013). The same habitat-related threats identified above for Chinook salmon and steelhead adversely affect natural-origin coho salmon population viability in the watershed.

Jamestown S'Klallam tribal commercial and ceremonial and subsistence fisheries for Dungeness River watershed coho salmon occur seasonally in Dungeness Bay and the lower Dungeness River, contingent on the availability of natural-origin fish surplus to natural spawning escapement needs. A WDFW-managed non-Indian commercial skiff gillnet fishery in Dungeness Bay also targets returning coho salmon surplus to escapement needs. These tribal and WDFW net fisheries predominantly harvest hatchery-origin coho salmon produced by Dungeness River Hatchery (85% to 95% of fish encountered – S. Chitwood, Jamestown S'Klallam Tribe, pers. comm., August 5, 2013), but natural-origin coho salmon also contribute to annual harvests. Recreational fisheries for coho salmon managed by WDFW occur in the Dungeness River and Dungeness Bay. Between 2007 and 2011, annual tribal and non-Indian net fishery harvests of coho salmon in the analysis area averaged 759 natural-origin fish and 2,576 hatchery-origin fish (J. Haymes, WDFW unpublished data, January 7, 2013). Annual recreational fisheries harvests from 2007-2011 averaged 144 natural-origin coho salmon and 506 hatchery-origin fish. Total annual coho salmon harvests in the Dungeness River and Dungeness Bay fisheries from 2007-2011 averaged 3,905 fish, of which 84% were caught in commercial fisheries and 16% were caught in sport fisheries.

3.4.7. Sockeye Salmon

There is no known persistent sockeye salmon population in the Dungeness River watershed. Similar to other Puget Sound rivers, low numbers of riverine spawning sockeye salmon are periodically observed in the watershed (Gustafson et al. 1997). 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. 1997). The status of riverine spawning sockeye salmon in the Dungeness River watershed is unknown.

There are no tribal or WDFW fisheries promulgated to harvest riverine sockeye salmon, but the species, if and when present, may potentially be taken incidentally in Chinook and coho salmon-directed fisheries.

3.5. Other Fish Species

Many fish species in the Dungeness River, Dungeness Bay, 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, bull trout, searun cutthroat trout, resident rainbow trout, minnows, suckers, white sturgeon, Pacific staghorn sculpin, rockfish, starry flounder, and spiny dogfish. All fish species in the Dungeness River action area may be prey for salmon and steelhead at some life stage. Additionally, all fish species in the watershed compete with salmon and steelhead for food and space.

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.

Bull trout in the Dungeness River watershed are also listed as a threatened fish species under the ESA (Table 9). The basin harbors two discrete populations delineated by the USFWS for recovery planning purposes for the listed Puget Sound/Washington Coastal bull trout DPS: Dungeness River and Gray Wolf River (USFWS 2004). These populations occupy the middle Dungeness River and its tributaries up to RM 24, and including Silver, Gold, and Canyon Creeks; and the Gray Wolf River upstream to its confluences with Cameron, Grand, and Cedar Creeks (USFWS 2004). The Dungeness River watershed 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. The two Dungeness bull trout populations are included by USFWS among 10 local populations distributed among the 6 identified core areas in the Olympic Peninsula portion of the listed DPS (Skokomish, Dungeness, Elwha, Hoh, Queets, Quinault) (USFWS 2004). The known spawning area in the watershed for the species is the Gray Wolf River (RM 2 to RM 4). The core area for the species includes spawning, rearing, foraging, migration, and over-wintering habitat. USFWS (2004) reports that multiple age classes of bull trout have been observed in the Dungeness mainstem, and it is likely that the core area supports fluvial and anadromous forms of bull trout. Little is known about bull trout spawning abundance or distribution in the Dungeness River watershed, as population abundance has not been monitored in the mainstem, and few surveys have been conducted in the tributaries (USFWS 2004). Bull trout may be affected by salmon hatchery activities in the watershed through ecological interactions in areas where juvenile bull trout and hatchery salmon interact, and through blockages or delays in upstream and downstream migration associated with hatchery weir and water intake operations. Bull trout may benefit from the proposed hatchery operations because they prey on juvenile salmonids (Table 9).

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

Species	Range in Dungeness River Watershed	Federal/State Listing Status	Type of Interaction with Salmon
Freshwater -			
Pacific Lamprey, Western Brook Lamprey, and River Lamprey	Pacific and River: basin reaches accessible to anadromous fish. Western Brook: entire basin above and below barriers to anadromous fish migration.	Pacific and Western Brook: Federal Species of Concern; Washington State Monitored Species. River: Federal Species of Concern, State Candidate Species	• Predator of salmon eggs and fry • Potential prey item for adult salmon • May compete with salmon for food and space • 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 • Potential prey item for adult salmon • May compete with salmon for food and space • 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 • Potential prey item for salmon • 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 • Potential prey item for adult salmon • May compete with salmon for food and space • 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 • Potential prey item for salmon • May compete with salmon for food and space • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
Bull Trout	Dungeness River watershed reaches upstream (resident form) and downstream (anadromous form) of impassable barriers; also estuarine and nearshore marine areas	Listed as threatened under the Federal ESA	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food and space • 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	None	• Predator of salmon eggs and fry • Potential prey item for salmon • May compete with salmon for food

	nearshore marine areas (sea-run form)		and space • May benefit from additional marine-derived nutrients provided by hatchery-origin fish
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 • Potential prey items for salmon • 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 • Potential prey item for salmon • May compete with salmon for food and space
Marine Areas -			
Pacific Staghorn Sculpin	Lower Dungeness River brackish and estuarine areas; Dungeness Bay; and adjacent nearshore marine areas	None	• Predator of salmon fry and smolts • Potential prey item for adult salmon • 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 • Juvenile rockfish are prey for juvenile and adult salmon • 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 • May compete with salmon for food
Three-spine Stickleback	Lower Dungeness River brackish and estuarine areas; Dungeness Bay; and adjacent nearshore marine areas	None	• Prey for juvenile and adult salmon • May compete with salmon for food
Shiner Perch	Most marine waters within Puget Sound	None	• Prey for juvenile and adult salmon • May compete with salmon for food
Starry Flounder	Lower Dungeness River brackish and estuarine areas; Dungeness Bay; and adjacent nearshore marine areas	None	• Predator of juvenile salmon • Juvenile flounders are prey for juvenile and adult salmon • May compete with salmon for food
Spiny Dogfish	Most marine waters within Puget Sound	None	• Predator of juvenile salmon • 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.

[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.

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 Dungeness River watershed and/or nearby marine areas. However, none of these species is located exclusively in the Dungeness River action area or nearby marine waters, and in most cases these areas are a very small percentage of their total range. Therefore, the interactions listed for these species in the fourth column of Table 9 occur largely, if not entirely, in marine areas outside the action area.

3.6. Wildlife

Hatchery operations have the potential to affect wildlife by changing the total abundance of salmon in aquatic and marine environments. Changes in the abundance of salmon can affect wildlife through predator/prey interactions. Wildlife species that prey on fish consume juvenile salmon where encountered, benefiting the survival and productivity of the wildlife species through the nourishment provided. Many wildlife species also feed on salmon carcasses in the Dungeness River watershed 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 prey on fish. In addition, hatcheries could affect wildlife through transfer of toxic contaminants from hatchery-origin fish to wildlife, the operation of weirs (which could block or entrap wildlife, or conversely, make salmon easier to catch through their corralling effect), or predator control programs (which may harass or kill wildlife preying on juvenile salmon at hatchery facilities).

The Dungeness River watershed area supports a variety of birds, large and small mammals, amphibians, and invertebrates that may eat or be eaten by salmon (Table 10). 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 eagle 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 period of the year that adult salmon return to the analysis area.

Within the analysis area, there are several wildlife species listed under the ESA (Table 10). The marbled murrelet is listed as endangered and the northern spotted owl is listed as threatened – both of these are found in Clallam County, Washington (USFWS 2012), the county encompassing the analysis area. Other ESA-listed wildlife species in Clallam County include the short-tailed albatross (outer coast only).

The Taylor's checkerspot butterfly is proposed for ESA-listing. The Pacific fisher is a Federal candidate wildlife species present within the Clallam County action area. The bald eagle, Brown pelican, Cascades frog, Cassin's auklet, long-eared myotis, long-legged myotis, Makah's copper, (Olympic) Mazama pocket gopher, northern goshawk , northern sea otter, olive-sided flycatcher, Olympic torrent salamander, Oregon vesper sparrow, Pacific Townsend's big-eared bat, peregrine falcon, tailed frog, Tufted puffin, valley silverspot, Van Dyke's salamander and western toad are present in the action area and are designated by the U.S. Fish and Wildlife Service as "species of concern" (USFWS 2012).

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

	Status	Habitat [1]			Relationship with Salmon and Steelhead			
Species		**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		

Amphibians (e.g., salamanders and 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 stocks	Protected under MMPA; State species of concern			X	X	X		
Dall's porpoise (California /Oregon/Washington stock)	Protected under MMPA			X	X	X		
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 Clallam County. As Prepared By The U.S. Fish And Wildlife Service Washington Fish And Wildlife Office. (Revised December 11, 2012; Washington State Species of Concern Lists: http://wdfw.wa.gov/conservation/endangered/lists/search.php?searchby=simple&search=black+bear&orderby=AnimalType%2CCommonName

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.

Harbor seals, sea lions, northern sea otters, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins are present in marine areas adjacent to the Dungeness River watershed, and southern resident killer whales also lurk 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. The southern resident killer whale is listed under the federal ESA as endangered.

Although southern resident killer whales, harbor seals, sea lions, northern sea otters, harbor porpoises, Dall's porpoises, and Pacific white-sided dolphins are not found in freshwater tributaries in the Dungeness River watershed (although harbor seals and sea lions may range into upper estuarine areas), they may intercept salmon returning to the basin when feeding in adjacent marine waters. No other marine mammals are likely to prey on Dungeness River watershed-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 82 percent of all salmon species consumed (Hanson et al. 2010). The density of Chinook salmon in the summer as they migrate into Puget Sound, predominantly 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). The summer months, when the whales may be most likely to consume Chinook salmon returning to the Dungeness River, are not likely to be the most critical period when Chinook salmon abundance affects southern resident killer whale population health. 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).

The number of adult salmon produced through the Dungeness River 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 3,452 Chinook salmon originating from all Strait of Juan de Fuca natural areas and hatcheries returned each year to Puget Sound (PFMC 2011). The 2000-2009 average total run size for all Chinook salmon populations combined in Puget Sound is 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). For these reasons, and because Dungeness River-origin 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, fish produced through the proposed actions are not expected to be a substantial component of the killer whale diet.

None of the hatchery facilities supporting the Dungeness River hatchery programs hazes wildlife to prevent them from eating fish being raised in the hatchery facilities. Instead, the hatchery facilities place nets over their raceways to exclude predators. This method of passively excluding potential predators is not thought to adversely affect any wildlife species (WDFW 2013a; WDFW 2013b; WDFW 2013c).

3.7. Socioeconomics

Socioeconomics is defined as the study of the relationship between economics and social interactions with affected regions, communities, and user groups. In addition to providing fish for harvest, hatchery programs directly affect socioeconomic conditions in the 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.

Annual operation of the Dungeness River salmon hatchery programs contributes approximately $298,080 (through the procurement of local goods and services) and 5 full-time jobs to the regional economy (WDFW 2013a: 2013b: 2013c). WDFW operates Dungeness River Hatchery and is satellite facility, Hurd Creek Hatchery for the purposes of salmon propagation. Three full-time hatchery workers are employed at Dungeness River Hatchery and two full-time workers are employed at Hurd Creek Hatchery to perform operation and maintenance duties (WDFW 2013a).

Fisheries implemented to harvest adult fish returning as a result of hatchery fish production 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 would be expected to support local businesses, but it is unknown how dependent these businesses are on fishing-related expenditures. Anglers would also be expected to contribute to the economy through payments for fishing outfitter, guide, and charter fees.

Salmon produced in the Dungeness River Basin are subject to annual harvest in commercial and recreational fisheries in Pacific Northwest marine waters, including Strait of Juan de Fuca waters proximate to the mouth of the Dungeness River, and for coho salmon, in Dungeness Bay and the Dungeness River (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). Hatchery program-origin salmon are harvested incidentally with fish originating from other regions in U.S. and Canadian marine area commercial and recreational fisheries. Fisheries to which Dungeness River watershed 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 2008; WDFW 2013a). 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 (WDFW 2013c).

Although hatchery salmon originating from Dungeness River Hatchery 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. Dungeness River watershed salmon

incidentally intercepted in fisheries in Puget Sound/Strait of Juan de Fuca, Washington Coast, Southeast Alaska, and British Columbia represent an unsubstantial proportion of the total number of fish harvested. Salmon present in those areas originate from watersheds throughout the U.S. and Canadian Pacific Northwest and Southeast Alaska regions, with the total abundance of Chinook salmon alone numbering about 1.0 million fish in an average year (L. LaVoy, NMFS, pers. comm., January 6, 2012). Because the number of adult salmon available for harvest as a result of Dungeness River Hatchery production is relatively low when considering the total coast-wide harvest availability of salmon, salmon originating specifically from basin hatchery programs do not meaningfully contribute to fisheries in other marine areas of the Pacific Northwest.

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 NMFS 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 is 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 impacts 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%) 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.

Data on the amount of money and the number of jobs in Washington currently supported through commercial and recreational fisheries harvests of Dungeness River Hatchery salmon, and fishing-related expenditures directed at Dungeness River watershed-origin salmon only, are not available. However, the annual amount of money (ex-vessel value) generated by Jamestown S'Klallam Tribe and WDFW commercial net fisheries for coho salmon in Dungeness Bay and the Dungeness River can be estimated based on available data. Assuming an annual total net fishery harvest of 3,335 coho salmon (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)) (2007-2011 average from J. Haymes, WDFW Run Reconstruction, January 7, 2013), an average individual fish weight of 8 pounds[5], and the average value per pound of $0.88 cited above, the average annual ex-vessel value of the net fishery harvest in those areas is $23,478. The average annual recreational fisheries harvest in Dungeness Bay and the Dungeness River over the same 5-year period was 650 fish (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). The monetary value of these recreational fishery-caught coho salmon to the local economy (i.e., through fishery-related expenditures), is unknown, but may be important to sectors of the community. Although the commercial and recreational coho salmon fisheries in Dungeness Bay and the Dungeness

[5] http://www.nmfs.noaa.gov/pr/species/fish/cohosalmon.htm

River are of high value to the Jamestown S'Klallam Tribe and perhaps to the local region, the relative contribution of the fisheries, and other fisheries supported by the Dungeness River salmon hatchery programs in the analyses to the total Washington State economy is likely unsubstantial.

3.8. Cultural Resources

Negative impacts on cultural resources typically occur when an action disrupts or destroys cultural artifacts, disrupt cultural use of natural resources, or would disrupt cultural practices. Hatchery programs have the potential to 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.

Salmon represent an important cultural resource to the Jamestown S'Klallam Tribe, and benefits to salmon populations can constitute a positive effect on cultural resources. Salmon are a core symbol of tribal identity, individual identity, and the ability of the tribe, and all Pacific Northwest Native American cultures to endure (NMFS 2005; Stay 2012; NWIFC 2013). 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 Jamestown S'Klallam Tribe's "usual and accustomed" fishing area encompasses the entire Dungeness River watershed, including marine waters of Dungeness Bay and the eastern Strait of Juan de Fuca. The use of hatcheries to foster returns of salmon to the Tribe's fishing areas, and to the Dungeness River watershed ecosystem has an important value and purpose. Historically, the basis for the economy of all tribes in Washington State, including the Jamestown S'Klallam Tribe, was fish. Salmon produced entirely through natural processes returned in abundance, and the fish formed the basis of nearly all aspects of tribal life. Fish were so plentiful they were used as a medium of trade in Pacific Northwest Coastal, Salish Sea, and Plateau regions. Fishing was more than a livelihood - it is part of the Jamestown S'Klallam Tribe's culture and life. The right to fish was so important that during the 1850s treaty period, fishing for salmon at traditional locations was specifically reserved by the Tribe, and not transferred to the United States. Human development of habitat sustaining natural salmon caused a dramatic decline in the number of natural-origin salmon available to meet tribal cultural needs. In an attempt to partially replace lost natural salmon production, the hatchery program on the Dungeness River was implemented early last century to foster adult salmon returns to the watershed. This effort continues to the present day. The availability of these hatchery-origin salmon greatly strengthens the Tribes' culture as well as the Tribe's self-sufficiency and competence in natural resource management. In addition, recreational and economic benefits to the Indian and non-Indian communities accrue through increased fishing opportunities for coho salmon, 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.

3.9. 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 3.3, Water Quality; Subsection 4.3, Water Quality; and in the Draft Environmental Impact Statement to Inform Columbia River Basin Hatchery Operations and the Funding of the Mitchell Act Hatchery Programs (NMFS 2010).

Hatchery facility workers may also be exposed to diseases while handling fish. A number of parasites, viruses, and bacteria are potentially harmful to human health and may be transmitted from fish species (NMFS 2010). Many of these are transmitted primarily through seafood consumption (i.e., improperly or under-cooked fish). However, exposure to these pathogens may also occur through skin contact with fish or accidental needle-stick injuries during vaccination of fish.

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 toxic 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). While hatchery-origin fish may contain chemicals of concern, the risk from consuming contaminants in hatchery-origin fish remains uncertain.

Several watersheds in Puget Sound 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 Dungeness River watershed and other Puget Sound regions occur at various times year-round in Puget Sound estuaries as juveniles, and to a lesser 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 53 ppb, compared to levels of 10-20 ppb in Chinook salmon from Alaska, British Columbia, and the Washington and Oregon coasts. 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. However, PCB loads in Puget Sound salmon are well below levels that would be of concern to humans through consumption of fish. 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% of the FDA limit. The amount of PCBs that could be contributed to the human diet from salmon is insignificant in the context of overall PCB intake from all food sources (e.g., beef, chicken, pork) of the average American (Hardy 2005).

3.10. 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 and Alaskan Native, Native Hawaiian or Other Pacific Islander, and Hispanic[6]
- 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.

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

The Dungeness River watershed and all facilities supporting salmon hatchery programs there are located in Clallam County. Dungeness River-origin salmon do not meaningfully contribute to fisheries outside of the watershed, including immediately adjacent marine areas (Subsection 3.7, Socioeconomics). Therefore, Clallam County is the only county that would be meaningfully affected by Dungeness River salmon hatchery programs. Clallam County is an environmental justice community of concern because 13.6 percent of the population is below the poverty level, compared to 12.5 percent for the state as a whole (Table 11).

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

Indicator	Clallam County	Washington State
Black (percent in 2011)	1.0	3.8
American Indian (percent in 2011)	5.3	1.8
Asian (percent in 2011)	1.5	7.5
Pacific Islanders (percent in 2011)	0.2	0.7
Hispanic or Latino origin (percent in 2011)	5.3	11.6
Per capita income (2007-2011)	$25,672	$30,481
Below poverty level (percent in 2007-2011)	13.6	12.5

Source: http://quickfacts.census.gov/qfd/states/53/53009.html; accessed November 29, 2013.

In addition, the presence of Native American tribes bears on the status of Clallam County as an environmental justice community, and, hence, evaluations of the effects of actions on environmental justice. Clallam County has a large proportion of Native Americans (5.3% of the county's population) compared to the proportion of Native Americans in the total Washington State population (1.8% of the state population). Within Clallam County, enrolled members of the Makah Tribe, Lower Elwha Klallam Tribe, and the Jamestown S'Klallam Tribe make up the majority of the population that self-identifies as Native American. 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" places, 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 Dungeness River valley has a long history of human habitation (this, and following from SSPS 2005; Jamestown S'Klallam 2012). Evidence from an archeological excavation near Sequim shows that people inhabited the region as early as 11,000 years ago. In the late 1700s, when the earliest European explorers came into the Strait of Juan de Fuca, they found native villages and camps along the shores and bays, indicating that bands of people moved between pre-established sites according to the seasons and availability of food resources. Based on archaeological reports, it is estimated that 400 to 2,100 native people were subsisting on salmon and other bountiful natural resources in the Dungeness River area prior to contact with European explorers and settlers. In 1855, the Treaty of Point No Point was intended to settle land ownership questions with the S'Klallams. However, many S'Klallams remained near their traditional bays and rivers, including within the Dungeness River watershed. By 1874, a band of S'Klallams under the leadership of Lord James Balch, whose father had signed the 1855 treaty, raised enough money to pay $500 in gold coin for a 210-acre tract near Dungeness, Washington Territory; thus began the Jamestown S'Klallam community. The Jamestown S'Klallam Tribe's population at that time was about one hundred individuals. The Tribe supported itself by gardening, fishing, farming, and working in the surrounding lumber and pulp mills.

In the late 1980s, a primary goal of the tribe was to acquire additional land. Tracts of land within and near the town of Blyn, Washington, were targeted for acquisition due to the area's central location for citizens in Clallam and Jefferson Counties. Tribal property in the Blyn area now totals 1,102 acres, of which 13.5 acres are reservation, 265 acres are Trust lands, and 824 acres are fee lands. The tribe employs 147 individuals in tribal governance, resource management, and enterprise activities in the Blyn area. As of 2012, 594 people are enrolled members of the Jamestown S'Klallam Tribe, of which 225 reside in Clallam or Jefferson County, 239 reside elsewhere in Washington State, and 130 live outside of Washington State (Jamestown S'Klallam 2012). The total number of people in Clallam County who self-identify as Native American is 3,909, based on 2012 census data.

4. ENVIRONMENTAL CONSEQUENCES

4.1. Introduction

The three alternatives being evaluated in this EA are described in Chapter 2, Alternatives Including the Proposed Action. The baseline conditions for the nine resources (water quantity; water quality; salmon and steelhead; other fish and their habitat; 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 its alternatives in the context of these changing environmental conditions. Cumulative effects are presented in Chapter 5, Cumulative Effects.

The effects of Alternative 1 are described relative to baseline conditions (Chapter 3, Affected Environment). The effects of the other alternatives are described relative to Alternative 1 (No-Action). Where applicable, the relative magnitude of impacts is described using the following terms:

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

4.1.1. Critical Habitat

Critical habitat for ESA-listed species in the Dungeness River watershed includes many of the identified primary constituent elements. The aspects of critical habitat that may be affected by the Proposed Action include (1) adequate water quantity and quality, and (2) freedom from excessive predation. Potential impacts on critical habitat are analyzed in this Environmental Assessment in the broader discussion of impacts on habitat (Subsection 4.2, Water Quantity; Subsection 4.3, Water Quality; Subsection 4.4, Salmon and Steelhead; and Subsection 4.5, Other Fish Species).

4.2. Water Quantity

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

Under Alternative 1 (No-Action), over the short and long terms, the Dungeness River salmon hatchery programs would have the same juvenile salmon production levels as under baseline conditions (Table 12), so the same amount of groundwater and surface water would be used as under baseline conditions for broodstock holding, egg incubation, juvenile rearing, and juvenile acclimation (Table 13). 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 baseline conditions (Subsection 3.2, Water Quantity). As noted in Table 4 (Subsection 3.2, Water Quantity), 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 4 (Subsection 3.2, 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 Dungeness River Hatchery and Hurd Creek Hatchery – which would potentially occur only during the late winter and spring high flow period – are not expected to have a measureable effect on the hydrology or water availability for fish migration or rearing in the Dungeness River, Canyon Creek, or Hurd Creek. For the Gray Wolf River program, removal of a maximum of up to 0.5 percent of the mean annual flow is not expected to have any observable effect on river hydrology or availability of water. Similarly, maximum removal of up to 0.3 percent of the mean annual surface water flow for fish rearing at the Upper Dungeness River Ponds is unlikely to cause any adverse effects, especially since the water is returned into the Dungeness River immediately downstream of the water intake structure.

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

Under Alternative 2, the Dungeness River salmon hatchery programs would have the same production levels as under Alternative 1 over the short and long terms (Table 12), so the same amount of groundwater and surface water would be used as under Alternative 1 for broodstock holding, egg incubation, juvenile rearing, and juvenile acclimation (Table 13). Because the same amount of water

Table 12. Annual juvenile hatchery salmon production levels by alternative relative to baseline conditions for Dungeness River Hatchery programs.

Species	Baseline	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Chinook Salmon	150,000 subyrlgs 50,000 yearlings	150,000 subyrlgs 50,000 yearlings	150,000 subyrlgs 50,000 yearlings	0 subyrlgs 0 yearlings	75,000 subyrlgs 25,000 yearlings
Coho Salmon	500,000 yrlgs 2,000 fry	500,000 yrlgs 2,000 fry	500,000 yrlgs 2,000 fry	0 yrlgs 0 fry	250,000 yrlgs 1,000 fry
Fall-run Pink Salmon	100,000 fry	100,000 fry	100,000 fry	0 fry	50,000 fry

Table 13. Water use by hatchery facility and alternative.

Hatchery Facility	Surface/ Ground Water Use By Hatchery Facility (Maximum cfs)									
	Baseline		Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground	Surface	Ground
Dungeness R. Hatchery	48.5	0	48.5	0	48.5	0	0 [1]	0	24.3	0
Hurd Creek Hatchery	1.4	4.5	1.4	4.5	1.4	4.5	<1.4 [2]	≤4.5 [2]	2.25	0.7
Gray Wolf Acclimation	1.0	0	1.0	0	1.0	0	0	0	0.5	0
U. Dung. Acclimation	1.0	0	1.0	0	1.0	0	0	0	0.5	0

[1] Some surface water may still be required at the facility to meet production needs for steelhead.

[2] Surface and groundwater use near levels required under Alternative 1 will still be required to support fish production for other hatchery programs (e.g., the Elwha Channel Hatchery Chinook salmon program).

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 4 (Subsection 3.2, 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 at Dungeness River Hatchery and Hurd Creek Hatchery – which would potentially occur only during the late winter

and spring high flow period – are not expected to have a measureable effect on the hydrology or water availability for fish migration or rearing in the Dungeness River, Canyon Creek, or Hurd Creek. For the Gray Wolf River program, removal of a maximum of up to 0.5 percent of the mean annual flow is not expected to have any observable effect on river hydrology or availability of water. Similarly, maximum removal of up to 0.3 percent of the mean annual surface water flow for fish rearing at the Upper Dungeness River Ponds is unlikely to cause any adverse effects on availability of water, especially since the water is returned into the Dungeness River immediately downstream of the water intake structure.

4.2.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River salmon hatchery programs would be terminated immediately (Subsection 2.3, Alternative 3). Consequently, water use would be low under Alternative 3 relative to Alternative 1. There would be no change in compliance with water permits or water rights at any of the hatchery facilities under Alternative 3 because less water would be used relative to Alternative 1. However, seasonal flows in river or stream reaches from the points of hatchery water withdrawal to the points of discharge may be increased to a medium extent under Alternative 3 relative to Alternative 1, to the benefit of fish migration. An analysis of the site-specific effects under this alternative of the Dungeness River hatchery programs is provided below.

Dungeness River Hatchery

Dungeness River Hatchery uses surface water only for salmon production (Subsection 3.2, Water Quantity). All surface water diverted from the Dungeness River and Canyon Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the 4,460 feet of the Dungeness River between the uppermost hatchery water intake structure and the hatchery discharge location, and the lower 500 feet of Canyon Creek downstream from the hatchery water intake structure (Subsection 3.2, Water Quantity).

Under Alternative 3, salmon production at Dungeness River Hatchery would be terminated. As a result, up to 40 cfs less water would be diverted from the Dungeness River, and up to 8.5 cfs less water would be withdrawn from Canyon Creek, affecting the quantity of surface water in the areas between the water intakes and discharge structures. 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 reach the annual maximums listed in Table 4 (Subsection 3.2, 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. Immeasurable effects on hydrology and water availability for fish migration or rearing in the Dungeness River are therefore expected under Alternative 1. For these reasons, cessation of surface water withdrawals under Alternative 3 will have the same immeasurable effect as Alternative 1 on hydrology and water availability for fish migration or rearing. Under Alternative 3, there would be no need to retrofit the water intake structure on Canyon Creek to improve fish passage as proposed under Alternative 1. Termination of salmon production at the facility under Alternative 3 would be expected to lead to demolition of the existing water intake structure that currently blocks fish passage. Termination of the salmon hatchery programs may reduce the potential for adverse impacts on fish migration and rearing that may result from stream dewatering and blockage by water intake structures relative to Alternative 1.

Hurd Creek Hatchery

Hurd Creek Hatchery uses groundwater exclusively except in the case of emergencies, when up to 1.4 cfs of surface water may be withdrawn from Hurd Creek (Subsection 3.2, Water Quantity). Under Alternative 3, the Hurd Creek Hatchery would not be used to support the Dungeness River Hatchery salmon programs. Although Hurd Creek Hatchery supports fish rearing for other hatchery programs in the region (e.g., the Elwha Channel Hatchery Chinook salmon program) and would maintain withdrawal of groundwater, and potentially surface water, up to the permitted levels, with termination of the Dungeness River Hatchery Chinook salmon program, up to a maximum of 4.5 cfs and 1.4 cfs less groundwater and surface water, respectively, would potentially be used than under Alternative 1 (Table 13). Surface water would be withdrawn only under emergency conditions, and therefore infrequently, under Alternative 1. Further, 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 Hurd Creek reach the annual maximum listed in Table 4 (Subsection 3.2, Water Quantity). 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 Hurd Creek occurs. Immeasurable effects on hydrology and water availability for fish migration or rearing in Hurd Creek are therefore expected under Alternative 1. For these reasons, cessation of surface water withdrawals under Alternative 3 will have the same immeasurable effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Hurd Creek. Reductions in groundwater use would have a slight but detectable effect, and may increase the amount of water available for other users of the aquifer. Therefore, Alternative 3 would have a low and beneficial effect on groundwater relative to Alternative 1.

Gray Wolf Acclimation Pond

The Gray Wolf Acclimation Pond uses surface water exclusively. All water diverted from the Gray Wolf River (minus evaporation) is returned after it circulates through the facility, so the only segment of the river that may be impacted by the hatchery facility would be the 505 feet of river between the water intake and discharge structures (Subsection 3.2, Water Quantity).

Under Alternative 3, the facility would be closed, and 1.0 cfs less water would be diverted from the Gray Wolf River in the area between the water intake and discharge structures. Because 1.0 cfs is only 0.5 percent of the mean annual flow in the Gray Wolf River, the effect on water quantity in the 505 feet of the Gray Wolf River between the water intake and discharge points would not be readily apparent. 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 stream dewatering. Consequently, the effects of Alternative 3 would be negligible relative to Alternative 1.

Upper Dungeness Acclimation Pond

The Upper Dungeness Acclimation Pond uses surface water exclusively. All water diverted from the upper Dungeness River (minus evaporation) is returned just downstream from the point of withdrawal after it circulates through the facility, so the only segment of the river that may be impacted by the hatchery facility would be the very small area between the water intake and discharge structures (Subsection 3.2, Water Quantity).

Under Alternative 3, the facility would be closed, and 1.0 cfs less water would be diverted from the upper Dungeness River in the unsubstantial area between the water intake and discharge structures.

Because 1.0 cfs is only 0.3 percent of the mean annual flow in the upper Dungeness River, and considering the location of the hatchery water discharge point immediately adjacent to and downstream of the withdrawal point, the effect on water quantity in any reach within the Dungeness River would not be readily apparent. 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 stream dewatering.

4.2.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

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, so short and long-term water use would be less under Alternative 4 than under Alternative 1. The programs would remain in compliance with water permits or water rights at the hatchery facilities under Alternative 4, because less water would be used relative to Alternative 1. An analysis of the site-specific effects of the Dungeness River watershed hatchery programs under Alternative 4 is provided below.

Dungeness River Hatchery

Dungeness River Hatchery uses surface water only for salmon production (Subsection 3.2, Water Quantity). All surface water diverted from the Dungeness River and Canyon Creek (minus evaporation) is returned after it circulates through the facility. Surface water segments impacted by the hatchery facility would be the 4,460 feet of the Dungeness River between the uppermost hatchery water intake structure and the hatchery discharge location, and the lower 500 feet of Canyon Creek downstream from the hatchery water intake structure (Subsection 3.2, Water Quantity).

Under Alternative 4, salmon production at Dungeness River Hatchery would be reduced by as much as one-half relative to Alternative 1. As a result, it is assumed that surface water needs for fish rearing would be reduced by up to one-half relative to Alternative 1. Up to 20 cfs less water would diverted from the Dungeness River for fish rearing, and, and up to 4.25 cfs less water would be withdrawn from Canyon Creek, increasing the quantity of surface water in the areas between the water intakes and discharge structures. 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 reach the annual maximums listed in Table 4 (Subsection 3.2, 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. Immeasurable effects on hydrology and water availability for fish migration or rearing in the Dungeness River are therefore expected under Alternative 1. For these reasons, reduction in surface water withdrawals by one-half under Alternative 4 will have the same immeasurable (negligible) effect as Alternative 1 on hydrology and water availability for fish migration or rearing. The need would remain to retrofit the water intake structure on Canyon Creek to improve fish passage as proposed under Alternative 1.

Hurd Creek Hatchery

Hurd Creek Hatchery uses groundwater exclusively except in the case of emergencies, when up to 1.4 cfs of surface water may be withdrawn from Hurd Creek (Subsection 3.2, Water Quantity). Under Alternative 4, Hurd Creek Hatchery would be used to support Dungeness River Hatchery Chinook

salmon program at a levels that is one-half of production relative to Alternative 1. Although Hurd Creek Hatchery supports fish rearing for other hatchery programs in the region (e.g., the Elwha Channel Hatchery Chinook salmon program) and would maintain withdrawal of groundwater, and potentially surface water, up to the permitted levels, with reduction in the Dungeness River Hatchery Chinook salmon program, up to a maximum of 2.25 cfs and 0.7 cfs less groundwater and surface water, respectively, would potentially be used than under Alternative 1 (Table 13). Surface water would be withdrawn only under emergency conditions, and therefore infrequently, under Alternative 1. Further, 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 Hurd Creek reach the annual maximum listed in Table 4 (Subsection 3.2, Water Quantity). 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 Hurd Creek occurs. Immeasurable effects on hydrology and water availability for fish migration or rearing in Hurd Creek are therefore expected under Alternative 1. For these reasons, reduction in surface water withdrawals under Alternative 4 will have the same immeasurable (negligible) effect as Alternative 1 on hydrology and water availability for fish migration or rearing in Hurd Creek. Reductions in groundwater use would have a slight but detectable effect, and may increase the amount of water available for other users of the aquifer. Therefore, Alternative 4 would have a low and beneficial effect on groundwater relative to Alternative 1.

Gray Wolf Acclimation Pond

The Gray Wolf Acclimation Pond uses surface water exclusively. All water diverted from the Gray Wolf River (minus evaporation) is returned after it circulates through the facility, so the only segment of the river that may be impacted by the hatchery facility would be the 505 feet of river between the water intake and discharge structures (Subsection 3.2, Water Quantity).

Under Alternative 4, Chinook salmon production at the facility would be reduced by up to one-half. Surface water withdrawal needs for fish rearing would therefore be assumed to be reduced by one-half relative to Alternative 1, from 1.0 cfs to 0.5 cfs. Up to 0.5 cfs less water would be diverted from the Gray Wolf River in the area between the water intake and discharge structures. Because 0.5 cfs is only 0.25 percent of the mean annual flow in the Gray Wolf River, the effect on water quantity in the 505 feet of the Gray Wolf River between the water intake and discharge points would not be readily apparent. 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 stream dewatering. Consequently, the effects of Alternative 4 would be negligible relative to Alternative 1.

Upper Dungeness Acclimation Pond

The Upper Dungeness Acclimation Pond uses surface water exclusively. All water diverted from the upper Dungeness River (minus evaporation) is returned just downstream from the point of withdrawal after it circulates through the facility, so the only segment of the river that may be impacted by the hatchery facility would be the very small area between the water intake and discharge structures (Subsection 3.2, Water Quantity).

Under Alternative 4, Chinook salmon production at the facility would be reduced by one-half. Surface water withdrawal needs for fish rearing would therefore be assumed to be reduced by one-half relative to Alternative 1, from 1.0 cfs to 0.5 cfs. Up to 0.5 cfs less water would be diverted from the Gray Wolf

River in the area between the water intake and discharge structures. Because 0.5 cfs is only 0.15 percent of the mean annual flow in the upper Dungeness River, and considering the location of the hatchery water discharge point immediately adjacent to and downstream of the withdrawal point, the effect on water quantity in any reach within the Dungeness River would not be readily apparent. Under Alternative 4, there would be a negligible effect, and negligible difference relative to Alternative 1, regarding the potential for impacts on fish or wildlife as a result of stream dewatering.

4.3. Water Quality

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

Under Alternative 1 (No-Action), the Dungeness River salmon hatchery programs would have the same production levels as under baseline conditions (Table 12), over the short and long terms, so there would 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 Dungeness River, Hurd Creek, the Gray Wolf River, or the Puget Sound from the hatchery programs (Subsection 3.3, Water Quality). Consequently, there would be no change in compliance with NPDES permits where required. While the hatchery facilities operate in compliance with NPDES permits, there could still be 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 and artificial wetland at Dungeness River Hatchery and the abatement pond at Hurd Creek Hatchery, both 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, the rearing ponds on the Gray Wolf River and the Upper Dungeness River do not produce enough effluent to cause measurable adverse effects.

Hurd Creek has been assigned a 303(d) “category 5” listing for bacteria, resulting from runoff from agriculture and other human developmental activities in the watershed (Subsection 3.3, Water Quality) (Table 5). Hatchery production is not included as one of the sources of bacteria leading to this listing. No changes would be expected to “category 5” 303(d) listings for Hurd Creek 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 (Subsection 3.3, Water Quality) (Table 5). There would continue to be no known mitigation actions implemented within the analysis area that would remove Hurd Creek from the 303(d) list in the foreseeable future.

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

Under Alternative 2, the Dungeness River salmon hatchery programs would have the same production levels as under Alternative 1 over the short and long terms (Table 12), 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, polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites, pathogens, anesthetics, pesticides, and herbicides into the Dungeness River, Hurd Creek, Gray Wolf River, or the Puget Sound from Dungeness River hatchery programs

(Subsection 3.3, Water Quality). Consequently, there would be no change in compliance with NPDES permits or tribal wastewater plans, and there would be no change in the contribution of hatcheries to water quality in any 303(d) listed segments of the analysis area (Subsection 3.3, Water Quality) (Table 5) 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.

4.3.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River salmon hatchery programs would be terminated 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, antibiotics, fungicides, disinfectants, steroid hormones, polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites, pathogens, anesthetics, pesticides, and herbicides into the Dungeness River, Hurd Creek, Gray Wolf River, or the Puget Sound that would be associated with implementation of the Dungeness River salmon hatchery programs (Subsection 3.3, Water Quality). The effects of a reduction in the discharge of these substances from Dungeness River Hatchery (the main hatchery fish production facility) and Hurd Creek Hatchery would be low because any hatchery effluent is passed through a pollution abatement pond to settle out uneaten food and waste before being discharged into receiving waters (Subsection 3.3, Water Quality). Also, both facilities would remain operating at reduced levels to support fish production for other regional programs. Termination of Chinook salmon production from the two acclimation ponds would completely reduce discharge of these substances from those locations relative to Alternative 1. Because changes may be detectable in the immediate vicinity of the Dungeness River Hatchery and Hurd Creek Hatchery discharge structures, and downstream of the terminated acclimation pond facilities, 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 3.3, 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 NPDES permits for Dungeness River Hatchery and Hurd Creek Hatchery relative to Alternative 1. However, because the Dungeness River Hatchery uses most of its capacity to raise Chinook, pink, and coho salmon for release into the Dungeness River, under Alternative 3, fish production for the facility would fall below levels for which a NPDES permit is required, and the permit would no longer be necessary or applicable. Hurd Creek Hatchery would continue to operate under Alternative 3, and because the facility does not raise Dungeness River salmon exclusively (Subsection 3.3, Water Quality), a NPDES permit would remain required under Alternative 3.

4.3.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under Alternative 4, juvenile salmon production through the Dungeness River salmon hatchery programs would be reduced by one-half relative to levels under Alternative 1. 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, antibiotics, fungicides, disinfectants, steroid hormones, polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT) and its metabolites, pathogens, anesthetics, pesticides, and herbicides into the Dungeness River, Hurd Creek, Gray Wolf River, or the Puget Sound that would be associated with implementation of the Dungeness River salmon hatchery programs (Subsection 3.3, Water Quality). The effects of a reduction in the discharge of these substances from Dungeness River Hatchery (the main hatchery fish production facility) and Hurd Creek Hatchery would be low because any hatchery effluent is passed through a pollution abatement pond to settle out uneaten food and waste before being discharged into receiving waters (Subsection 3.3, Water Quality). Also, both facilities would remain operating at reduced levels to support fish production for other regional programs. Reduction of Chinook salmon production from the two acclimation ponds would reduce discharge of these substances from those locations relative to Alternative 1. Because changes may be detectable in the immediate vicinity of the Dungeness River Hatchery and Hurd Creek Hatchery discharge structures, and downstream of the terminated acclimation pond 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 3.3, 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 Dungeness River Hatchery and Hurd Creek Hatchery relative to Alternative 1. However, because the Dungeness River Hatchery uses most of its capacity to raise Chinook, pink, and coho salmon for release into the Dungeness River, under Alternative 4, fish production for the facility may fall below levels for which a NPDES permit is required, and the permit would potentially no longer be necessary or applicable. Hurd Creek Hatchery would continue to operate under Alternative 4 at levels requiring a NPDES permit, because the facility does not raise Dungeness River salmon exclusively (Subsection 3.3, Water Quality).

4.4. Salmon and Steelhead

Table 7 lists the general mechanisms through which hatchery programs can affect natural-origin salmon and steelhead populations in the Dungeness River watershed. However, NMFS also recognizes the substantial hatchery program elements included in the HGMPs are designed to minimize those hatchery-related effects. Potential effects such as disease, competition, and predation are minimized by the release of seawater-ready smolts that will exit river areas where they may interact with natural-origin salmon and steelhead quickly. Also, the majority of salmon produced through the programs are released from Dungeness River Hatchery, located in the lower Dungeness River about 10 miles upstream from the mouth of the river, which limits the potential for interactions between hatchery and natural-origin fish. Disease is further minimized by the hatchery operators' strict adherence to the Co-managers' Washington State Fish Health protocols. Genetic risks are minimized by using native fish stocks, using large effective breeding population sizes during spawning, collecting broodstock across the entire run-timing of the species, and applying proper broodstock selection and mating protocols.

4.4.1. Puget Sound Chinook Salmon (ESA-listed)

4.4.1.1.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 12), would be implemented the same as under baseline conditions (Subsection 2.1, Alternative 1), as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, there would be no change in hatchery-related risks to Chinook salmon associated with hatchery program implementation relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). The risks identified in Table 7, including genetic diversity loss, competition and predation effects, facility effects, natural population status masking, incidental fishing effects, and disease transfer, would not change relative to baseline conditions as they pertain to effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity. Nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, an estimated 619 adult Chinook salmon would return to the Dungeness River in the short term (Table 14). After removal of 112 fish for use as hatchery broodstock, 507 Chinook salmon – or 6.3 percent of the historical equilibrium spawner abundance level of 8,100 naturally spawning Chinook salmon – would be available to spawn naturally under properly functioning habitat conditions in the Dungeness River watershed (Table 14).

Under current critically low Chinook salmon abundance levels, the hatchery program operating under baseline conditions and Alternative 1 would be primarily responsible for the conservation of genetic diversity of the native population in the Dungeness River. Similar to baseline conditions, under Alternative 1, the program would benefit the diversity of the native Dungeness Chinook salmon population by preserving and assisting in the restoration of the unique stock while habitat remains degraded, and as the habitat is restored. The supportive breeding program would preserve the population until prospects for its survival in the wild improve. Under baseline conditions and Alternative 1, the program would preserve and help restore the genetically unique Dungeness Chinook salmon population which would otherwise be at high risk of extinction due to current critically low natural-origin fish abundance levels (under 200 adult fish per year) and threats to the remaining population posed by degraded freshwater habitat. Similar to baseline conditions, increased smolt emigration and adult fish returns afforded under Alternative 1 over levels achievable under current natural conditions will help ensure that this unique population is retained to the point where local adaptation and creation of a self-sustaining population, without the need for supportive breeding, will be achieved. Benefits to Chinook population genetic diversity would remain unchanged under Alternative 1, relative to baseline conditions.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for Chinook salmon survival and productivity. Projects helping to remediate habitat limiting factors to Chinook salmon would be expected to benefit the proposed hatchery program for the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 1, habitat restoration actions implemented to improve salmon survival and productivity in the watershed as part of

the Dungeness River watershed recovery plan would remain the same as under baseline condition, 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, no fisheries would directly harvest hatchery-origin or natural-origin Dungeness River Chinook salmon. However, Dungeness River Chinook salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River Chinook salmon would also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon. As under baseline conditions, when projected total (hatchery and natural-origin fish) escapement to the

Table 14. Total annual adult Chinook salmon return and naturally spawning fish contributions by alternative.

Alt	Dungeness River Chinook Smolt Release Numbers	Estimated Hatchery-Origin Adult Return [1]	Estimated Natural-origin Adult Return [2]	Estimated Total Adult Return	Required Number of Broodstock to Meet Annual Smolt Release Target	Number of Naturally Spawning Fish [3]	Historical Equilibrium Chinook Abundance [4]	Naturally Spawning Fish Percent of Equilibrium Abundance
1	200,000	490	129	619	112	507	8,100	**6.3**
2	200,000	490	129	619	112	507	8,100	**6.3**
3	0	0	129	129	N/A	129	8,100	**1.6**
4	100,000 [5]	245	129	374	56	318	8,100	**3.9**

1 Estimated hatchery-origin adult return is based on recent average smolt-to-adult survival rates of 0.23% for subyearlings and 0.29% for yearlings (WDFW 2013a).
2 Recent year annual average natural-origin adult salmon abundance estimate derived assuming a 2000-2011 average annual total escapement of 559 fish, of which 77% were hatchery-origin adults (WDFW 2013a). Of the total average escapement, an average of 129 fish were therefore of hatchery-origin.
3 The estimate of natural spawners under each alternative is the average natural-origin adult return (129 fish) plus the number of hatchery-origin Chinook surplus to broodstock needs.
4 "Historical equilibrium abundance" from Ruckelshaus et al. (2002) is the estimated maximum (upper level) number of naturally spawning Chinook salmon under properly functioning habitat conditions in the Dungeness River watershed. The lower level of the planning range for equilibrium spawner abundance is 4,700 fish.
5 Juvenile fish releases reduced to 1/2 of proposed levels – 75,000 subyearlings and 25,000 yearlings (Table 12).

Dungeness River exceeds 500 fish, U.S. fisheries would be managed to not exceed a 10.0% exploitation rate on the population. If escapement is projected to be below 500 fish, U.S. fisheries would be managed to further reduce incidental mortality to an exploitation rate on adult and sub-adult Dungeness Chinook salmon of less than 6.0% (PSIT and WDFW 2010a; NMFS 2011).

Over the longer term, continued operation of the Chinook salmon program, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total Chinook salmon populations in the Dungeness River to a healthy status approaching historical levels. Together, these actions would be expected to improve low natural-origin Chinook salmon egg to juvenile outmigrant survival rates experienced under baseline conditions. The level of potential benefit to Chinook salmon population viability under Alternative 1 as the program continues into the future would be increased above the baseline level. New fisheries with direct harvest impacts on a restored Dungeness River Chinook salmon population could potentially be initiated over the longer term under Alternative 1. Harvest-related risks to natural-origin Chinook salmon in the Dungeness River and Dungeness Bay under Alternative 1 would be expected to be increased above baseline levels (direct harvest of Chinook salmon in these areas are currently lacking), with no differences in effects likely in mixed-stock marine area fisheries where Dungeness River 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.

4.4.1.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have impacts on natural-origin Chinook salmon and their habitat identical to those 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 Table 7. Specifically, the 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 (Subsection 3.4, Salmon and Steelhead), and effects on Chinook salmon life history, abundance, diversity, spatial structure, and productivity would remain the same. Similarly, nutrient cycling or population viability benefits would remain at similar levels relative to Alternative 1.

Relative to Alternative 1, benefits to the abundance of the total Chinook salmon return to the Dungeness River, and the number of fish spawning naturally, would be the same under Alternative 2. Under Alternative 2, as under Alternative 1, an estimated 619 adult Chinook salmon would return to the Dungeness River in the short term (Table 14). After removal of 112 fish for use as hatchery broodstock, 507 Chinook salmon would be available to spawn naturally, or 6.3 percent of the historical equilibrium

spawner abundance level of 8,100 naturally spawning Chinook salmon under properly functioning habitat conditions in the Dungeness River watershed (Table 14).

Under current critically low Chinook salmon abundance levels, the hatchery program operating under Alternative 1 and Alternative 2 would be primarily responsible for the conservation of genetic diversity of the native population in the Dungeness River. Similar to Alternative 1, under Alternative 2, the program would benefit the diversity of the native Dungeness Chinook salmon population by preserving and assisting in the restoration of the unique stock while habitat remains degraded, and as the habitat is restored. The supportive breeding program would preserve the population until prospects for its survival in the wild improve. Under Alternative 1 and Alternative 2, the program would preserve and help restore the genetically unique Dungeness Chinook salmon population which would otherwise be at high risk of extinction due to current critically low natural-origin fish abundance levels (under 200 adult fish per year) and threats to the remaining population posed by degraded freshwater habitat. Similar to Alternative 1, increased smolt emigration and adult fish returns afforded under Alternative 2 over levels achievable under current natural conditions will help ensure that this unique population is retained to the point where local adaptation and creation of a self-sustaining population, without the need for supportive breeding, will be achieved. Benefits to Chinook population genetic diversity would remain unchanged under Alternative 2, relative to Alternative 1.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for Chinook salmon survival and productivity. Projects helping to remediate habitat limiting factors for Chinook salmon would be expected to benefit the proposed hatchery program for the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 2, 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 Action.

Under Alternative 2, there would be no change over the short term in fisheries affecting Dungeness River Chinook salmon relative to Alternative 1. No fisheries would directly harvest hatchery-origin or natural-origin Dungeness River Chinook salmon, but Chinook salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River Chinook salmon would also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon. As under Alternative 1, when projected total (hatchery and natural-origin fish) escapement to the Dungeness River exceeds 500 fish, U.S. fisheries would be managed to not exceed a 10.0% exploitation rate on the population. If escapement is projected to be below 500 fish, U.S. fisheries would be managed to further reduce incidental mortality to an exploitation rate on adult and sub-adult Dungeness Chinook salmon of less than 6.0% (PSIT and WDFW 2010a; NMFS 2011).

Over the longer term, continued operation of the Chinook salmon program, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total Chinook salmon populations in the Dungeness River to a healthy status approaching historical levels. Together, these actions would be expected to

improve low natural-origin Chinook salmon egg to juvenile outmigrant survival rates experienced under baseline conditions. The levels of potential benefit 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. However, there would be relative benefits to Chinook salmon abundance attendant with the increasing likelihood that the hatchery programs will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. New fisheries with direct harvest impacts on a restored Dungeness River Chinook salmon population could potentially be initiated over the longer term under Alternative 2. Harvest-related risks to natural-origin Chinook salmon in the Dungeness River and Dungeness Bay 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 Dungeness River 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.

4.4.1.3. Alternative 3 -- Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River Hatchery salmon programs would be terminated. Implementation of Alternative 3 would eliminate risks identified in Table 7 associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer from salmon hatchery programs in the watershed, because the hatchery programs would cease operation. The potential adverse salmon hatchery-related effects 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. Similarly, population viability and nutrient cycling benefits for Dungeness River Chinook salmon would be eliminated, and become negligible, after hatchery-origin fish stop returning to the watershed to spawn (Subsection 3.4, Salmon and Steelhead). However, because the native Chinook salmon population propagated through the Dungeness River Hatchery Chinook salmon program is at critically low abundance levels (Subsection 3.4, Salmon and Steelhead), and the condition of natural habitat is currently limiting survival and productivity of the population in the wild, Alternative 3 may increase to a medium extent the risk of extirpation, and delay attainment of a viable abundance level to a medium extent relative to Alternative 1.

Under Alternative 3, salmon would have access to habitat in the Dungeness River watershed similar to Alternative 1, but the low abundance of natural-origin Chinook salmon that would be provided under Alternative 3 (Table 14) limits dispersal of the species throughout the watershed. The hatchery program for the species under Alternative 1 would foster increased use of available productive habitat, particularly in the upper Dungeness River and Gray Wolf River, by increasing to a medium extent the number of returning adult fish. Termination of the hatchery Chinook salmon program under Alternative 3 would therefore decrease the spatial structure and productivity status of the Dungeness River Chinook salmon population to a medium extent relative to Alternative 1.

Under Alternative 1, high proportions of hatchery-origin Chinook salmon in the naturally spawning population and in hatchery broodstock may pose high risks of adverse effects on the diversity of the Dungeness Chinook salmon population. Eliminating the Dungeness River Hatchery Chinook salmon

hatchery program under Alternative 3 may reduce genetic diversity and fitness loss risks to the natural-origin population to a medium to high extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin Chinook salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the Chinook salmon recovery effort (WDFW 2013a), including those proposed to preserve the Chinook salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the severely depressed abundance status of natural-origin Dungeness Chinook salmon returns, and very low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.1, Puget Sound Chinook Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that would result from hatchery intervention as proposed under Alternative 1. Termination of the Chinook salmon program under Alternative 3 would eliminate this off-setting extinction prevention benefit afforded under Alternative 1 to a medium to high extent. The conservation-directed program under Alternative 1, while implementing measures designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would preserve what remains of the Dungeness Chinook salmon population to a medium to high extent relative to Alternative 3.

Relative to Alternative 1, benefits to the abundance of the total Chinook salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to negligible under Alternative 3. Implementation of Alternative 3 would lead to the annual return of an estimated 129 all natural-origin adult Chinook salmon to the Dungeness River in the short term (Table 14). With termination of the hatchery program for the species, no adult Chinook salmon would be collected for use as broodstock, and all 129 fish would escape to spawn naturally. This level of natural escapement would be 1.6 percent of the historical equilibrium spawner abundance level for naturally spawning Chinook salmon under properly functioning habitat conditions in the Dungeness River watershed (Table 14).

Under current critically low Chinook salmon abundance levels, the hatchery program operating under Alternative 1 is primarily responsible for the conservation of genetic diversity of the native population in the Dungeness River. Relative to Alternative 3, the program operating under Alternative 1 would benefit the diversity of the native Dungeness Chinook salmon population to a medium to high extent by preserving and assisting in the restoration of the unique stock while habitat remains degraded, and as the habitat is restored. Under Alternative 1, the supportive breeding program would preserve the population until prospects for its survival in the wild improve. Termination of the program under Alternative 3 would place the genetically unique Dungeness Chinook salmon population at high risk of extinction due to current critically low natural-origin fish abundance levels (under 200 adult fish per year) and threats to the remaining population posed by degraded freshwater habitat. Increased smolt emigration and adult fish returns afforded to the Chinook salmon population under Alternative 1 over no increased levels under Alternative 3 will help ensure that this unique population is retained to the point where local adaptation and creation of a self-sustaining population, without the need for supportive breeding, will be achieved. Implementation of Alternative 3 would make genetic diversity preservation conservation benefits to the Chinook salmon population negligible, and reduced by a medium to high extent relative to Alternative 1.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest

practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for Chinook salmon survival and productivity. Projects helping to remediate habitat limiting factors to Chinook salmon would be expected to benefit the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 3, 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 these actions are part of the environmental baseline. However, for the reasons described above, elimination of the hatchery program for Chinook salmon under Alternative 3 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness Chinook salmon population viability would therefore be expected to be reduced under Alternative 3 relative to Alternative 1, at least over the short term.

Over the longer term, when implemented, habitat restoration actions would be expected to increase naturally spawning Chinook salmon survival and productivity. However, the pace of recovery of the total population would be slowed under Alternative 3 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive, and the high risk of extirpation means that recovery may never be achieved. As noted above, although some progress has been made in preserving and restoring habitat critical for natural-origin Chinook salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions thus far to restore habitat have not kept pace with other components of the Chinook salmon recovery effort. If this trend continues and habitat conditions do not improve, degraded habitat conditions would continue to place all salmonid stocks in the Dungeness River watershed at great risk. The hatchery program operating under Alternative 1 over the long term would remain primarily responsible for the conservation of the Dungeness River Chinook salmon population. Relative to Alternative 1, implementation of Alternative 3 would reduce the likelihood for recovery of the Dungeness Chinook salmon population to a medium to high extent if habitat conditions are not restored from the currently degraded state over the longer term.

Similar to Alternative 1, under Alternative 3, there would be no fisheries that would directly harvest hatchery-origin or natural-origin Dungeness River Chinook salmon, but Chinook salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River Chinook salmon would no longer also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing the species would be terminated and adult coho returns supporting the fisheries would cease. As under Alternative 1, when projected total (hatchery and natural-origin fish) escapement to the Dungeness River exceeds 500 fish, U.S. fisheries would be managed to not exceed a 10.0% exploitation rate on the population. If escapement is projected to be below 500 fish, U.S. fisheries would be managed to further reduce incidental mortality to an exploitation rate on adult and sub-adult Dungeness Chinook salmon of less than 6.0% (PSIT and WDFW 2010a; NMFS 2011). However, the adverse effects of any fisheries would likely be greater to a low extent under Alternative 3 than under Alternative 1. Under Alternative 3, the harvest impact consequences to the total Dungeness River Chinook salmon population would increase as the number and proportion of hatchery-origin fish decreased, increasing the focus of effort, and removal effects, on natural-origin fish.

For the above reasons, under Alternative 3, adverse hatchery-related effects on Chinook salmon and the species' habitat would be reduced to a medium extent relative to Alternative 1, and beneficial effects would be reduced to a medium extent relative to Alternative 1. It is possible that implementation of Alternative 3 would result in long-term recovery of the population, assuming the population could become viable based only on natural-origin fish production in currently degraded habitat. However, the extremely low abundance of the current total population, and the reduced risk of extirpation and genetic diversity preservation benefits afforded by the hatchery supportive breeding program, make Alternative 3 an overall risky approach relative to Alternative 1.

4.4.1.4. Alternative 4 -- Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under Alternative 4, juvenile salmon production through the Dungeness River Hatchery salmon programs would be reduced by one-half relative to Alternative 1 (Table 12). Implementation of Alternative 4 would reduce hatchery-related risks identified in Table 7 associated with competition and predation, facility effects, masking, incidental fishing effects, or disease transfer to Dungeness River Chinook salmon, because juvenile 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, 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. Any population viability and nutrient cycling benefits for Dungeness River 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 3.4, Salmon and Steelhead). However, because the native Chinook salmon population propagated through the Dungeness River Hatchery Chinook salmon program is at critically 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 to medium extent the risk of extirpation, and delay attainment of a viable abundance level to a low to medium extent relative to Alternative 1.

Under Alternative 4, salmon would have access to habitat in the Dungeness River watershed similar to Alternative 1, but the expected lower abundance of natural-origin Chinook salmon limits dispersal of the species throughout the watershed. Under Alternative 1, the hatchery program for the species fosters use of available productive habitat, particularly in the upper Dungeness River and Gray Wolf River, by increasing to a medium extent the number of returning adult fish. Reduction of the hatchery Chinook salmon program under Alternative 4 would therefore decrease the spatial structure and productivity status of the Dungeness River Chinook salmon population to a low to medium extent relative to Alternative 1. Reducing by half the Dungeness River Hatchery Chinook salmon hatchery program may reduce fitness loss risks to the natural-origin population relative to Alternative 1. The degree to which this risk reduction would occur, and on which life stages, is speculative, but may be negligible relative to Alternative 1, considering the current degraded state of natural habitat productivity and survival conditions, which would make differences in hatchery-related effects between the alternatives inconsequential as they bear on Chinook salmon population viability. However, given that fish produced by the hatchery program are the major component of the population, Alternative 4 would be less effective to a medium extent at conserving genetic diversity of the Dungeness River Chinook salmon population relative to Alternative 1.

Under Alternative 1, high proportions of hatchery-origin Chinook salmon in the naturally spawning population and in hatchery broodstock may pose high risks of adverse effects on the diversity of the Dungeness Chinook salmon population. Reducing the Dungeness River Hatchery Chinook salmon hatchery program under Alternative 4 may reduce genetic diversity and fitness loss risks to the natural-origin population to a low to medium extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin Chinook salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the Chinook salmon recovery effort (WDFW 2013a), including those proposed to preserve the Chinook salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the severely depressed abundance status of natural-origin Dungeness Chinook salmon returns, and very low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.1, Puget Sound Chinook Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that may result from hatchery intervention as proposed under Alternative 1. Reduction of the Chinook salmon program by one-half under Alternative 4 would reduce this off-setting extinction prevention benefit afforded under Alternative 1 to a medium to high extent. The conservation-directed program under Alternative 1, while implementing measures designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would preserve what remains of the Dungeness Chinook salmon population to a medium to medium to high extent relative to Alternative 4.

Relative to Alternative 1, benefits to the abundance of the total Chinook salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to a medium extent under Alternative 4. Under Alternative 4, an estimated 374 adult Chinook salmon would return to the Dungeness River in the short term compared with 619 Chinook salmon under Alternative 1 (Table 14). After removal of 56 fish for use as hatchery broodstock, under Alternative 4, 318 Chinook salmon – or 3.9 percent (rather than 6.3 percent under Alternative 1) of the historical equilibrium spawner abundance level of 8,100 naturally spawning Chinook salmon – would be available to spawn naturally under properly functioning habitat conditions in the Dungeness River watershed (Table 14).

Under current critically low Chinook salmon abundance levels, the hatchery program operating under Alternative 1 is primarily responsible for the conservation of genetic diversity of the native population in the Dungeness River. Relative to Alternative 4, the program operating under Alternative 1 would benefit the diversity of the native Dungeness Chinook salmon population to a medium to high extent by preserving and assisting in the restoration of the unique stock while habitat remains degraded, and as the habitat is restored. Under Alternative 1, the supportive breeding program would preserve the population until prospects for its survival in the wild improve. Reduction of the program under Alternative 3 would place the genetically unique Dungeness Chinook salmon population at an increased risk of extinction relative to Alternative 1 due to current, critically low natural-origin fish abundance levels (under 200 adult fish per year) and threats to the remaining population posed by degraded freshwater habitat. Increased smolt emigration and adult fish returns afforded to the Chinook salmon population under Alternative 1 over no reduced levels under Alternative 4 will help ensure that this unique population is retained to the point where local adaptation and creation of a self-sustaining population, without the need for supportive breeding, will be achieved. Implementation of Alternative 4 would reduce genetic

diversity preservation conservation benefits to the Chinook salmon population to a medium to high extent relative to Alternative 1.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for Chinook salmon survival and productivity. Projects helping to remediate habitat limiting factors to Chinook salmon would be expected to benefit the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 4, 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 these actions are part of the environmental baseline. However, for the reasons described above, reduction of the hatchery program for Chinook salmon under Alternative 4 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness Chinook salmon population viability would therefore be expected to be reduced to a medium extent under Alternative 4 relative to Alternative 1 over the short term.

Over the longer term, when implemented, habitat restoration actions would be expected to increase naturally spawning Chinook salmon survival and productivity. However, the pace of recovery of the total population would be slowed under Alternative 4 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive. As noted above, although some progress has been made in preserving and restoring habitat critical for natural-origin Chinook salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions thus far to restore habitat have not kept pace with other components of the Chinook salmon recovery effort. If this trend continues and habitat conditions do not improve, degraded habitat conditions would continue to place all salmonid stocks in the Dungeness River watershed at great risk. The hatchery program operating under Alternative 1 over the long term would remain primarily responsible for the conservation of the Dungeness River Chinook salmon population. Relative to Alternative 1, implementation of Alternative 4 would reduce the likelihood for recovery of the Dungeness Chinook salmon population to a medium extent if habitat conditions are not restored from the currently degraded state over the longer term.

Similar to Alternative 1, under Alternative 4, there would be no fisheries that would directly harvest hatchery-origin or natural-origin Dungeness River Chinook salmon. Chinook salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Relative to Alternative 1, Dungeness River Chinook salmon would be harvested incidentally to a lower extent in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing the species would be reduced and adult coho returns supporting the fisheries would decrease. As under Alternative 1, when projected total (hatchery and natural-origin fish) escapement to the Dungeness River exceeds 500 fish, U.S. fisheries would be managed to not exceed a 10.0% exploitation rate on the population. If escapement is projected to be below 500 fish, U.S. fisheries would be managed to further reduce incidental mortality to an exploitation rate on adult and sub-adult Dungeness Chinook salmon of less than 6.0% (PSIT and WDFW 2010a; NMFS 2011). However, the adverse effects of any fisheries would likely be greater to a low extent under Alternative 4 compared to Alternative 1. Under Alternative 4, the

harvest impact consequences to the total Dungeness River Chinook salmon population would increase as the number and proportion of hatchery-origin fish decreased, increasing the focus of effort, and removal effects, on natural-origin fish.

For the above reasons, under Alternative 4, adverse hatchery-related effects on Chinook salmon and the species' habitat would be reduced to a low to medium extent relative to Alternative 1, and beneficial effects would be reduced to a medium extent relative to Alternative 1. Similar to Alternative 3, it is possible that implementation of Alternative 4 would result in long-term recovery of the population, assuming the population could become viable based largely on natural-origin fish production in currently degraded habitat. However, the extremely low abundance of the current total population, and the reduced risk of extirpation and genetic diversity preservation benefits afforded by the hatchery supportive breeding program as proposed, make Alternative 4 an overall risky approach relative to Alternative 1.

4.4.2. Puget Sound Steelhead (ESA-listed)

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

The proposed action is limited to hatchery production of Chinook, pink and coho salmon. Therefore, effects on steelhead do not include hatchery-related genetic diversity and fitness loss and other risks associated with the spawning of hatchery and natural-origin populations of the same species. Rather, under all alternatives, NMFS has examined whether the salmon hatchery actions incidentally affect steelhead, as described below.

Under Alternative 1, no steelhead would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under baseline conditions (Subsection 2.1, Alternative 1) as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to steelhead associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4.2, Puget Sound Steelhead (ESA-listed)). Effects on steelhead life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 1 relative to the baseline conditions for the species described in detail in Subsection 3.4.2. Nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, no fisheries would directly harvest natural-origin Dungeness River steelhead. Tribal and recreational fisheries directed at hatchery-origin steelhead would retain the same regulations under Alternative 1 as described for baseline conditions (Subsection 3.4.2). There would be a low likelihood that Dungeness River steelhead would be encountered and harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon, the lone other salmonid species for which in-river tribal and recreational fisheries occur. Coho fisheries are scheduled from late September through October, and occur too early in the season to result in interaction with, and incidental harvest of the later-timed winter-spring adult steelhead in the watershed. Under Alternative 1, and as under baseline conditions, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin winter-run steelhead would remain similar to the recent year (1998-2008) average harvest levels

of 15 fish and 54 fish, respectively (PSIT and WDFW 2010b). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, but incidental harvests of natural steelhead would likely remain low under Alternative 1, and as under baseline conditions.

4.4.2.2. 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 Dungeness River Hatchery 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 competition and predation, facility effects, masking, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, 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. Similarly, nutrient cycling or population viability benefits would persist at similar levels relative to Alternative 1.

Under Alternative 2, salmon fisheries effects on steelhead would persist at similar levels relative to Alternative 1. Consistent with current regulations (Subsection 3.4.2), no fisheries would directly harvest natural-origin Dungeness River steelhead. Tribal and recreational fisheries directed at hatchery-origin steelhead would retain the same regulations under Alternative 2 and Alternative 1. There would continue to be a low likelihood that Dungeness River steelhead would be encountered and harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon. Coho fisheries are scheduled from late September through October, and occur too early in the season relative to the winter-spring migration timing for adult steelhead in the watershed. 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 low, similar to the recent year (1998-2008) average harvest levels of 15 fish and 54 fish, respectively (PSIT and WDFW 2010b). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, but incidental harvests of natural steelhead would likely remain low under Alternative 2, and the same as under Alternative 1.

4.4.2.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River steelhead from salmon hatchery programs, because the programs would be immediately terminated. Any salmon hatchery-related effects on 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 over the short and long terms. Similarly, any short and long term population viability and nutrient cycling benefits for Dungeness River steelhead would be eliminated, and become negligible,

after hatchery-origin salmon stop returning to the Basin to spawn (Subsection 3.4, 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 Dungeness River steelhead. However, there would be no likelihood that Dungeness River steelhead would be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing coho salmon would be terminated and hatchery-origin adult coho returns supporting the fisheries would cease. There would therefore be a potential that a small, but increased number of natural-origin steelhead would be available for natural production relative to Alternative 1 as a result of cessation of hatchery coho salmon production under Alternative 3, because hatchery-origin coho directed fisheries that may incidentally harvest steelhead would not occur. Under Alternative 3, and as under Alternative 1, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin winter-run steelhead would remain low, similar to the recent (1998-2008) average harvest levels of 15 fish and 54 fish, respectively (PSIT and WDFW 2010b). Mortalities of the earliest returning natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, but incidental harvests of natural steelhead would likely remain low under Alternative 3, and the same as under Alternative 1.

4.4.2.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River steelhead, because juvenile 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 over the short and long terms. Any short and long term population viability and nutrient cycling benefits for Dungeness River 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 3.4, 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 Dungeness River steelhead. However, there would be a reduced likelihood that Dungeness River steelhead would be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing coho salmon would be reduced by on-half, and hatchery-origin adult coho returns supporting the fisheries would thereby be reduced by one-half relative to Alternative 1. There would therefore be a potential that a small, but increased number of natural-origin steelhead would be available for natural production relative to Alternative 1 as a result of reduction of hatchery coho salmon production under Alternative 4, because hatchery-origin coho directed fisheries that may incidentally harvest steelhead would be reduced. Under Alternative 4, and as under Alternative 1, annual tribal and recreational fisheries harvests of mainly non-listed hatchery-origin winter-run steelhead would remain low, similar to the recent (1998-2008) average harvest levels of 15 fish and 54 fish, respectively (PSIT and WDFW 2010b). Mortalities of the earliest returning

natural-origin steelhead would likely continue to occur in hatchery steelhead-directed tribal and recreational fisheries, but incidental harvests of natural steelhead would likely remain low under Alternative 4, and the same as under Alternative 1.

4.4.3. Hood Canal Summer-Run Chum Salmon (ESA-listed)

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

The proposed action is limited to hatchery production of Chinook, pink and coho salmon. Therefore, effects on summer-run chum salmon do not include hatchery-related genetic diversity and fitness loss and other risks associated with the spawning of hatchery and natural-origin populations of the same species. Rather, under all alternatives, NMFS has examined whether the hatchery actions incidentally affect summer-run chum salmon, as described below.

Under Alternative 1, no summer chum salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would be operated the same as under baseline conditions (Subsection 2.1, Alternative 1) as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. Therefore, salmon hatchery-related risks to summer-run chum salmon associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). Effects on Dungeness River summer chum salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 1 relative to the baseline conditions for the species described in Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed). Any nutrient cycling and population viability benefits would also remain the same under Alternative 1 relative to baseline conditions.

The SCSP (HCCC 2005), the recovery plan for summer chum salmon, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of the primary habitat-related limiting factors to summer chum salmon recovery (i.e., habitat degradation and logging – Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)), on habitat processes and conditions critical for the species' survival and productivity. Under Alternative 1, habitat restoration actions implemented to improve summer chum salmon survival and productivity in the watershed as part of the recovery plan for the species (WDFW and PNPTT 2000) would remain the same as under baseline conditions, as the actions are not affected by, or included as part of the Proposed Action. Although not part of the Proposed Action, projects helping to remediate habitat limiting factors to summer chum salmon recovery would be expected to reduce the effects of the proposed hatchery programs for Chinook, pink, and coho salmon by increasing naturally spawning summer chum survival and abundance. Improvements in habitat condition leading to improvements in summer chum salmon viability may offset any salmon hatchery-related risks associated with implementation of the hatchery programs under Alternative 1 and baseline conditions. Overall effects of implementation of Alternative 1 on the pace of summer chum salmon recovery would be negligible, and unchanged from baseline conditions.

Under Alternative 1, as under baseline conditions, no fisheries associated with implementation of the salmon hatchery programs and adult returns from them would directly harvest Dungeness River summer chum salmon. Under Alternative 1 and the baseline, Dungeness River summer salmon would continue

to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Under both alternatives, summer chum salmon from the watershed could potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery. Dungeness Bay gillnet fisheries directed at coho salmon would continue to start after the return of summer chum salmon each season, and so would continue to avoid encounters with summer chum salmon. Under Alternative 1, and similar to baseline conditions, salmon fishery harvest impacts on summer chum salmon in the Dungeness River would remain unknown, but likely be very low due to the low and infrequent observations of the species. Spawning ground surveys of potential summer chum salmon spawning areas currently occurring under baseline conditions (Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)) would continue under Alternative 1 to monitor the status of the species.

4.4.3.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on summer chum salmon 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 competition and predation, facility effects, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)). Effects on Dungeness River summer chum salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1. Similarly, nutrient cycling or population viability benefits would persist at similar levels relative to Alternative 1.

The SCSP (HCCC 2005), the recovery plan for summer chum salmon, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of the primary habitat-related limiting factors to summer chum salmon recovery (i.e., habitat degradation and logging – Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)), on habitat processes and conditions critical for the species' survival and productivity. Under Alternative 2, habitat restoration actions implemented to improve summer chum salmon survival and productivity in the watershed as part of the recovery plan for the species (WDFW and PNPTT 2000) would remain the same as under Alternative 1. Under both alternatives, the habitat restoration actions are not affected by, or included as part of the Proposed Action. Although not part of the Proposed Action, projects helping to remediate habitat limiting factors to summer chum salmon recovery would be expected to reduce the effects of the proposed hatchery programs for Chinook, pink, and coho salmon by increasing naturally spawning summer chum survival and abundance. Improvements in habitat condition leading to improvements in summer chum salmon viability may offset salmon hatchery-related risks associated with implementation of the hatchery programs under Alternative 2 and Alternative 1. Overall effects of implementation of Alternative 2 on the pace of summer chum salmon recovery would be negligible, and unchanged from Alternative 1.

Under Alternative 2, fisheries harvest effects associated with implementation of the salmon hatchery programs would persist at similar levels relative to Alternative 1. No fisheries would directly harvest Dungeness River summer chum salmon. As under Alternative 1, Dungeness River summer chum salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Under both alternatives, summer chum salmon from the watershed would also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery. Under Alternative 2, and similar to Alternative 1, salmon fishery harvest impacts on summer chum salmon in the Dungeness River would remain unknown, but likely be very low due to the low and infrequent observations of the species. Spawning ground surveys of potential summer chum salmon spawning areas that would occur under Alternative 1 would continue under Alternative 2 to monitor the status of the species.

4.4.3.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River summer chum salmon from salmon hatchery programs, because the programs would be immediately terminated. Any salmon hatchery-related effects on summer chum salmon: life history, and population abundance, diversity, spatial structure, and productivity occurring under Alternative 1 would therefore be eliminated under Alternative 3. Salmon hatchery-related effects on Dungeness River summer chum salmon life history, and population abundance, diversity, spatial structure, and productivity would be reduced to a negligible to low extent under Alternative 3 relative to Alternative 1. Although posing a negligible to low risk Under Alternative 1, releases of juvenile salmon that could potentially compete with or prey on summer chum salmon would be eliminated under Alternative 3. Similarly, any population viability and nutrient cycling benefits for Dungeness River summer chum salmon resulting from implementation of Alternative 1 would be eliminated under Alternative 3, after hatchery-origin salmon that may deposit marine-derived nutrients stop returning to the Basin to spawn (Subsection 3.4, Salmon and Steelhead). Benefits to summer chum salmon would be reduced to negligible under Alternative 3, from low under Alternative 1.

The SCSP (HCCC 2005), the recovery plan for summer chum salmon, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of the primary habitat-related limiting factors to summer chum salmon recovery (i.e., habitat degradation and logging – Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)), on habitat processes and conditions critical for the species' survival and productivity. Under Alternative 3, habitat restoration actions implemented to improve summer chum salmon survival and productivity in the watershed as part of the recovery plan for the species (WDFW and PNPTT 2000) would remain the same as under Alternative 1. Under both alternatives, the habitat restoration actions are not affected by, or included as part of the Proposed Action. Although not part of the Proposed Action, projects helping to remediate habitat limiting factors to summer chum salmon recovery would be expected to increase naturally spawning summer chum survival and abundance. Elimination of the salmon hatchery programs under Alternative 3 would be expected to increase to a negligible extent habitat restoration-related benefits to summer chum salmon relative to Alternative 1, because potential salmon hatchery-related risks to summer chum salmon would remain negligible, and habitat restoration benefits remain unchanged.

Under Alternative 3, fisheries effects may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural-origin Dungeness River summer chum salmon, though they would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. However, there would be no likelihood that Dungeness River summer chum salmon would be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon, because the Dungeness River Hatchery program producing coho salmon would be terminated and hatchery-origin adult coho returns supporting the fisheries would cease. There would therefore be a potential that a small, but increased number of summer chum salmon would be available for natural production relative to Alternative 1 as a result of cessation of hatchery coho salmon production under Alternative 3, because hatchery-origin coho directed fisheries that may incidentally harvest summer chum salmon would not occur. Under Alternative 3, hatchery-origin salmon fishery harvest impacts on summer chum salmon in the Dungeness River would be reduced to zero with cessation of hatchery salmon releases and fisheries targeting the fish. Spawning ground surveys of potential summer chum salmon spawning areas that would occur under Alternative 1 would continue under Alternative 3 to monitor the status of the species.

4.4.3.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 may reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River summer chum salmon, because juvenile salmon release levels would be reduced by one-half relative to Alternative 1. 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 under Alternative 4, and unchanged from Alternative 1. With reduced salmon production levels, salmon hatchery-related effects on summer 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. Although posing a negligible to low risk under Alternative 1, releases of juvenile salmon that could potentially compete with or prey on summer chum salmon would be reduced under Alternative 3. Similarly, any population viability and nutrient cycling benefits for Dungeness River summer chum salmon resulting from implementation of Alternative 1 would be reduced under Alternative 3, after hatchery-origin salmon that may deposit marine-derived nutrients returning to the Basin to spawn at reduced levels (Subsection 3.4, Salmon and Steelhead). For these reasons, risks and benefits to summer chum salmon would be reduced to a negligible to low extent under Alternative 4 relative to Alternative 1.

The SCSP (HCCC 2005), the recovery plan for summer chum salmon, includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of the primary habitat-related limiting factors to summer chum salmon recovery (i.e., habitat degradation and logging – Subsection 3.4.3, Hood Canal Summer-Run Chum Salmon (ESA-Listed)), on habitat processes and conditions critical for the species' survival and productivity. Under Alternative 4, habitat restoration actions implemented to improve summer chum salmon survival and productivity in the watershed as part of the recovery plan for the species (WDFW and PNPTT 2000) would remain the same as under Alternative 1. Under both alternatives, the habitat restoration actions are not affected by, or included as part of the Proposed Action. Although not part of the Proposed Action, projects helping to remediate habitat limiting factors to summer chum salmon recovery would be expected to reduce the effects of the hatchery programs for Chinook, pink, and coho salmon implemented under Alternative 4 by increasing

naturally spawning summer chum survival and abundance. Improvements in habitat condition leading to improvements in summer chum salmon viability may offset any salmon hatchery-related risks associated with implementation of the hatchery programs under Alternative 4. Reduction of the salmon hatchery programs under Alternative 4 would be expected to increase to a low extent habitat restoration-related benefits to summer chum salmon relative to Alternative 1, because potential salmon hatchery-related risks to summer chum salmon may be reduced, and habitat restoration benefits may therefore be more fully realized.

Under Alternative 4, fisheries effects may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural-origin Dungeness River summer chum salmon, though they would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. However, there would be a reduced likelihood that Dungeness River summer chum salmon would be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon, because the Dungeness River Hatchery program producing coho salmon would be reduced by one-half, and hatchery-origin adult coho returns supporting the fisheries would be reduced by one-half. There would therefore be a potential that a small, but increased number of summer chum salmon would be available for natural production relative to Alternative 1 as a result of reduced hatchery coho salmon production under Alternative 4, because hatchery-origin coho directed fisheries that may incidentally harvest summer chum salmon would be reduced. Under Alternative 4, hatchery-origin salmon fishery harvest impacts on summer chum salmon in the Dungeness River would be reduced with reductions by one-half in hatchery salmon releases and fisheries targeting the fish. Spawning ground surveys of potential summer chum salmon spawning areas that would occur under Alternative 1 would continue under Alternative 4 to monitor the status of the species.

4.4.4. Puget Sound Fall Chum Salmon – not ESA-listed

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

The proposed action is limited to hatchery production of Chinook, pink and coho salmon. Therefore, effects on fall chum salmon do not include hatchery-related genetic diversity and fitness loss and other risks associated with the spawning of hatchery and natural-origin populations of the same species. Rather, under all alternatives, NMFS has examined whether the hatchery actions incidentally affect fall chum salmon, as described below.

Under Alternative 1, no fall chum salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would continue operation as under baseline conditions (Subsection 2.1, 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 fall chum salmon associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). Effects on Dungeness River fall chum salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 1 relative to the baseline conditions for the species that are

described in Subsection 3.4.4 (Puget Sound Fall Chum Salmon (Non-listed)). Any nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, no fisheries would directly harvest Dungeness River fall chum salmon. Dungeness River fall chum salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks under Alternative 1 and the baseline. Under Alternative 1 and the baseline, because the species overlap in migration timing to a low extent, fall chum salmon would also potentially be harvested incidentally to a low extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

4.4.4.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on fall chum salmon 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. 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, negligible changes would be expected in risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, Salmon and Steelhead). Effects on Dungeness River fall chum salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1. Similarly, nutrient cycling or population viability benefits would persist at similar levels relative to Alternative 1.

Under Alternative 2, fisheries effects would persist at similar levels relative to Alternative 1. No fisheries would directly harvest Dungeness River fall chum salmon. Dungeness River fall chum salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks under Alternative 2 and Alternative 1. Under Alternative 2 and Alternative 1, because the species overlap in migration timing to a low extent, Dungeness River fall chum salmon would also potentially be harvested incidentally to a low extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

4.4.4.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River fall chum salmon from salmon hatchery programs, because the programs would be immediately terminated. Salmon hatchery-related effects on Dungeness River fall chum salmon life history, and population abundance, diversity, spatial structure, and productivity would be reduced to a low extent under Alternative 3 relative to Alternative 1. Elimination of hatchery-origin juvenile and adult salmon production under Alternative 3

would eliminate risks to fall chum salmon juveniles associated with competition and predation posed by hatchery-origin salmon. Under Alternative 3, any population viability and nutrient cycling benefits for Dungeness River fall chum salmon would be eliminated after hatchery-origin salmon stop returning to the Basin to spawn (Subsection 3.4, Salmon and Steelhead), and benefits from these factors would be expected to decrease to a low extent relative to Alternative 1.

Under Alternative 3, fisheries effects may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural-origin Dungeness River fall chum salmon. Under both alternatives, Dungeness River fall chum salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. However, in contrast to Alternative 1, Dungeness River fall chum salmon would no longer be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing the species would be terminated and adult coho salmon returns supporting the fisheries would cease.

4.4.4.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to Dungeness River fall chum salmon, because juvenile salmon release levels would be reduced by one-half relative to Alternative 1. 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 under Alternative 4 relative to Alternative 1. Reduction of hatchery-origin juvenile and adult salmon production under Alternative 3 would reduce risks to fall chum salmon juveniles associated with competition and predation posed by hatchery-origin salmon to a negligible to low extent. For these reasons, salmon hatchery-related effects on 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 Dungeness River 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 3.4, Salmon and Steelhead).

Under Alternative 4, fisheries effects may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest natural-origin Dungeness River fall chum salmon. Under both alternatives, Dungeness River fall chum salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River fall chum salmon would continue to be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon, but to a lower extent relative to Alternative 1, because the Dungeness River Hatchery program producing the species would be reduced by one-half, and adult coho salmon returns supporting the fisheries would be reduced by that amount.

4.4.5. Puget Sound Pink Salmon

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

Under Alternative 1, the hatchery programs, including the fall-run pink salmon program, would be operated the same as under baseline conditions (Subsection 2.1, 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 fall-run and summer-run pink salmon associated with hatchery program implementation (i.e., from Table 7, genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). Effects on Dungeness River fall-run and summer-run pink salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 1 relative to the baseline conditions for the species that are described in Subsection 3.4.5 (Puget Sound Pink Salmon (Non-listed)). Nutrient cycling and population viability benefits to both pink salmon races in the Dungeness River would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, an estimated 8,902 (8,402 natural-origin and 500 hatchery-origin) adult fall-run pink salmon would return to the Dungeness River (Table 15). After removal of 220 mostly natural-origin fish for use as hatchery broodstock, 8,682 pink salmon would be available to spawn naturally, or up to 87% percent of the recent year historical spawner abundance level of greater than 10,000 naturally spawning fall-run pink salmon (Table 15).

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for pink salmon survival and productivity. Projects helping to remediate habitat limiting factors to pink salmon would be expected to benefit the proposed hatchery program for the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 1, 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 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, no fisheries would directly harvest hatchery-origin or natural-origin Dungeness River fall-run pink salmon. Dungeness River pink salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River pink salmon would also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon.

Table 15. Total annual adult fall-run pink salmon return and naturally spawning fish contributions by alternative.

Alt	Dungeness River Fall Pink Fry Release Numbers	Estimated Hatchery-Origin Adult Return [1]	Estimated Natural-origin Adult Return [2]	Estimated Total Adult Return	Required Number of Broodstock to Meet Annual Fry Release Target	Number of Naturally Spawning Fish [3]	Recent Historical Pink Salmon Abundance [4]	Naturally Spawning Fish Percent of Historical Abundance
1	100,000	500	8,402	8,902	220	8,682	>10,000	**< 87%**
2	100,000	500	8,402	8,902	220	8,682	>10,000	**< 87%**
3	0	0	8,402	8,402	N/A	8,402	>10,000	**<84%**
4	50,000 [5]	250	8,402	8,652	110	8,542	>10,000	**<85%**

1 Estimated hatchery-origin adult return is based on an average fry-to-adult survival rate of 0.5% (WDFW 2013b).
2 Recent year (2003-2011) annual average natural-origin adult fall-run pink salmon escapement estimate from WDFW (2013b).
3 The estimate of natural spawners under each alternative is the average natural-origin adult return (8,402 fish) plus the number of hatchery-origin pink salmon surplus to broodstock needs.
4 Prior to the 1980s, Dungeness River fall run pink salmon population escapements usually exceeded 10,000 spawners (WDF and WWIT 1994); in 1963, escapement for the race exceeded 100,000 fish (Haring 1999).
5 Pink salmon fry releases reduced to 1/2 of proposed levels – 50,000 fry (Table 12).

Over the longer term, continued operation of the fall-run pink salmon hatchery program based on propagation of fish largely derived from natural-origin broodstock, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total fall-run pink salmon population in the Dungeness River to a healthy status approaching historical levels. Together, these actions would be expected to improve natural-origin pink salmon egg to juvenile outmigrant survival rates experienced under baseline conditions. The level of potential benefit to fall-run pink salmon population viability under Alternative 1 as the program continues into the future would be increased above the baseline level. New fisheries with direct harvest impacts on the restored Dungeness River fall-run pink salmon population could potentially be initiated over the longer term under Alternative 1. Harvest-related risks to natural-origin fall-run pink salmon in the Dungeness River and Dungeness Bay under Alternative 1 would be expected to be increased above baseline levels (direct harvest of pink salmon in these areas are currently lacking), with no differences in effects likely in mixed-stock marine area fisheries where Dungeness River pink salmon would continue to be harvested incidentally.

For the above reasons, under Alternative 1, adverse hatchery-related effects on fall-run and summer-run pink 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

4.4.5.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have low impacts on Dungeness River fall-run and summer-run pink salmon and their habitat, identical to those 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. 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, negligible changes would be expected in risks to fall-run and summer-run pink salmon associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, Salmon and Steelhead). Salmon hatchery-related effects on Dungeness River pink salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1. Because adult fish production levels would remain the same, under Alternative 2, nutrient cycling or population viability benefits would persist at similar levels relative to Alternative 1.

Relative to Alternative 1, benefits to the abundance of the total fall-run pink salmon return to the Dungeness River, and the number of fish spawning naturally, would be the same under Alternative 2. Under Alternative 2, as under Alternative 1, an estimated 8,902 (8,402 natural-origin and 500 hatchery-origin) adult fall-run pink salmon would return to the Dungeness River (Table 15). After removal of 220 fish for use as hatchery broodstock, 8,682 fall-run pink salmon would be available to spawn

naturally, or up to 87% percent of the recent year historical spawner abundance level of greater than 10,0000 naturally spawning fall-run pink salmon (Table 15).

Under Alternative 2, over the short term, fisheries effects on Dungeness River pink salmon would persist at similar levels relative to Alternative 1. No fisheries would directly harvest hatchery-origin or natural-origin Dungeness River pink salmon, and under both alternatives, pink salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River pink salmon would also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon to the same low extent under both alternatives.

Over the longer term, continued operation of the pink salmon program, in conjunction with other watershed actions implemented to recover listed Chinook salmon under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total fall-run pink salmon populations in the Dungeness River to a healthy status approaching historical levels. The levels of potential benefit to fall-run pink salmon population viability under Alternative 2 and Alternative 1 would be similarly low, because program operation and hatchery-origin adult return levels would be similar. However, there would be relative low benefits to fall-run pink salmon abundance attendant with the increasing likelihood that the hatchery programs will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. New fisheries with direct harvest impacts on a restored Dungeness River fall-run pink salmon population could potentially be initiated over the longer term under Alternative 2. Harvest-related risks to natural-origin pink salmon in the Dungeness River and Dungeness Bay under Alternative 2 would be expected to be low, similar to Alternative 1, with no differences in effects between the alternatives likely in mixed stock marine area fisheries where Dungeness River Chinook salmon would continue to be harvested incidentally at low levels.

For the above reasons, under Alternative 2, adverse hatchery-related effects on fall-run and summer-run pink 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.

4.4.5.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River Hatchery salmon programs would be terminated. Implementation of Alternative 3 would eliminate risks to fall-run and summer-run pink salmon identified in Table 7 associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer from salmon hatchery programs in the watershed, because the hatchery programs would cease operation. The potential adverse salmon hatchery-related effects on fall-run and summer-run pink 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. Similarly, population viability and nutrient cycling benefits for Dungeness River fall-run and summer-run pink salmon would be eliminated, and become negligible, after hatchery-origin fish stop returning to the watershed to spawn (Subsection 3.4.5, Puget Sound Pink Salmon (Non-listed)). However, because the native fall-run pink salmon population propagated through the Dungeness River Hatchery pink salmon program is at a low abundance level (Subsection 3.4.5, Puget Sound Pink Salmon (Non-listed), and the condition of natural habitat is currently limiting survival and productivity of the population in the wild, Alternative 3 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 3, salmon would have access to habitat in the Dungeness River watershed similar to Alternative 1, but the total abundance of fall-run pink salmon that would be provided under Alternative 3 (Table 15) limits dispersal of the species throughout the watershed. The hatchery program for the species under Alternative 1 would foster increased use of available productive habitat, by increasing to a low extent the number of returning adult fish. Termination of the hatchery fall-run pink salmon program under Alternative 3 would therefore lead to a low decrease in the spatial structure and productivity status of the Dungeness River pink salmon population relative to Alternative 1.

Under Alternative 1, low to moderate proportions of hatchery-origin fall-run pink salmon in the naturally spawning population and in hatchery broodstock may pose low to medium risks of adverse effects on the diversity of the Dungeness River pink salmon populations. Eliminating the Dungeness River Hatchery fall-run pink salmon hatchery program under Alternative 3 may reduce genetic diversity and fitness loss risks to the natural-origin populations to a negligible to low extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin pink salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the salmon recovery effort for the watershed (WDFW 2013a), including those proposed to restore the fall-run pink salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the generally depressed abundance status of natural-origin fall-run pink salmon returns (Table 15), and low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.5, Puget Sound Pink Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that would result from hatchery intervention as proposed under Alternative 1. Termination of the fall-run pink salmon program under Alternative 3 would eliminate this off-setting extinction prevention benefit afforded under Alternative 1 to a low extent. The conservation-directed program under Alternative 1, while implementing measures designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would help preserve the Dungeness River fall-run pink salmon population to a low extent relative to Alternative 3.

Relative to Alternative 1, benefits to the abundance of the total fall-run pink salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to negligible under Alternative 3. Implementation of Alternative 3 would lead to the annual return of an estimated 8,402 all natural-origin adult fall-run pink salmon to the Dungeness River in the short term (Table 15). With termination of the hatchery program for the species, no adult pink salmon would be collected for use as broodstock, and all 8,402 fish would escape to spawn naturally. This level of natural escapement would be less than 84% percent of the recent historical spawner abundance level of over 10,000 naturally spawning pink salmon in the Dungeness River watershed (Table 15). Under the current fall-run pink salmon abundance level, the hatchery program under Alternative 1 is partially responsible for the conservation of genetic diversity of the native population in the Dungeness River. Implementation of Alternative 3 would make genetic diversity conservation benefits to the fall-run pink salmon population negligible, and reduced to a low extent relative to Alternative 1 over the short and long terms.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for pink salmon survival and productivity. Projects helping to remediate habitat limiting factors to salmon would be expected to benefit pink salmon by increasing naturally spawning fish survival and fry to adult return rates for fish produced by the program. Under Alternative 3, 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 Action. However, for the reasons described above, elimination of the hatchery program for pink salmon under Alternative 3 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness pink salmon population viability would therefore be expected to be reduced under Alternative 3 relative to Alternative 1, at least over the short term. Over the longer term, habitat restoration actions would increase naturally spawning pink salmon survival and productivity, but the pace of recovery of the total population would be slowed under Alternative 3 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive.

Similar to Alternative 1, under Alternative 3, there would be no fisheries that would directly harvest hatchery-origin or natural-origin Dungeness River pink salmon, but pink salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Dungeness River pink salmon would no longer also potentially be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing the species would be terminated and adult coho returns supporting the fisheries would cease. However, the adverse effects of any fisheries would be increased to a low extent over Alternative 1, as the consequences to the population would increase as the abundance and proportion of hatchery-origin fish in the total adult return, and hence the total Dungeness River pink salmon population size, decreases.

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

4.4.5.4. Alternative 4 -- Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under Alternative 4, juvenile salmon production through the Dungeness River Hatchery salmon programs would be reduced by one-half relative to Alternative 1. Implementation of Alternative 4 would reduce hatchery-related risks associated with competition and predation, facility effects, masking, incidental fishing effects, or disease transfer to Dungeness River fall-run and summer-run pink salmon, because fry 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 fall-run and summer-run 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

Dungeness River 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 3.4, Salmon and Steelhead). However, because the native fall-run pink salmon population propagated through the Dungeness River Hatchery fall-run pink salmon program is at a low abundance level relative to recent historical abundance, 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 fall-run pink salmon population 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 Dungeness River watershed similar to Alternative 1, but the current abundance of natural-origin fall-run pink salmon limits dispersal of the species throughout the watershed. Under Alternative 1, the hatchery program for the species helps foster use of available productive habitat by increasing to a low extent the number of returning adult fish. Reduction of the hatchery fall-run pink salmon program under Alternative 4 would therefore decrease the spatial structure and productivity status of the Dungeness River fall-run pink salmon population to a low extent relative to Alternative 1.

Under Alternative 1, low to moderate proportions of hatchery-origin fall-run pink salmon in the naturally spawning population and in hatchery broodstock may pose low to medium risks of adverse effects on the diversity of the Dungeness River pink salmon populations. Reducing the Dungeness River Hatchery fall-run pink salmon hatchery program under Alternative 4 may reduce genetic diversity and fitness loss risks to the natural-origin populations to a negligible to low extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin pink salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the salmon recovery effort for the watershed (WDFW 2013a), including those proposed to restore the fall-run pink salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the generally depressed abundance status of natural-origin fall-run pink salmon returns (Table 15), and low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.5, Puget Sound Pink Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that would result from hatchery intervention as proposed under Alternative 1. Reduction of the fall-run pink salmon program under Alternative 4 would reduce this off-setting extinction prevention benefit afforded under Alternative 1 to a negligible to low extent. The conservation-directed program under Alternative 1, while implementing measures designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would help preserve the Dungeness River fall-run pink salmon population to a negligible to low extent relative to Alternative 4.

Relative to Alternative 1, benefits to the abundance of the total fall-run pink salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to a low extent under Alternative 4. Under Alternative 4, an estimated 8,652 adult pink salmon would return to the Dungeness River in the short term compared with 8,902 pink salmon under Alternative 1 (Table 15). After removal of 110 fish for use as hatchery broodstock, under Alternative 4, 8,542 pink salmon would be available to spawn naturally, or <85 percent of the recent historical spawner abundance level of over 10,000 naturally spawning fall-run pink salmon in the Dungeness River watershed (Table 15). Under

Alternative 1, 8,682 fall-run pink salmon would be available to spawn naturally, or less than 87 percent of the recent historical naturally spawning fall-run pink salmon abundance.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for pink salmon survival and productivity. Projects helping to remediate habitat limiting factors for salmon would be expected to benefit pink salmon by increasing naturally spawning fish survival and fry to adult return rates for fish produced by the program. Under Alternative 4, 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 Action. However, for the reasons described above, reduction of the hatchery program for pink salmon under Alternative 4 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness River pink salmon population viability would therefore be expected to be reduced to a low extent under Alternative 4 relative to Alternative 1, at least over the short term. Over the longer term, habitat restoration actions would increase naturally spawning fall-run pink salmon survival and productivity, but the pace of recovery of the total population would be slowed to a low extent under Alternative 4 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive.

Similar to Alternative 1, under Alternative 4, there would be no fisheries that would directly harvest hatchery-origin or natural-origin Dungeness River pink salmon. Pink salmon produced in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Relative to Alternative 1, Dungeness River pink salmon would be harvested incidentally to a lower extent in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness River Hatchery program producing coho salmon would be reduced and adult coho returns supporting the fisheries would decrease. Because the total pink salmon population would be reduced in size, the adverse effects of any coho salmon fisheries on the pink salmon population would likely be greater to a low extent under Alternative 4 compared to Alternative 1. Under Alternative 4, the harvest impact consequences to the total Dungeness River pink salmon population would increase to a low extent as the number and proportion of hatchery-origin fish decreased, increasing the focus of effort, and removal effects, on natural-origin fish.

For the above reasons, under Alternative 4, adverse hatchery-related effects on fall-run and summer-run pink salmon and the species' habitat would be reduced to a low extent relative to Alternative 1, and beneficial effects would be reduced to a low extent relative to Alternative 1.

4.4.6. Puget Sound Coho Salmon

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

Under Alternative 1, the hatchery programs, including the program for coho salmon, would be operated the same as under baseline conditions (Subsection 2.1, 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., from Table 7, genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). Effects on Dungeness River coho salmon life history; adult migration and spawning behavior, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 1 relative to the baseline conditions for the species described in Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed). Nutrient cycling and population viability benefits would also remain the same relative to baseline conditions, as over the short and longer terms, the programs under Alternative 1 would continue to function at the same operational levels.

Under Alternative 1, as under baseline conditions, an estimated 6,406 (2056 natural-origin and 4,350 hatchery-origin) adult coho salmon would return to the Dungeness River watershed (Table 16). After removal of 500 largely hatchery-origin, native Dungeness River stock coho salmon adults for use as hatchery broodstock, 5,906 coho salmon would be available for harvest, or to escape to the hatchery or natural spawning areas to spawn naturally. The total number abundance of coho salmon above hatchery broodstock needs would be up to 27% percent of the recent year historical run size abundance level of greater than 22,000 coho salmon (Table 16).

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for coho salmon survival and productivity. Projects helping to remediate habitat limiting factors to coho salmon would be expected to benefit the proposed hatchery program for the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 1, 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 baseline conditions, as the actions are not affected by, or included as part of the Proposed Action. Effects on recovery of a self-sustaining coho salmon population over the short and long terms would therefore remain unchanged under Alternative 1 relative to baseline conditions.

Under Alternative 1, as under baseline conditions, tribal and non-Indian net fisheries, and non-Indian sport fisheries, directed at the harvest of hatchery-origin and natural-origin coho salmon would occur each year in Dungeness Bay and the Dungeness River (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). Dungeness River coho salmon would also continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Similar to the baseline, these fisheries would continue to harvest predominantly hatchery-origin coho salmon produced by Dungeness River Hatchery, and also natural-origin coho salmon. Under Alternative 1, hatchery coho

Table 16. Total annual adult coho salmon return and contributions to natural and hatchery escapement by alternative.

Alt	Dungeness River Coho Salmon Smolt Release Numbers [1]	Hatchery-Origin Adult Return [2]	Natural-origin Adult Return [3]	Total Adult Return	Required Number of Broodstock to Meet Annual Smolt Release Target	Number of Fish Available to Fisheries and Escapement [4]	Recent Historical Coho Salmon Abundance [5]	Naturally Spawning Fish Percent of Historical Abundance
1	500,000	4,350	2,056	6,406	500	5,906	>22,000	**<27%**
2	500,000	4,350	2,056	6,406	500	5,906	>22,000	**<27%**
3	0	0	2,056	2,056	N/A	2,056	>22,000	**<9%**
4	250,000 [6]	2,175	2,056	4,231	250	3,981	>22,000	**<18%**

1 Coho salmon fry (2,000 per year) are also proposed for release in Cooper Creek (in a partnership with North Olympic Salmon Coalition). Up to 1,900 eyed eggs are also proposed for transfer for educational purposes to local school projects (WDFW 2013c). Because fry and eyed egg survival rates to adult return for these very low numbers of fry and eggs under the Proposed Action would lead to the production of few (<20) adult fish each year, effects of this component of the Dungeness River Hatchery program are expected to be inconsequential under all alternatives, and are not analyzed.

2 Estimated hatchery-origin adult return is based on a 2005-2006 *brood year* average smolt-to-adult survival rate of 0.87% for Dungeness River Hatchery coho salmon (WDFW 2013c).

3 Recent five year (2007-2011) annual average natural-origin adult coho salmon run size (contribution to fisheries and escapement) to Dungeness River and Dungeness Bay ((Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). Source: Puget Sound Coho Salmon Run Reconstruction, unpublished data from J. Haymes, WDFW, January 7, 2013).

4 Estimated number of adult coho salmon returning to the Dungeness River and Dungeness Bay that would be available for harvest, escape to Dungeness River Hatchery, or spawn naturally under each alternative is the average natural-origin adult return (2,056 fish), plus the estimated number of returning hatchery-origin coho salmon, minus the annual number of adult fish required as broodstock to sustain the hatchery program.

5 Estimated maximum total coho salmon hatchery and natural-origin spawner escapement estimate for 1967-1997 from Haring (1999).

6 Coho salmon releases reduced to 250,000 yearling smolts per year, which is 1/2 of the proposed level (Table 12).

salmon production would continue as per baseline conditions, and total annual coho salmon harvests in Dungeness River and Dungeness Bay fisheries directed at hatchery adult returns would remain similar to the recent year average harvest of 3,905 fish (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)).

Under Alternative 1, as under baseline conditions, tribal and non-Indian net fisheries, and non-Indian sport fisheries, directed at the harvest of hatchery-origin and natural-origin coho salmon would occur each year in Dungeness Bay and the Dungeness River (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). Dungeness River coho salmon would also continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Similar to the baseline, these fisheries would continue to harvest predominantly hatchery-origin coho salmon produced by Dungeness River Hatchery, and also natural-origin coho salmon. Under Alternative 1, hatchery coho salmon production would continue as per baseline conditions, and total annual coho salmon harvests in Dungeness River and Dungeness Bay fisheries directed at hatchery adult returns would remain similar to the recent year average harvest of 3,905 fish (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)).

For the above reasons, under Alternative 1, adverse hatchery-related effects on coho 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.

4.4.6.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on Dungeness River coho salmon 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. Considering that risk aversion 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, negligible changes would be expected in risks to coho salmon associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, Salmon and Steelhead). Effects on Dungeness River coho salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1. Nutrient cycling and population viability benefits would also remain the same relative to Alternative 1 as over the short and longer terms, the programs under Alternative 2 would continue to function at the same operational levels under both alternatives.

Relative to Alternative 1, the estimated number of adult coho salmon would return to the Dungeness River watershed – 6,406 fish, of which 2,056 would be natural-origin and 4,350 would be hatchery-origin – would remain the same (Table 16). After removal of 500 fish for use as hatchery broodstock, 5,906 coho salmon would be available for harvest, or to escape to the hatchery or natural spawning areas to spawn naturally. The total number abundance of coho salmon above hatchery broodstock needs

would be up to 27% percent of the recent year historical run size abundance level of greater than 22,000 coho salmon (Table 16).

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for coho salmon survival and productivity. Projects helping to remediate habitat limiting factors to coho salmon would be expected to benefit the proposed hatchery program for the species by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the program. Under Alternative 2, 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 Action. Effects on recovery of a self-sustaining coho salmon population over the short and long terms would therefore remain unchanged under Alternative 1 relative to Alternative 1.

Under Alternative 2, fisheries effects on Dungeness River coho salmon would persist at similar levels relative to Alternative 1. The number of hatchery-origin adult coho salmon produced under Alternative 1 and the Proposed Action would not be different because smolt-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, tribal and non-Indian fisheries directed at the harvest of hatchery-origin and natural-origin coho salmon would continue to occur each year in Dungeness Bay and the Dungeness River, harvesting coho salmon at similar annual levels. Under both alternatives, Dungeness River coho salmon would also continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks.

For the above reasons, under Alternative 2, adverse hatchery-related effects on coho 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.

4.4.6.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River Hatchery salmon programs would be terminated. Implementation of Alternative 3 would eliminate risks identified in Table 7 associated with genetic effects, competition and predation, facility effects, natural population status masking, incidental fishing effects, and disease transfer from salmon hatchery programs in the watershed, because the hatchery programs would cease operation. The potential adverse salmon hatchery-related effects on coho 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. Similarly, population viability and nutrient cycling benefits for Dungeness River coho salmon would be eliminated, and become negligible, after hatchery-origin fish stop returning to the watershed to spawn (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). However, because the natural-origin component of the native coho salmon population propagated through the Dungeness River Hatchery coho salmon program is at a low abundance level, hatchery-origin coho salmon make up a majority of total annual returns (Subsection 3.4.6, Puget Sound Coho Salmon), and the condition of natural habitat is currently limiting

survival and productivity of the population in the wild, Alternative 3 may increase to a medium extent the population's risk of extirpation, and delay attainment of a viable abundance level to a medium extent relative to Alternative 1. Under Alternative 3, salmon would have access to habitat in the Dungeness River watershed similar to Alternative 1, but the total abundance of coho salmon that would be provided under Alternative 3 (Table 16) limits dispersal of the species throughout the watershed. The hatchery program for the species under Alternative 1 would foster increased use of available productive habitat, by increasing to a medium extent the number of returning adult fish. Termination of the hatchery coho salmon program under Alternative 3 would therefore lead to a medium decrease in the spatial structure and productivity status of the Dungeness River coho salmon population relative to Alternative 1.

Under Alternative 1, high proportions of hatchery-origin coho salmon in the naturally spawning population and in hatchery broodstock may pose medium risks of adverse effects on the diversity of the Dungeness River coho salmon population. Although the hatchery fish are derived from the native Dungeness River coho population, eliminating the Dungeness River Hatchery coho salmon program under Alternative 3 may reduce hatchery-related genetic diversity and fitness loss risks to the natural-origin coho salmon population to a medium extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin coho salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the salmon recovery effort for the watershed (WDFW 2013a), including those proposed to restore the coho salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the depressed abundance status of natural-origin coho salmon returns (Table 16), and low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.6, Puget Sound Coho Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that would result from hatchery intervention as proposed under Alternative 1. Termination of the coho salmon program under Alternative 3 would eliminate this off-setting extinction prevention benefit afforded under Alternative 1 to a low extent. The coho salmon hatchery program under Alternative 1, while implementing measures designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would help preserve the Dungeness River coho salmon population to a medium extent relative to Alternative 3.

Relative to Alternative 1, benefits to the abundance of the total coho salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to negligible under Alternative 3. Implementation of Alternative 3 would lead to the annual return of an estimated 2,056 all natural-origin adult coho salmon to the Dungeness River in the short term (Table 16). With termination of the hatchery program for the species, no adult coho salmon would be collected for use as broodstock, and all 2,056 fish would escape to spawn naturally. This level of natural escapement would be less than 9% percent of the recent historical spawner abundance level of over 22,000 coho salmon spawners in the Dungeness River watershed (Table 16). Under the current coho salmon abundance level, the hatchery program under Alternative 1 is partially responsible for the conservation of genetic diversity of the native population in the Dungeness River. Implementation of Alternative 3 would make genetic diversity conservation benefits to the coho salmon population negligible, and reduced to a medium extent relative to Alternative 1.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest

practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for coho salmon survival and productivity. Projects helping to remediate habitat limiting factors to salmon would be expected to benefit coho salmon by increasing naturally spawning fish survival and smolt to adult return rates for fish produced by the hatchery program. Under Alternative 3, 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 Action. However, for the reasons described above, elimination of the hatchery program for coho salmon under Alternative 3 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness River coho salmon population viability would therefore be expected to be reduced to a medium extant under Alternative 3 relative to Alternative 1, at least over the short term. Over the longer term, habitat restoration actions would increase naturally spawning coho salmon survival and productivity, but the pace of recovery of the total population would be slowed to a low extent under Alternative 3 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive. It is possible that the natural-origin coho salmon component of the population, without supportive breeding assistance, could take advantage of habitat improvements and eventually reach a viable population status. However, the unpredictable nature of the timing of and extent to which habitat will recover makes it impossible to calculate the time frame for recovery by an all-natural-origin coho salmon aggregation. The risks associated with terminating supportive breeding afforded by the hatchery program under Alternative 1 lingers, creating a medium degree of uncertainty as to whether recovery by an all-natural-origin component of the population is likely relative to Alternative 1.

Under Alternative 3, Dungeness River Hatchery coho salmon would no longer be harvested in Dungeness Bay and in-river fisheries targeting coho salmon because the hatchery program producing the species would be terminated. Adult hatchery-origin coho salmon returns supporting the fisheries under Alternative 1 would cease and the coho-directed fisheries in Dungeness Bay and the Dungeness River would be terminated because natural-origin coho salmon returns only could not sustain harvests. Annual harvests of coho salmon would be expected to be reduced by an annual average of 3,905 fish relative to Alternative 1 (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). However, coho salmon produced naturally in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Because the main fisheries affecting natural-origin coho salmon would be terminated, the adverse effects of fisheries would become negligible relative to Alternative 1.

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

4.4.6.4. Alternative 4 -- Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under Alternative 4, juvenile salmon production through the Dungeness River Hatchery salmon programs would be reduced by one-half relative to Alternative 1. Implementation of Alternative 4 would reduce hatchery-related risks associated with competition and predation, facility effects, masking, incidental fishing effects, or disease transfer to Dungeness River coho salmon, because smolt 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 coho salmon life history, population abundance, diversity, spatial structure, and productivity would be reduced to a to low extent under Alternative 4 relative to Alternative 1. Any population viability and nutrient cycling benefits for Dungeness River coho salmon resulting from implementation of Alternative 1 would be reduced to a medium under Alternative 4 after hatchery-origin salmon return in reduced abundances to the Basin to spawn (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). However, because the natural-origin component of the coho salmon population propagated through the Dungeness River Hatchery coho salmon program is at a low abundance level relative to recent historical abundance, 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 to medium extent the risk of extirpation, and delay attainment of a viable abundance level to a low to medium extent relative to Alternative 1. Under Alternative 4, salmon would have access to habitat in the Dungeness River watershed similar to Alternative 1, but the current abundance of natural-origin coho salmon limits dispersal of the species throughout the watershed. Under Alternative 1, the hatchery program for the species helps foster use of available productive habitat by increasing to a medium extent the number of returning adult fish. Reduction of the hatchery coho salmon program under Alternative 4 would therefore decrease the spatial structure and productivity status of the Dungeness River coho salmon population to medium extent relative to Alternative 1. Reducing by half the Dungeness River Hatchery coho salmon hatchery program may reduce genetic diversity and fitness loss risks to the natural-origin population relative to Alternative 1. The degree to which this risk reduction would occur, and on which life stages, is speculative, but may be low to medium relative to Alternative 1, given that hatchery-origin coho salmon compose the majority of annual total returns of the species (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). However, considering the current degraded state of natural habitat productivity and survival conditions, differences in hatchery-related effects between the alternatives may be inconsequential as they bear on coho salmon population viability.

Under Alternative 1, high proportions of hatchery-origin coho salmon in the naturally spawning population and in hatchery broodstock may pose medium risks of adverse effects on the diversity of the Dungeness River coho salmon population. Although the hatchery fish are derived from the native Dungeness River coho population, reducing the Dungeness River Hatchery coho salmon hatchery program under Alternative 4 may reduce genetic diversity and fitness loss risks to the natural-origin population to a low extent relative to Alternative 1. However, although some progress has been made in preserving and restoring habitat critical for natural-origin pink salmon survival and productivity (Subsection 3.4, Salmon and Steelhead), actions to restore habitat have not kept pace with other components of the salmon recovery effort for the watershed (WDFW 2013a), including those proposed to restore the coho salmon population under Alternative 1. Habitat conditions continue to place all salmonid stocks in the Dungeness River watershed at great risk (Subsection 3.4, Salmon and Steelhead). Considering the generally depressed abundance status of natural-origin coho salmon return (Table 16), and low productivity for fish migrating, spawning naturally, and rearing in currently degraded habitat (Subsection 3.4.6, Puget Sound Coho Salmon), the risk of extinction for the natural population outweighs genetic diversity loss risks that would result from hatchery intervention as proposed under Alternative 1. Reduction of the coho salmon program under Alternative 4 would reduce this off-setting extinction prevention benefit afforded under Alternative 1 to a low to medium extent. The hatchery coho salmon program under Alternative 1, while implementing measures

designed to retain extant genetic diversity until habitat is restored to properly functioning conditions, would help preserve the Dungeness River coho salmon population to a low extent relative to Alternative 4.

Relative to Alternative 1, benefits to the abundance of the total coho salmon return to the Dungeness River, and the number of fish spawning naturally, would be reduced to a medium extent under Alternative 4. Under Alternative 4, an estimated 4,231 adult coho salmon would return to the Dungeness River in the short term compared with 6,106 coho salmon under Alternative 1 (Table 16). After removal of 500 fish for use as hatchery broodstock, under Alternative 4, 3,981 coho salmon would be available for fisheries harvest and escapement, or less than 18 percent of the recent historical adult return abundance level of over 22,000 coho salmon in the Dungeness River watershed (Table 16). Under Alternative 1, 5,906 coho salmon would be available for fisheries harvest and escapement, or less than 27 percent of the recent historical coho salmon return abundance to the watershed.

The watershed recovery plan for the Dungeness River (SSPS 2005) includes projects under implementation, or proposed for implementation, that would reduce the adverse effects of past forest practice, dike and levee placement, and agricultural development actions, and on-going water withdrawal actions, on habitat processes and conditions critical for coho salmon survival and productivity. Projects helping to remediate habitat limiting factors for salmon would be expected to benefit coho salmon by increasing naturally spawning fish survival and fry to adult return rates for fish produced by the hatchery program. Under Alternative 4, 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 Action. However, for the reasons described above, reduction of the hatchery program for coho salmon under Alternative 4 would reduce the abundance and spatial distribution of the population that would benefit from habitat restoration actions implemented in the watershed. The benefits of habitat restoration actions to Dungeness River coho salmon population viability would therefore be expected to be reduced to a low extent under Alternative 4 relative to Alternative 1, at least over the short term. Over the longer term, habitat restoration actions would increase naturally spawning coho salmon survival and productivity, but the pace of recovery of the total population would be slowed to a low extent under Alternative 4 relative to Alternative 1, because fewer adult fish would be available to spawn naturally until restored habitat became more productive. It is possible that the natural-origin coho salmon component of the population, with reduced assistance by supportive breeding, could take advantage of habitat improvements and eventually reach a viable population status. However, the unpredictable nature of the timing of and extent to which habitat will recover makes it impossible to calculate the time frame for recovery by a predominately natural-origin coho salmon aggregation. The risks associated with reducing supportive breeding afforded by the hatchery program as proposed under Alternative 1 lingers, creating a low to medium degree of uncertainty as to whether recovery by an all-natural-origin component of the population is likely relative to Alternative 1.

Under Alternative 4, tribal and non-Indian net fisheries, and non-Indian sport fisheries, directed at the harvest of hatchery-origin and natural-origin coho salmon would occur each year in Dungeness Bay and the Dungeness River (Subsection 3.4.6, Puget Sound Coho Salmon (Non-listed)). With a reduction of hatchery coho salmon smolt releases, and resultant adult return levels to the watershed by one-half (Table 16), coho salmon harvests in these fisheries would be expected to be reduced to a medium extent (from 3,905 fish to perhaps 1,953 fish) relative to Alternative 1 (Subsection 3.4.6, Puget Sound Coho

Salmon (Non-listed)). Under Alternative 4, Dungeness River coho salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks, but at reduced levels relative to Alternative 1, because less fish would be available for harvest. Similar to Alternative 1, these fisheries would continue to harvest predominantly hatchery-origin coho salmon produced by Dungeness River Hatchery, and also natural-origin coho salmon.

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

4.4.7. Sockeye Salmon

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

The proposed action is limited to hatchery production of Chinook, pink and coho salmon. Therefore, effects on sockeye salmon do not include hatchery-related genetic diversity and fitness loss and other risks associated with the spawning of hatchery and natural-origin populations of the same species. Rather, under all alternatives, NMFS has examined whether the hatchery actions incidentally affect sockeye salmon, as described below.

Under Alternative 1, no sockeye salmon would be produced as part of the hatchery actions, and the salmon hatchery programs would continue operation as under baseline conditions (Subsection 2.1, Alternative 1), as habitat restoration and harvest management actions are implemented to improve salmon survival and productivity. There is no known persistent sockeye salmon population in the Dungeness River watershed, but riverine sockeye are occasionally observed (Subsection 3.4.7, Sockeye Salmon). 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 any sockeye salmon associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). Effects on sockeye salmon life history, and population abundance, diversity, spatial structure, and productivity in the Dungeness River would remain unchanged under Alternative 1 relative to the baseline conditions for the species that are described in Subsection 3.4.7, Sockeye Salmon. Any nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Under Alternative 1, as under baseline conditions, no fisheries would directly harvest sockeye salmon present in the Dungeness River. Sockeye salmon returning to the Dungeness River would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks under Alternative 1 and the baseline. Under Alternative 1 and the baseline, because abundance levels are very low, late returning sockeye salmon would also potentially be harvested incidentally to a negligible extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

4.4.7.2. 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 Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on any sockeye salmon in the Dungeness River 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. 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, negligible changes would be expected in risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, Salmon and Steelhead). There is no known persistent sockeye salmon population in the Dungeness River watershed, but riverine sockeye are occasionally observed, and any effects on riverine sockeye salmon life history, and population abundance, diversity, spatial structure, and productivity would remain unchanged under Alternative 2 relative to Alternative 1. Potential nutrient cycling and population viability benefits would also remain the same relative to Alternative 1 as over the short and longer terms, the programs under Alternative 2 would continue to function at the same operational levels under both alternatives.

Under Alternative 2, as under Alternative 1, no fisheries would directly harvest sockeye salmon present in the Dungeness River. Sockeye salmon returning to the Dungeness River would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks under Alternative 2 and Alternative 1. Under both alternatives, because abundance levels are very low, late returning sockeye salmon would also potentially be harvested incidentally to a negligible extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

4.4.7.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate, and make negligible, any risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to sockeye salmon present in the Dungeness River from salmon hatchery programs, because the programs would be immediately terminated. Under Alternative 3, any population viability and nutrient cycling benefits for sockeye salmon in the river would be eliminated, and become negligible, after hatchery-origin salmon stop returning to the watershed to spawn (Subsection 3.4, Salmon and Steelhead), so benefits from these factors would be decreased relative to Alternative 1.

Under Alternative 3, fisheries effects on sockeye salmon may be reduced to negligible relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest sockeye salmon. Under both alternatives, any sockeye salmon returning to the Dungeness River watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. However, in contrast to Alternative 1, sockeye salmon would no longer be subject to incidental harvest in Dungeness Bay and in-river fisheries targeting coho salmon because the Dungeness

River Hatchery program producing the species would be terminated and adult coho salmon returns supporting the fisheries would cease. Due to the very low number of sockeye salmon observed in the watershed, this decrease in harvest pressure is likely to have an immeasurable effect on the population(s) from which these sockeye salmon may originate relative to Alternative 1.

4.4.7.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 would reduce risks associated with competition and predation, facility effects, incidental fishing effects, or disease transfer to sockeye salmon in the Dungeness River, because juvenile 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 sockeye 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 sockeye salmon in the Dungeness River 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 3.4, Salmon and Steelhead).

Under Alternative 4, fisheries effects may be reduced to a low extent relative to Alternative 1. Similar to Alternative 1, no fisheries would directly harvest sockeye salmon originating from the Dungeness River. Under both alternatives, Dungeness River sockeye salmon would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Any sockeye salmon would continue to be harvested incidentally in Dungeness Bay and in-river fisheries targeting coho salmon, but to a lower extent relative to Alternative 1, because the Dungeness River Hatchery program producing the species would be reduced by one-half, and adult coho salmon returns supporting the fisheries would be reduced by that amount.

4.5. Other Fish Species

4.5.1. 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 longer terms (Subsection 2.1, Alternative 1). On-going habitat restoration actions implemented to improve salmon survival and productivity in conjunction with implementation of the salmon hatchery programs would also benefit other fish species. Therefore, hatchery-related risks to other fish species associated with hatchery program implementation (i.e., from Table 7, competition and predation, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to baseline conditions (Subsection 3.4, Salmon and Steelhead). Nutrient cycling and population viability benefits would also remain the same relative to baseline conditions.

Bull trout, a listed species present in the Dungeness River watershed, and other non-listed fish species identified in Subsection 3.5, Table 9 (hereafter “other non-listed fish species”, which includes sea-run cutthroat trout, resident rainbow trout, lamprey species, sculpin species, three-spine stickleback, mountain whitefish, smallmouth bass, minnow species, and sucker species) 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. As under baseline conditions, any effects are expected to be negligible or low under Alternative 1 for the following reasons: (1) bull trout and other non-listed fish species would largely benefit from having hatchery-origin salmon released into the Dungeness River watershed because they eat juvenile salmon; (2) based on recent data (WDFW 2013), few bull trout and other non-listed fish species would be expected to be intercepted at the hatchery weirs and during in-river broodstock collection activities, and no mortalities would be expected; and (3) bull trout and other non-listed fish species are not found exclusively in the Dungeness River watershed or nearby marine waters (the watershed is a very small percentage of the species' total range, so any mortalities as a result of the Proposed Action would not be expected to impact the overall abundance, health, survival, or status of the species). For these reasons, salmon hatchery-related effects on Dungeness River bull trout and other non-listed fish species life history and population abundance, diversity, spatial structure, and productivity would be low to negligible under Alternative 1, similar to effects under baseline conditions.

Because the marine fish species identified in Subsection 3.5, Table 9, including Pacific staghorn sculpin, rockfish species, forage fish species, three-spine stickleback, shiner perch, starry flounder, and spiny dogfish, are not located exclusively in the Dungeness River estuary or nearby marine waters, and in most cases these areas are a very small percentage of their total range, 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 is not expected to impact the overall size, health, survival, or status of those species.

Under Alternative 1, as under baseline conditions, no fisheries occurring to harvest returning hatchery-origin salmon would directly harvest other fish species in the Dungeness River and Dungeness Bay. Fish species susceptible to harvest in net and sport gear types used in tribal commercial and Washington State recreational salmon fisheries would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks (e.g., rockfish). Other fish species susceptible to these gear types would also potentially be harvested incidentally to a very low extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

Over the longer term, continued operation of the Chinook salmon and pink salmon hatchery programs, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total populations for the species in the Dungeness River to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased Chinook salmon and pink salmon abundances to other fish species under Alternative 1 as the program continues into the future would be increased to a medium extent above the baseline level (Table 9) (Subsection 3.5, Other Fish Species). New fisheries with direct harvest impacts on restored Dungeness River Chinook and pink salmon populations could potentially be initiated over the longer term under Alternative 1. Harvest-related risks to other fish species in the Dungeness River and Dungeness Bay under Alternative 1 would also be expected to increase to a medium extent above baseline levels, as salmon abundance increases could lead to fisheries for Chinook and pink salmon in those areas that are currently lacking. No differences in effects between Alternative 1 and the baseline are likely in mixed stock marine area fisheries where Dungeness River Chinook and pink salmon would continue to be harvested incidentally.

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

Under Alternative 2, operation of the Dungeness River Hatchery salmon programs would be the same as under Alternative 1 over the short and long terms (Subsection 2.2, Alternative 2), so the hatchery programs would have identical impacts on other fish species and their habitat in the Dungeness River watershed 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 to other fish species associated with competition and predation, facility effects, incidental fishing effects, or disease transfer relative to Alternative 1 (Table 7) (Subsection 3.4, Salmon and Steelhead). For these reasons, salmon hatchery-related effects on Dungeness River bull trout life history, and population abundance, diversity, spatial structure, and productivity would be negligible under Alternative 1, similar to effects under baseline conditions. Similarly, nutrient cycling or population viability benefits would persist at similar levels relative to Alternative 1.

Bull trout, and the other non-listed fish species identified in Subsection 3.5, Table 9, may be affected by the salmon hatchery programs operating under Alternative 2 through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations. But similar to Alternative 1, any effects are expected to be negligible under Alternative 2 for the following reasons: (1) bull trout, and the other non-listed fish species would largely benefit from having hatchery-origin salmon released into the Dungeness River watershed because they eat juvenile salmon; (2) based on recent data (WDFW 2013), few bull trout, and the other non-listed fish species would be expected to be intercepted at the hatchery weirs and during in-river broodstock collection activities, and no mortalities would be expected; and (3) bull trout, and the other non-listed fish species are not found exclusively in the Dungeness River watershed or nearby marine waters (the watershed is a very small percentage of the species' total range, so any mortalities as a result of the Proposed Action would not be expected to impact the overall abundance, health, survival, or status of the species). For these reasons, salmon hatchery-related effects on Dungeness River bull trout, and other non-listed fish species life history, and population abundance, diversity, spatial structure, and productivity would be low to negligible under Alternative 2, the same as effects under Alternative 1.

Similar to Alternative 1, because the marine fish species identified in Subsection 3.5, Table 9, including Pacific staghorn sculpin, rockfish species, forage fish species, three-spine stickleback, shiner perch, starry flounder, and spiny dogfish, are not located exclusively in the Dungeness River estuary or nearby marine waters, and in most cases these areas are a very small percentage of their total range , 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 would be low, and not expected to impact the overall size, health, survival, or status of those species.

Under Alternative 2, as under Alternative 1, over the short term, no fisheries would directly harvest other fish species in the Dungeness River and Dungeness Bay. Fish species susceptible to harvest in net and sport gear types used in tribal commercial and Washington State recreational salmon fisheries would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting

more abundant salmon stocks (e.g., rockfish). Similar to Alternative 1, other fish species susceptible to these gear types would also potentially be harvested incidentally to a low extent in Dungeness Bay and in-river fisheries targeting coho salmon returning to Dungeness River Hatchery.

Over the longer term, continued operation of the Chinook and pink salmon hatchery programs, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total Chinook and pink salmon populations in the Dungeness River to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to other fish species under Alternative 2 and Alternative 1 would be similar because program operation and hatchery-origin adult return levels would be similar. There would be low benefits to other fish species attendant with the increasing likelihood that the hatchery programs will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. New fisheries with direct harvest impacts on restored Dungeness River Chinook and pink salmon populations could potentially be initiated over the longer term under Alternative 2. Harvest-related risks to other fish species in the Dungeness River and Dungeness Bay 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 Dungeness River Chinook and pink salmon would continue to be harvested incidentally.

4.5.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate, and make negligible, 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 watershed, because the hatchery programs would be immediately terminated. Similarly, any population viability and nutrient cycling benefits for other fish species would be eliminated, and become negligible, after hatchery-origin fish stop returning to the Basin to spawn (Subsection 3.4, Salmon and Steelhead). Termination of the three salmon hatchery programs under Alternative 3 would therefore make risks and benefits to other fish species negligible relative to Alternative 1.

Risks to bull trout, and the other non-listed fish species identified in Subsection 3.5, Table 9, posed by the salmon hatchery programs through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations would be eliminated, and become negligible, under Alternative 3. The salmon hatchery programs would be terminated, and there would be no juvenile fish releases, adult fish returns, or hatchery operational activities that would potentially harm bull trout, and the other non-listed fish species. Under Alternative 3, benefits to bull trout, and other non-listed fish species population viability and to nutrient cycling that would enhance the species would also be eliminated, and become negligible, through termination of hatchery salmon production from the Dungeness River hatchery programs. But similar to Alternative 1, any effects are expected to be low to negligible under Alternative 3 for the following reasons: (1) lacking seasonally available juvenile hatchery-origin salmon, bull trout, and the other non-listed fish species identified as salmon predators in Subsection 3.5, Table 9 would still prey on and benefit from natural-origin juvenile salmon; (2) based on recent data (WDFW 2013), few bull trout, and other non-listed fish species would be expected to be intercepted at the hatchery weirs and during in-river broodstock collection activities, and no mortalities would be expected, so termination of the programs will not substantially change already low effects; and (3) bull trout, and the other non-listed fish species

are not found exclusively in the Dungeness River watershed or nearby marine waters (the watershed is a very small percentage of the species' total range, so termination of the salmon hatchery programs would not be expected to impact the overall abundance, health, survival, or status of the species). Salmon hatchery-related effects on Dungeness River bull trout, and other non-listed fish species life history, and population abundance, diversity, spatial structure, and productivity would be eliminated under Alternative 3, and likely reduced from low to negligible to negligible relative to effects expected under Alternative 1.

Similar to Alternative 1, because the marine fish species identified in Subsection 3.5, Table 9, including Pacific staghorn sculpin, rockfish species, forage fish species, three-spine stickleback, shiner perch, starry flounder, and spiny dogfish, are not located exclusively in the Dungeness River estuary or nearby marine waters, and in most cases these areas are a very small percentage of their total range, any adverse or beneficial effects on these species that would result from termination of the salmon hatchery programs are expected to have negligible impacts on the overall size, health, survival, or status of those species.

Under Alternative 3, Dungeness River Hatchery coho salmon would no longer be harvested in Dungeness Bay and in-river fisheries targeting coho salmon because the hatchery program producing the species would be terminated. Adult hatchery-origin coho salmon returns to the watershed would cease, and the coho-directed fisheries in Dungeness Bay and the Dungeness River would be terminated because natural-origin coho salmon returns only could not sustain harvests in tribal and Washington State fisheries. However, salmon produced naturally in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Because directed salmon fisheries in Dungeness Bay and the Dungeness River would be terminated, any adverse effects of fisheries on other fish species susceptible to harvest in commercial or recreational salmon fishing gear would become negligible relative to Alternative 1 over the short and longer terms.

4.5.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 would reduce 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 watershed, because juvenile salmon production would be reduced by one-half, reducing the number of fish that could potentially interact with other fish species. 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 other fish species associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to Alternative 1 (Subsection 3.4, Salmon and Steelhead). Any population viability and nutrient cycling benefits for other fish species would be reduced to a low extent relative to Alternative 1, after reduced numbers of hatchery-origin fish return to the Basin to spawn (Subsection 3.4, Salmon and Steelhead).

Risks to bull trout, and the other non-listed fish species identified in Subsection 3.5, Table 9, posed by the salmon hatchery programs through facility operations (water intakes), predation, competition, marine-derived nutrients, fishing, and interception during broodstock collection operations would be

reduced to a low extent under Alternative 4. Juvenile fish releases from the salmon hatchery programs would be reduced by one-half relative to Alternative 1, and there would be less juvenile hatchery fish, less adult fish returns, and less hatchery operational activities that would potentially harm bull trout, and the other fish species. Under Alternative 4, benefits to bull trout and other fish species population viability, and to nutrient cycling that would enhance the species, would also be reduced to a low extent because fewer hatchery salmon would be available relative to Alternative 1. But similar to Alternative 1, any effects are expected to be low to negligible under Alternative 4 for the following reasons: (1) with reductions in seasonally available juvenile hatchery-origin salmon, bull trout, and the other non-listed fish species identified as salmon predators in Subsection 3.5, Table 9 would still prey on and benefit from natural-origin juvenile salmon; (2) based on recent data (WDFW 2013), few bull trout, and other non-listed fish species would be expected to be intercepted at the hatchery weirs and during in-river broodstock collection activities, and no mortalities would be expected, so reduction of the programs will not substantially change already low effects; and (3) bull trout, and the other fish species are not found exclusively in the Dungeness River watershed or nearby marine waters (the watershed is a very small percentage of the species' total range, so reduction of the salmon hatchery programs would not be expected to impact the overall abundance, health, survival, or status of the species). Salmon hatchery-related effects on Dungeness River bull trout, and other non-listed fish species life history, and population abundance, diversity, spatial structure, and productivity would be reduced under Alternative 4, and likely reduced from low to negligible to negligible relative to effects expected under Alternative 1.

Similar to Alternative 1, because the marine fish species identified in Subsection 3.5, Table 9, including Pacific staghorn sculpin, rockfish species, forage fish species, three-spine stickleback, shiner perch, starry flounder, and spiny dogfish, are not located exclusively in the Dungeness River estuary or nearby marine waters, and in most cases these areas are a very small percentage of their total range, any adverse or beneficial effects on these species that would result from reduction of the salmon hatchery programs are expected to have negligible impacts on the overall size, health, survival, or status of those species.

Under Alternative 4, Dungeness River Hatchery coho salmon would be harvested to a lower extent relative to Alternative 1 in Dungeness Bay and in-river fisheries targeting coho salmon because the hatchery program producing the species would be reduced by one-half. Adult hatchery-origin coho salmon returns to the watershed would also be reduced by one-half. Coho salmon-directed fisheries in Dungeness Bay and the Dungeness River would be reduced because total coho salmon returns sustaining harvests in tribal and Washington State fisheries would be reduced. However, salmon produced naturally in the watershed would continue to be harvested incidentally in U.S. and Canadian mixed-stock marine area fisheries targeting more abundant salmon stocks. Although directed salmon fisheries in Dungeness Bay and the Dungeness River would be reduced, any adverse effects of fisheries on other fish species susceptible to harvest in commercial or recreational salmon fishing gear would remain low and the same as under Alternative 1.

Over the longer term, continued operation of the Chinook and pink salmon hatchery programs at reduced levels, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total Chinook and pink salmon populations in the Dungeness River to a healthy status approaching historical levels. However, the pace of restoration of these populations would be expected to be reduced to a low to medium extent relative to Alternative 1, because juvenile and adult fish production that would

contribute to natural spawning would be reduced by on-half. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to other fish species under Alternative 4 would be reduced to a low to medium level relative to Alternative 1 because program operation and hatchery-origin adult return levels would be reduced by one-half. New fisheries with direct harvest impacts on restored Dungeness River Chinook and pink salmon populations could potentially be initiated over the longer term under Alternative 4, but at a reduced pace relative to Alternative 1. Harvest-related risks to other fish species in the Dungeness River and Dungeness Bay under Alternative 4 would be expected to be similar to Alternative 1, with no differences in effects between the alternatives on other fish species likely in mixed stock marine area fisheries where Dungeness River Chinook and pink salmon, and other fish species, would continue to be harvested incidentally.

4.6. Wildlife

4.6.1. 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 longer terms (Subsection 2.1, Alternative 1). The low risk of transfer of toxic contaminants from hatchery-origin fish to the wildlife species identified in Subsection 3.6, Table 10 (hereafter "wildlife species", including the bald eagle, northern spotted owl, marbled murrelet, northern goshawk, Pacific fisher, peregrine falcon, gulls, cormorants, great blue heron, duck species, beaver, cougar, black bear, river otter. mink, weasel species, bat species, amphibians (including salamanders and frogs), aquatic/terrestrial/riparian zone invertebrates (e.g., insects and snails), southern resident killer whale, harbor seal, Steller sea lion, California sea lion, northern sea otter, harbor porpoise (Inland Washington and Oregon-Washington Coastal stocks), Dall's porpoise (California /Oregon / Washington stock), Pacific white-sided dolphin (California/ Oregon/ Washington stock), and marine invertebrates (e.g., zooplankton and crab) would persist at similar levels relative to baseline conditions. Low 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 operation, or habitat disruption from tribal and non-Indian net fisheries for coho salmon (Subsection 3.6, Wildlife) would also persist at similar levels relative to 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 the riverine, estuarine, and terrestrial wildlife species identified in Subsection 3.6 and Table 10. Under Alternative 1, these nutrient cycling benefits would persist at similar levels relative to baseline conditions.

Increasing the total number of Dungeness River-origin salmon above levels achievable naturally through the implementation of the Dungeness River Hatchery salmon programs under Alternative 1 would increase the total amount of food available for marine mammals that prey on salmon, such as southern resident killer whales, harbor seals, sea lions, sea otters, dolphin species, and porpoise species (Subsection 3.6) (Table 10). However, because total adult salmon production from the hatchery programs is relatively small, and considering that Dungeness River 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 the programs implemented under Alternative 1 on the abundance of predator marine mammal species would be negligible (i.e., at the lower levels of detection), and the same as under baseline conditions.

Increasing the total number of Dungeness River-origin salmon above levels achievable naturally through the implementation of the Dungeness River Hatchery salmon programs under Alternative 1 would also increase food availability for salmon predators (e.g., river otters) and scavengers (e.g., gulls, bald eagles), which may have a low to medium beneficial impact on these wildlife species (Table 10) (Section 3.6, Wildlife). Increasing the number of salmon in the Dungeness River watershed 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 birds, invertebrates and amphibian species in the watershed. However, because of the seasonal nature of juvenile hatchery salmon releases and adult returns, and the small number of adult salmon produced by the hatchery programs relative to total salmon production in the Puget Sound, effects would likely be negligible and the same as levels experienced under baseline conditions. Hatchery management measures taken to discourage predation by wildlife species (e.g., river otters, great blues herons, gulls) by covering hatchery salmon rearing areas rather than hazing the potential predator species would continue under Alternative 1, and remain the same as under baseline conditions.

Similar to baseline conditions, implementation of Alternative 1 would not be expected to change the size, health, survival, or Federal listing status of Northern spotted owl, marbled murrelet, southern resident killer whale, and Steller sea lion populations. None of these listed species is located exclusively in the Dungeness River watershed or nearby marine waters, and the analysis area represents a very small percentage of their total range. Implementation of Alternative 1 would also not be expected to change, relative to baseline conditions, the population sizes, health, or survival of the non-listed bird, mammal, amphibian, and invertebrate species identified in Subsection 3.6 and Table 10 for the same reasons.

Over the longer term, continued operation of the salmon hatchery programs, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total populations of salmon in the Dungeness River to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to wildlife species under Alternative 1 as the programs continue into the future would be increased to a low or medium extent above the baseline level. New fisheries with direct harvest impacts on restored Dungeness River salmon populations could potentially be initiated over the longer term under Alternative 1. Harvest-related risks to wildlife species in the Dungeness River and Dungeness Bay under Alternative 1 would be expected to be increased to a low or medium extent above baseline levels (direct harvest of species other than coho salmon are currently lacking), with no differences in effects likely in mixed stock marine area fisheries where Dungeness River salmon would continue to be harvested incidentally.

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

Under Alternative 2, over the short and long terms, the operation of the Dungeness River Hatchery salmon programs would be the same as under Alternative 1 (Subsection 2.2, Alternative 2), so the

hatchery programs would have identical impacts on wildlife species 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. Considering hatchery operation actions, including fish health management procedures, would remain the same, salmon hatchery-related risks to other fish species associated with hatchery program implementation (i.e., from Table 7, competition and predation effects, facility effects, incidental fishing effects, or disease transfer) would persist at similar levels relative to Alternative 1 (Subsection 3.4, Salmon and Steelhead). Negligible changes relative to Alternative 1 would be expected in risks to wildlife species associated with: the risk of transfer of toxic contaminants from hatchery-origin fish to wildlife; 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 operation; and habitat disruption from tribal commercial coho salmon fisheries (Subsection 3.6, Wildlife). Similarly, nutrient cycling benefits would persist at similar levels relative to Alternative 1.

Increasing the total number of Dungeness River-origin salmon above levels achievable naturally through the implementation of the Dungeness River Hatchery salmon programs under Alternative 2 would increase the total amount of food available for marine mammals that prey on salmon, such as southern resident killer whales, harbor seals, sea lions, sea otters, dolphin species, and porpoise species. However, because total adult salmon production from the hatchery programs is relatively small, and considering that Dungeness River salmon 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 predator marine mammal species would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Increasing the total number of Dungeness River-origin salmon above levels achievable naturally through the implementation of the Dungeness River Hatchery salmon programs under Alternative 2 would also increase to a low extent food availability for salmon predators (e.g., river otters) and scavengers (e.g., bald eagles), which may have a low to medium beneficial impact on these wildlife species (Table 10) (Section 3.6, Wildlife). Increasing the number of salmon in the Dungeness River watershed would also increase to a low extent the number of salmon competitors for food for some wildlife species, and the number of salmon predators on some invertebrates and amphibian species. These latter interactions might have an adverse impact on the abundance of birds, invertebrates and amphibian species in the watershed. However, because of the seasonal nature of juvenile hatchery salmon releases and adult returns, and the small number of adult salmon produced by the hatchery programs relative to total salmon production in the Puget Sound, effects would likely be negligible, and the same as levels experienced under Alternative 1. Hatchery management measures taken to discourage predation by wildlife species (e.g., river otters, great blues herons, gulls) by covering hatchery salmon rearing areas rather than hazing the potential predator species would continue under Alternative 2, and remain the same as under Alternative 1.

Similar to Alternative 1, implementation of Alternative 2 would not be expected to change the size, health, survival, or Federal listing status of northern spotted owl, marbled murrelet, southern resident killer whale, and Steller sea lion populations. None of these species is located exclusively in the

Dungeness River watershed or nearby marine waters and the analysis area represents a very small percentage of their total range. Implementation of Alternative 2 would also not be expected to change, relative to Alternative 1, the population sizes, health, or survival of the non-listed bird, mammal, amphibian, and invertebrate species identified in Subsection 3.6 and Table 10 for the same reasons.

Over the longer term, continued operation of the salmon hatchery programs, in conjunction with other watershed actions implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), would be expected to restore the natural-origin and total salmon populations in the Dungeness River to a healthy status approaching historical levels. The levels of potential nutrient cycling and population viability benefits from increased salmon abundance levels to wildlife species under Alternative 2 and Alternative 1 would be similar because program operation and hatchery-origin adult return levels would be similar. However, there would be relative low to medium benefits to wildlife species attendant with the increasing likelihood that the hatchery programs will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. New fisheries with direct harvest impacts on restored Dungeness River salmon populations could potentially be initiated over the longer term during the time period considered in Alternative 2. Harvest-related risks to wildlife species in the Dungeness River and Dungeness Bay 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 Dungeness River Chinook and pink salmon would continue to be harvested incidentally.

4.6.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Implementation of Alternative 3 would eliminate, and make negligible relative to Alternative 1, risks to wildlife species associated with transfer of toxic 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, or habitat disruption from tribal commercial coho salmon fisheries (Subsection 3.6, Wildlife), because the salmon hatchery programs (and associated fisheries targeting hatchery coho salmon in the immediate action area) would be immediately terminated. Similarly, any nutrient cycling benefits for wildlife would be eliminated, and become negligible, after hatchery-origin fish stop returning to the watershed to spawn commensurate with termination of the hatchery programs (Subsection 3.6, Wildlife). Termination of the three salmon hatchery programs under Alternative 3 would therefore make salmon hatchery-related risks and benefits to wildlife species negligible relative to Alternative 1.

Decreasing the total number of Dungeness River-origin salmon through termination of the Dungeness River Hatchery salmon programs under Alternative 3 would decrease the total amount of food available for marine mammals that prey on salmon, such as southern resident killer whales, harbor seals, sea lions, sea otters, dolphin species, and porpoise species. However, because total adult salmon production from the hatchery programs is relatively small, and considering that Dungeness River 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 on the abundance of predator marine mammal species would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Decreasing the total number of Dungeness River-origin salmon through the termination of the Dungeness River Hatchery salmon programs under Alternative 3 would also decrease food availability for salmon predators (e.g., river otters) and scavengers (e.g., bald eagles). Relative to Alternative 1, because hatchery-origin Chinook salmon and coho salmon compose the majority of production of the species in the watershed, Alternative 3 may reduce benefits to wildlife populations to a medium extent (Table 10) (Section 3.6, Wildlife). Elimination of hatchery salmon production in the Dungeness River watershed 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 low beneficial impact on the abundance of birds, invertebrates, and amphibian species in the watershed relative to Alternative 1. Hatchery management measures taken to discourage predation by wildlife species (e.g., river otters, great blues herons, gulls) by covering hatchery salmon rearing areas rather than hazing the potential predator species would cease under Alternative 3, because there would no longer be a need to protect rearing salmon. Effects would remain negligible and the same as under 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, and Steller sea lion populations. Termination of the salmon hatchery programs under Alternative 3 would have a negligible effect on the status of these species, because none of them are located exclusively in the Dungeness River watershed or nearby marine waters, and the analysis area represents a very small percentage of their total range. Implementation of Alternative 3 would not be expected to change, relative to Alternative 1, the population sizes, health, or survival of the non-listed bird, mammal, amphibian, and invertebrate species identified in Subsection 3.6 and Table 10 for the same reasons.

Over the longer term, although, other watershed actions would continue to be implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), the salmon hatchery programs contributing to salmon recovery would be discontinued. These SSPS recovery actions would be expected to help restore the natural-origin and total populations of salmon in the Dungeness River to a healthy status approaching historical levels. However, because hatchery-origin Chinook salmon and coho salmon compose most of returning abundances for those species (Section 3.4, Salmon and Steelhead), potential nutrient cycling and population viability benefits to wildlife species under Alternative 3 would be decreased to a medium degree relative to Alternative 1 as a result of hatchery program termination. The likelihood for implementation of new fisheries with direct harvest impacts on restored Dungeness River salmon populations that could potentially be initiated over the long term would be low compared to Alternative 1, as no hatchery salmon would be produced that would contribute to natural salmon population abundance increases in subsequent years. Harvest-related risks to wildlife species in the Dungeness River and Dungeness Bay under Alternative 3 would therefore be expected to be low relative to Alternative 1 as direct harvest of salmon species including coho salmon would not occur. There would be no measurable differences in effects on wildlife species likely in mixed stock marine area fisheries, where Dungeness River salmon would continue to be harvested incidentally.

4.6.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Implementation of Alternative 4 would reduce, relative to Alternative 1, risks to wildlife species associated with transfer of toxic 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, or habitat disruption from tribal commercial coho salmon fisheries (Subsection 3.6, Wildlife), because salmon production from the hatchery programs (and associated fisheries targeting hatchery coho salmon in the immediate action area) would be reduced by one-half. These risks to wildlife would remain low under Alternative 4. Any nutrient cycling benefits for wildlife (Subsection 3.6, Wildlife) would be reduced to a low extent under Alternative 4, after hatchery-origin fish return at reduced abundance levels to the watershed to spawn commensurate with reductions in the salmon hatchery programs by one-half.

Decreasing the total number of Dungeness River-origin salmon through reductions in the number of salmon produced through the Dungeness River Hatchery salmon programs under Alternative 4 would decrease the total amount of food available for marine mammals that prey on salmon, such as southern resident killer whales, harbor seals, sea lions, sea otters, dolphin species, and porpoise species. However, because total adult salmon production from the hatchery programs is relatively small, and considering that Dungeness River 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 salmon production on the abundance of predator marine mammal species would be negligible (i.e., at the lower levels of detection), and the same as under Alternative 1.

Decreasing the total number of Dungeness River-origin salmon through fish production reductions under Alternative 4 would also decrease food availability for salmon predators (e.g., river otters) and scavengers (e.g., bald eagles). Relative to Alternative 1, because hatchery-origin Chinook salmon and coho salmon compose the majority of production of the species in the watershed, Alternative 4 may reduce benefits to wildlife populations to a low extent (Table 10) (Section 3.6, Wildlife). Reductions in hatchery salmon production in the Dungeness River watershed 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 low beneficial impact on the abundance of birds, invertebrates, and amphibian species in the watershed relative to Alternative 1. Hatchery management measures taken to discourage predation by wildlife species (e.g., river otters, great blues herons, gulls) by covering hatchery salmon rearing areas rather than hazing the potential predator species would continue under Alternative 4, and effects on wildlife species would remain negligible and the same as under 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, and Steller sea lion populations. Reductions in the number of salmon produced through the hatchery programs under Alternative 4 would have a negligible effect on the status of these species, because none of them are located exclusively in the Dungeness River watershed or nearby marine waters, and the analysis area represents a very small percentage of their total range. Implementation of Alternative 4 would not be expected to change, relative to Alternative 1, the population sizes, health, or survival of the non-listed bird, mammal, amphibian, and invertebrate species identified in Subsection 3.6 and Table 10 for the same reasons.

Over the longer term, although, other watershed actions would continue to be implemented under the Shared Strategy for Puget Sound recovery plan (SSPS 2005), under Alternative 4, the salmon hatchery programs contributing to salmon recovery would be reduced to one-half the production levels proposed under Alternative 1. These SSPS recovery actions would be expected to help restore the natural-origin and total populations of salmon in the Dungeness River to a healthy status approaching historical levels. However, because hatchery-origin Chinook salmon and coho salmon compose most of returning abundances for those species (Section 3.4, Salmon and Steelhead), potential nutrient cycling and population viability benefits to wildlife species under Alternative 4 would be decreased to a low degree relative to Alternative 1 as a result of hatchery program reduction. The likelihood for implementation of new fisheries with direct harvest impacts on restored Dungeness River salmon populations that could potentially be initiated over the long term would be low compared to Alternative 1, as fewer hatchery salmon would be produced that would contribute to natural salmon population abundance increases in subsequent years. Harvest-related risks to wildlife species in the Dungeness River and Dungeness Bay under Alternative 4 would therefore be expected to be low relative to Alternative 1 as direct harvest of salmon species including coho salmon would be reduced. There would be no measurable differences in effects on wildlife species likely in mixed stock marine area fisheries, where Dungeness River salmon would continue to be harvested incidentally.

4.7. Socioeconomics

4.7.1. 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 3.7, Socioeconomics).

Under Alternative 1 and the baseline, Jamestown S'Klallam Tribe and WDFW-managed fisheries for coho salmon, and mixed stock marine area fisheries affecting salmon returns to the Dungeness River, would be implemented with the same timings and durations. Fishery impacts on salmon produced in the Dungeness River watershed 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 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, socioeconomic benefits associated with fisheries are expected to substantially increase above baseline conditions under Alternative 1.

Under baseline conditions, annual operation of the three Dungeness River salmon hatchery programs contributes approximately $298,080 (through the procurement of local goods and services) and 5 full-time jobs to the regional economy (Section 3.7, Socioeconomics), and these benefits would not likely change over the longer term under Alternative 1. Although, under Alternative 1, it is unknown how much the local economy would benefit from fisheries-related expenditures, or through employment, sales, income, and value added impacts, and expenditures on fishing trips and durable equipment associated with implementation of the salmon hatchery programs, local net fisheries for largely

hatchery-origin coho salmon produced through the Dungeness River Hatchery program would generate about $23,478 in ex-vessel value each year. Under Alternative 1 and the baseline, the value to the local economy of an estimated 650 coho salmon caught in recreational fisheries each year may be important to sectors of the community through fishery-related expenditures. Commercial and recreational coho salmon fisheries in Dungeness Bay and the Dungeness River are of high value to the Jamestown S'Klallam Tribe and perhaps to the local region. However, for the reasons described in Subsection 3.7, the relative contribution of the fisheries, and other fisheries supported by the Dungeness River salmon hatchery programs in the analysis area to the total Washington State economy is likely very low under Alternative 1 and under baseline conditions.

Increased socioeconomic impacts relative to baseline levels are expected to evolve as natural salmon populations increase over the longer term under Alternative 1. For example, increased fisheries-related expenditures resulting from an increase in the number of harvestable salmon would be similarly beneficial for the Jamestown S'Klallam Tribe and local entities supporting recreational and commercial fishing in the action area. Effects on the purchase of fishing-related supplies at local businesses, and benefits to the regional economy from salmon fisheries-related activities (Subsection 3.7, Socioeconomics), would be expected to be the same as under baseline conditions over the short term, but, for the above reasons, Alternative 1 may increase the likelihood of these benefits to a low extent over the longer term.

4.7.2. 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 Dungeness River salmon hatchery programs would be the same as under Alternative 1, so effects on employment opportunities or the local procurement of goods and services for hatchery operations would persist at similar levels relative to Alternative 1.

Under Alternative 2, Jamestown S'Klallam Tribe and WDFW-managed fisheries for coho salmon, and mixed stock marine area fisheries affecting salmon returns to the Dungeness River, would be implemented with the same timings and durations, and would have the same effects on salmon produced in the Dungeness River watershed, as under Alternative 1. 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 2 relative to Alternative 1, and hatchery-origin salmon would be expected to survive and return as adults for potential harvest at similar abundance levels under both alternatives.

Under both alternatives, annual operation of the three Dungeness River salmon hatchery programs would contribute approximately $298,080 (through the procurement of local goods and services) and 5 full-time jobs to the regional economy (Section 3.7, Socioeconomics). 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, socioeconomic benefits to the tribe and its fisheries are expected to increase to a low to medium level relative to the baseline under both Alternative 1 and Alternative 2.

These short term socioeconomic impacts evolving over the longer term would be similarly beneficial for the Jamestown S'Klallam Tribe and local entities supporting recreational and commercial fishing in the action area. There would be a relative, but immeasurable, benefit to increasing the likelihood that the

hatchery programs will be able to continue, as Alternative 2 would provide through ESA authorization of the hatchery programs. Effects on the purchase of fishing-related supplies at local businesses, and low benefits to the regional economy from salmon fisheries-related activities (Subsection 3.7, Socioeconomics), would be expected to be the same as under Alternative 1 over the short and longer terms, but Alternative 2 may increase the likelihood of these benefits over the longer term to a low extent.

4.7.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the salmon hatchery programs would be closed and no longer contribute revenue and jobs to the regional economy through operation of the hatcheries or production of salmon that would be harvested in fisheries.

Under Alternative 3, the Dungeness River Hatchery coho salmon program which operates 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 $298,080 (reduction in procurement of local goods and services) and 5 full-time jobs to the regional economy would occur as a result of ending operation of the three Dungeness River salmon hatchery programs. With termination of the Dungeness River hatchery coho salmon program under Alternative 3, hatchery-origin adult coho salmon sustaining the co-managers' commercial net fisheries in Dungeness Bay and the Dungeness River would cease to return, leading to the estimated annual loss of $23,478 per year in economic benefits to tribal and non-Indian commercial fishers relative to Alternative 1 (ex-vessel value; Subsection 3.7, Socioeconomics). Similarly, with termination of the salmon hatchery programs, economic benefits from recreational fishery harvests of coho salmon in the same areas would also be lost under Alternative 3, relative to Alternative 1 for the same reasons. Adverse effects on the local economy within the action area would be increased relative to Alternative 1 from negligible to low under Alternative 3, but for the reasons described in Subsection 3.7, Alternative 3 would result in similarly negligible impacts on the regional economy relative to Alternative 1.

Also, considering longer term effects, natural-origin Chinook, fall pink, and coho salmon populations in the Dungeness River watershed would be expected to require a much longer time, possibly decades, to reach abundances that would support sustainable fisheries harvest under Alternative 3 relative to Alternative 1. Under Alternative 3, supportive breeding efforts implemented through the salmon hatchery programs in conjunction with habitat restoration activities to restore healthy salmon returns (SSPS 2005) would be terminated. Curtailment of adult hatchery-origin salmon returns to the watershed under Alternative 3 would lead to substantially lower numbers of naturally spawning salmon relative to Alternative 1. When 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.

4.7.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

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 three Dungeness River salmon hatchery programs would result in a loss of approximately $149,040 (reduction in procurement of local goods and services by one-half, relative to Alternative 1) and 2.5 full-time jobs to the regional economy. Under Alternative 4, returns of hatchery-origin adult coho salmon sustaining the co-managers' commercial net fisheries in Dungeness Bay and the Dungeness River would be reduced by one-half relative to Alternative 1. The reduction in adult coho returns would lead to an estimated annual loss of $11,739 per year in economic benefits to tribal and non-Indian commercial fishers relative to Alternative 1 (ex-vessel value; Subsection 3.7, Socioeconomics). Similarly, with reduction of the salmon hatchery programs, economic benefits from recreational fishery harvests of coho salmon in the same areas would also be reduced by one-half relative to Alternative 1. Adverse effects on the local economy within the action area would be increased relative to Alternative 1 from negligible to low under Alternative 4, but for the reasons described in Subsection 3.7, Alternative 4 would result in similarly negligible impacts on the regional economy relative to Alternative 1.

Also, considering longer term effects, natural-origin Chinook, fall pink, and coho salmon populations in the Dungeness River watershed would be expected to require a longer time to reach abundances that would support sustainable fisheries harvest under Alternative 4 relative to Alternative 1. Under Alternative 4, supportive breeding efforts implemented through the salmon hatchery programs in conjunction with habitat restoration activities to restore healthy salmon returns (SSPS 2005) would be reduced by one-half relative to Alternative 1. Reductions in adult hatchery-origin salmon returns to the watershed under Alternative 4 would lead to lower numbers of naturally spawning salmon relative to Alternative 1. When 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 to medium extent under Alternative 4 relative to Alternative 1, to the detriment of local socioeconomic resources over the longer term.

4.8. Cultural Resources

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

Under Alternative 1, the same as under baseline conditions, there would be no construction or expansion of the hatchery facilities, so no cultural artifacts would be disrupted or destroyed. The hatchery programs would also continue to operate as under baseline conditions in both the near and long-terms. Under Alternative 1, risks to the survival and well-being of salmon posed by the hatchery program operation 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 Jamestown S'Klallam Tribe, considering the inextricable linkage between tribal cultural resource values and salmon in the Dungeness River watershed (Subsection 3.8, 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 medium under Alternative 1 relative to the baseline, which currently imparts low benefits.

The Jamestown S'Klallam Tribe's "usual and accustomed" fishing area includes the entire Dungeness River watershed, including Dungeness Bay and adjacent marine waters in the eastern Strait of Juan de Fuca (Subsection 3.8, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Jamestown S'Klallam Tribe's culture. These ceremonial and subsistence fisheries are of particular cultural value and importance to the tribe (Subsection 3.8, Cultural Resources). Under Alternative 1, there would be no changes in salmon production levels from the Dungeness River Hatchery programs relative to the baseline, and no changes in resultant adult hatchery-origin salmon return levels to tribal fishing areas in the Dungeness River and Dungeness Bay. There would therefore be no expected differences between Alternative 1 and the baseline in cultural resource benefits or effects associated with the Jamestown S'Klallam Tribes' participation in commercial, ceremonial and subsistence fisheries in the portion of the tribe's usual and accustomed fishing area encompassed by the Dungeness River watershed and Dungeness Bay. 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.

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

Under Alternative 2, there would be no construction or expansion of the hatchery facilities, and 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 near and long-terms (Subsection 2.2, Alternative 2). Under Alternative 2, risks to the survival and well-being of salmon posed by hatchery program operation would persist at similar levels relative to Alternative 1. There would therefore be no differences between Alternative 2 and Alternative 1 regarding any attendant effects on the well-being of the Jamestown S'Klallam Tribe, considering the inextricable linkage between tribal cultural resource values and salmon in the Dungeness River watershed (Subsection 3.8, 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 are expected to increase to a medium level under both Alternative 1 and Alternative 2. There would be a relative low benefit to increasing the likelihood that the hatchery programs will be able to continue over the longer term, as Alternative 2 would provide through ESA authorization of the hatchery programs.

The Jamestown S'Klallam Tribe's "usual and accustomed" fishing area includes the entire Dungeness River watershed, including Dungeness Bay and adjacent marine waters in the eastern Strait of Juan de Fuca (Subsection 3.8, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Jamestown S'Klallam Tribe's culture. These ceremonial and subsistence fisheries are of particular cultural value and importance to the tribe (Subsection 3.8, Cultural Resources). Under Alternative 2, there would be no changes in salmon production levels from the Dungeness River Hatchery programs relative to Alternative 1, and no changes in resultant adult hatchery-origin salmon return levels to tribal fishing areas in the Dungeness River and Dungeness Bay. There would therefore be no expected differences between Alternative 2 and Alternative 1 in cultural resource benefits or effects associated with the Jamestown S'Klallam Tribes'

participation in commercial, ceremonial and subsistence fisheries targeting Dungeness River Hatchery-origin salmon in the portion of the tribe's usual and accustomed fishing area encompassed by the Dungeness River watershed and Dungeness Bay. However, Alternative 2 may lead to a low increase in the likelihood of these benefits over the longer term relative to Alternative 1, because of the increased likelihood that the hatchery programs would continue under Alternative 2.

4.8.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River salmon hatchery programs would be terminated immediately. As under Alternative 1, there would be no construction or expansion of the hatchery facilities, and no cultural artifacts would be disrupted or destroyed. However, because the hatchery programs would be terminated, they would no longer produce salmon, or apply the same program operation measures as implemented under Alternative 1 in both the near and long-terms (Subsection 2.2, Alternative 3). Therefore, under Alternative 3, effects on the survival and well-being of salmon associated with hatchery program operation would be medium relative to Alternative 1. Under Alternative 3, there may therefore be medium effects relative to Alternative 1 in any attendant effects on the well-being of the Jamestown S'Klallam Tribe, considering the inextricable linkage between tribal cultural resource values and salmon in the Dungeness River watershed (Subsection 3.8, Cultural Resources).

The Jamestown S'Klallam Tribe's "usual and accustomed" fishing area includes the entire Dungeness River watershed, including Dungeness Bay and adjacent marine waters in the eastern Strait of Juan de Fuca (Subsection 3.8, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Jamestown S'Klallam Tribe's culture. These ceremonial and subsistence fisheries are of particular cultural value and importance to the tribe (Subsection 3.8, Cultural Resources). Under Alternative 3, salmon production through the Dungeness River Hatchery programs would be terminated. Resultant adult hatchery-origin salmon return levels to tribal fishing areas in the Dungeness River and Dungeness Bay would be reduced to zero. There would therefore be medium reductions under Alternative 3 relative to Alternative 1 in cultural resource benefits, and medium increases relative to Alternative 1 in adverse effects on the Jamestown S'Klallam Tribes' participation in commercial, ceremonial and subsistence fisheries targeting Dungeness River Hatchery-origin salmon in the portion of the tribe's usual and accustomed fishing area encompassed by the Dungeness River watershed and Dungeness Bay.

Because habitat conditions in the Dungeness River watershed 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 longer term 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 to a medium degree the Jamestown S'Klallam Tribe's access to salmon for ceremonial and other cultural practices, and would be expected to reduce to a medium degree the well-being of the Tribe over the longer term.

4.8.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

Under Alternative 4, juvenile salmon releases and adult hatchery-origin salmon returns to the Dungeness River would be reduced by one-half relative to Alternative 1. As under Alternative 1, there would be no construction or expansion of the hatchery facilities, and no cultural artifacts would be disrupted or destroyed. Because the hatchery programs would be reduced in size, they would produce less salmon relative to Alternative 1, but would continue to apply the same program operation measures as implemented under Alternative 1 in both the near and long-terms (Subsection 2.2, Alternative 4). Therefore, under Alternative 4, effects on the survival and well-being of salmon associated with hatchery program operation would be low to medium relative to Alternative 1. Under Alternative 4, there may therefore be low to medium effects relative to Alternative 1 in any attendant effects on the well-being of the Jamestown S'Klallam Tribe, considering the inextricable linkage between tribal cultural resource values and salmon in the Dungeness River watershed (Subsection 3.8, Cultural Resources).

The Jamestown S'Klallam Tribe's "usual and accustomed" fishing area includes the entire Dungeness River watershed, including Dungeness Bay and adjacent marine waters in the eastern Strait of Juan de Fuca (Subsection 3.8, Cultural Resources). Commercial, ceremonial, and subsistence fisheries in these freshwater and marine areas have played a central role in the Jamestown S'Klallam Tribe's culture. These ceremonial and subsistence fisheries are of particular cultural value and importance to the tribe (Subsection 3.8, Cultural Resources). Under Alternative 4, salmon production through the Dungeness River Hatchery programs would be reduced by one-half. Resultant adult hatchery-origin salmon return levels to tribal fishing areas in the Dungeness River and Dungeness Bay would also be reduced by one-half. Expected would be medium reductions under Alternative 4 relative to Alternative 1 in cultural resource benefits, and medium increases relative to Alternative 1 in adverse effects on the Jamestown S'Klallam Tribes' participation in commercial, ceremonial and subsistence fisheries targeting Dungeness River Hatchery-origin salmon in the portion of the tribe's usual and accustomed fishing area encompassed by the Dungeness River watershed and Dungeness Bay.

Because habitat conditions in the Dungeness River watershed are currently limiting the survival, productivity and abundance of natural-origin salmon in the watershed, implementation of Alternative 4 would reduce total salmon abundance over the longer term 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 and reduced hatchery-origin salmon production under Alternative 4. Relative to Alternative 1, Alternative 4 would reduce to a medium degree the Jamestown S'Klallam Tribe's access to salmon for ceremonial and other cultural practices, and would be expected to reduce to a medium degree the well-being of the Tribe over the longer term.

4.9. Human Health and Safety

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

Under Alternative 1, the Dungeness River salmon hatchery programs would continue to operate as under baseline conditions, and the risk of exposure of hatchery workers to chemicals or pathogens that may be associated with the production of hatchery-origin fish would persist at similar levels relative to baseline conditions (Subsection 3.9, Human Health and Safety). Because of facility operational measures applied at the hatchery sites, this exposure risk is negligible under both Alternative 1 and the baseline. Likewise, potential nutritional benefits of the hatchery programs to human health and the risk of consumer

exposure to toxic contaminants would persist at similar levels relative to Alternative 1 (Subsection 3.9, Human Health and Safety). 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, nutritional benefits associated with salmon consumption are expected to increase by a low degree under Alternative 1 relative to the baseline.

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

Under Alternative 2, the Dungeness River salmon hatchery programs would continue as under Alternative 1, and the risk of exposure of hatchery workers to chemicals or pathogens would persist at similar levels relative to Alternative 1. Because of facility operational measures applied at the hatchery sites, this exposure risk is negligible under both Alternative 2 and Alternative 1. Likewise, there potential nutritional benefits of the hatchery programs to human health and the risk of consumer exposure to toxic contaminants would persist at similar levels relative to Alternative 1 (Subsection 3.9, Human Health and Safety). 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, nutritional benefits associated with salmon consumption would be the same as under Alternative 1. 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 and continuity of relative nutritional benefits, as Alternative 2 would provide ESA authorization of the hatchery programs.

4.9.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the salmon hatchery programs would be immediately 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), and it would reduce to a low degree the risk of consumer exposure to toxic contaminants relative to Alternative 1 (Subsection 3.9, Human Health and Safety). These risk levels 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.

4.9.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

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), and it would reduce to a low degree the risk of consumer exposure to toxic contaminants relative to Alternative 1 (Subsection 3.9, Human Health and Safety). These risk levels 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 4 relative to Alternative 1.

4.10. Environmental Justice

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

In the analysis area, one county (Clallam County) has been identified as an environmental justice community of concern, due to the presence of Native Americans of several tribes (Subsection 3.10, Environmental Justice). All effects in the analysis area under Alternative 1 as described in Subsection 4.2 (Water Quantity) through Subsection 4.9 (Human Health and Safety) would impact these environmental justice communities.

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, Water Quantity; Subsection 4.3, Water Quality). Juvenile salmon production levels, and resultant adult salmon return abundances, would remain the same as baseline levels (Table 12). Effects on environmental justice communities including: maintenance of hatchery-origin adult salmon returns (Subsection 4.4, Salmon and Steelhead); employment opportunities or the local procurement of goods and services (Subsection 4.7, Socioeconomics); and, cultural benefits (Subsection 4.8, Cultural Resources) 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 4.9, 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.

4.10.2. 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, Water Quantity; Subsection 4.3, Water Quality). 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 4.4, Salmon and Steelhead), employment opportunities or the local procurement of goods and services (Subsection 4.7, Socioeconomics), and cultural benefits (Subsection 4.8, Cultural Resources) 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 4.9, 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.

4.10.3. Alternative 3 – Termination of hatchery salmon programs in the Dungeness River watershed

Under Alternative 3, the Dungeness River salmon hatchery programs would be immediately 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 for other uses besides the hatchery production of salmon (Subsection 4.2, Water Quantity);
- An undetectable and likely negligible (taking into account hatchery program compliance under Alternative 1 with NPDES permit discharge requirements) increase in water quality in watershed areas downstream of the hatcheries;
- A low impact on the action area economy and a negligible impact on the regional economy resulting from loss of $298,080 through the procurement of local goods and services and the loss of 5 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 $23,478 annually in potential net economic benefits from commercial salmon fisheries to the Jamestown S'Klallam Tribe and WDFW-managed commercial net fisheries (Subsection 4.7, Socioeconomics);
- A medium impact resulting from a reduction in the Jamestown S'Klallam Tribe's access to salmon for ceremonial and other cultural practices (Subsection 4.8, 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 4.9, Human Health and Safety);
- A negligible reduction in the risk of consumer exposure to toxic contaminants, due to fewer salmon available for consumption (Subsection 4.9, Human Health and Safety); and,
- A medium impact resulting from fewer harvestable salmon and steelhead available in the Jamestown S'Klallam Tribe's usual and accustomed fishing areas in the eastern Strait of Juan de Fuca (Subsection 4.10, Environmental Justice).

4.10.4. Alternative 4 – Reduction of hatchery salmon release levels from programs in the Dungeness River watershed

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 for other uses besides the hatchery production of salmon (Subsection 4.2, Water Quantity);
- An undetectable and likely negligible (taking into account hatchery program compliance under Alternative 1 with NPDES permit discharge requirements) increase in water quality in watershed areas downstream of the hatcheries;
- A low impact on the action area economy and a negligible impact on the regional economy resulting from loss of $148,040 through the procurement of local goods and services and the loss of 2.5 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 $11,739 annually in potential net economic benefits from commercial salmon fisheries to the Jamestown S'Klallam Tribe and WDFW-managed commercial net fisheries (Subsection 4.7, Socioeconomics);
- A medium impact resulting from a reduction in the Jamestown S'Klallam Tribe's access to salmon for ceremonial and other cultural practices (Subsection 4.8, 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 4.9, Human Health and Safety);
- A negligible reduction in the risk of consumer exposure to toxic contaminants, due to fewer salmon available for consumption (Subsection 4.9, Human Health and Safety); and,
- A medium impact resulting from fewer harvestable salmon and steelhead available in the Jamestown S'Klallam Tribe's usual and accustomed fishing areas in the eastern Strait of Juan de Fuca (Subsection 4.10, Environmental Justice).

5. CUMULATIVE IMPACTS

5.1. Introduction

This section discusses the impact on the environment that results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). The purpose of this assessment is to describe the additional impact of the three salmon hatchery programs in light of all the other impacts on all nine resources.

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

hatchery production is assumed to continue and affect salmon and steelhead at the same impact levels as presently occur. In fact, future hatchery reviews such as those identified in the Puget Sound DEIS are likely to reduce the impact levels resulting from hatchery operations in the region. However, as that review is in draft form and hatchery improvements have not yet occurred, NMFS' calculation of both baseline conditions and cumulative impacts do not rely on those reductions to hatchery impacts, and instead rely on an assumption of hatchery impacts continuing indefinitely.

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 the effects of continuation of current operations into the future.

Chapter 5, Cumulative Effects, now considers any additional, incremental, cumulative impacts that may result from past, present, and reasonably foreseeable future actions and conditions within the vicinity of the action area, when the effects of the Proposed Action are added.

5.2. Other Programs, Plans, and Policies

Other actions are expected to occur within the action area, the Puget Sound, or in the Pacific Ocean that would affect the salmon populations considered under the Proposed Action. These include fishing activities that may incidentally intercept Dungeness River salmon in the Pacific Ocean and salmon habitat restoration actions implemented consistent with project review recommendations of the Dungeness River Management Team (DRMT). Habitat restoration actions in the watershed effectuate salmon habitat-related recovery objectives included in the Dungeness River watershed chapter of the Shared Strategy for Puget Sound recovery plan (SSPS 2005) and the NMFS recovery plan for the listed Puget Sound Chinook salmon ESU (NMFS 2007) (Subsection 1.5, Relationship to Other Plans, Regulations, Agreements, Laws, Secretarial Orders, and Executive Orders). The presence of hatchery-origin salmon, like natural-origin salmon, within the Olympic Wilderness Area is compatible with Wilderness Act policy.

Many future actions – especially those implementing hatchery operations, fisheries, and conservation efforts – would be managed based on the impacts on ESA-listed salmon and steelhead. If the cumulative effects of other hatchery programs, fisheries, ocean conditions, or conservation efforts do not allow sufficient escapement of returning adult salmon and steelhead to the action area to meet recovery goals while providing for the operation of the proposed salmon hatchery programs, adjustments to fisheries and to the hatchery production levels and management actions would likely be proposed.

If the cumulative effects of salmon management efforts fail to provide for recovery of listed species, then actions would be taken to substantially diminish any adverse impacts due to the hatchery programs and any fishing in the action area. Management of the hatchery programs and of fishing opportunity is only one element of a large suite of regulations and environmental factors that may influence the overall health of listed salmon and steelhead populations and their habitat. The proposed hatchery programs are coordinated with monitoring so that hatchery managers can respond to changes in the status of affected listed species. Monitoring and adaptive management would help ensure that the affected ESA-listed species are adequately protected and would help mitigate potential for adverse cumulative impacts.

For the above reasons, the proposed action is not expected to contribute cumulatively to effects of other actions on the nine resources evaluated in this document.

5.3. 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 averaged air temperature rose about 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 in the cool season (October through March) are likely to increase the percentage of precipitation falling as rain rather than snow, and to contribute to earlier snowmelt. The amount of snowpack measured on April 1, a key indicator of natural water storage available for the warm season, has already declined substantially throughout the region. 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. The April 1 snowpack is likely to decline as much as 40 percent 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 increase 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).

In areas where it snows, a warmer climate means major changes in the timing 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 areas dominated by rain rather than snow (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, 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 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 exceeded (USGCRP 2009).

Climate change is also likely to affect 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 change, abundances of salmon and steelhead will continue to change accordingly, resulting in changes in abundance of adults returning to freshwater to spawn.

In the Dungeness River watershed, impacts from climate change may be similar to those described above. The watershed is fed largely by snow melt; if climate change reduces the average snow pack, then reductions in summer-time flows would result, potentially reducing the condition 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. Climate change may also increase the frequency of major flood events that can scour redds. 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 may also increase the incidence of disease outbreaks and virulence in both the natural-origin and hatchery-origin juveniles.

If climate change contributes to a substantial decline in the viability of listed salmon populations in the Dungeness River watershed through impacts on habitat and from changes in ocean conditions, the proposed hatchery program for Chinook salmon may continue to be used as a "safety net" program to maintain genetic resources. The adult and earliest life stages of fish held in the proposed hatchery programs are somewhat protected from the possible increase in disease prevalence from warmer water temperatures 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.

While climate change may well have impacts on the abundance and/or distribution of ESA-listed salmonids that are considered under the Proposed Action, the proposed hatchery management described in the HGMPs and the associated monitoring provides the ability to evaluate hatchery program risks and benefits as abundances change, making adjustments in the Proposed Action responsive to any observable effects of climate change.

6. AGENCIES AND PERSONS CONSULTED

Jamestown S'Klallam Tribe
Washington Department of Fish and Wildlife
Port Gamble S'Klallam Tribe
Lower Elwha Klallam Tribe
Skokomish Tribe
Northwest Indian Fisheries Commission
U.S. Department of the Interior, Bureau of Indian Affairs

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.

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 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.

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.

CTC (Chinook Technical Committee). 2008. Pacific Salmon Commission joint Chinook technical committee report. 2007 annual report of catches and escapements, exploitation rate analysis and model calibration. Report TCCHINOOK (08)-1. Pacific Salmon Commission, Vancouver, B.C. 231 p.

Cripps, S.J. 1995. Serial particle size fractionation and characterization of an aquacultural effluent. Aquaculture 133: 323-339.

Cohen, F. S. 2005. Handbook of Federal Indian Law. Washington, D.C. Available at: http://thorpe.ou.edu/cohen.html (as of November 29, 2013).

Dungeness-Quilcene Water Resources Management Plan. 1994. Regional Planning Group, Jamestown S'Klallam Tribe Coordinating Entity. June 30, 1994. Blyn, Washington. 612 p.

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.

EDPU (Elwha-Dungeness Planning Unit). 2005. Elwha-Dungeness Watershed Plan, Water Resource Inventory Area 18 (WRIA 18) and Sequim Bay in West WRIA 17. May, 2005. Published by Clallam County. Volume 1: Chapters 1-3 and 15 appendices; Volume 2: Appendix 3-E.

EPA (Environmental Protection Agency). 1998. Reviewing for Environmental Justice: EIS and Permitting Resource Guide. EPA Review. Region 10 – Environmental Justice Office.

Flagg, T.A., C.W. McAuley, P.K. Kline, M.S. Powell, D. Taki, J.C. Gislason. 2004. Application of captive broodstocks to preservation of ESA-listed stocks of Pacific Salmon: Redfish Lake sockeye salmon case example. American Fisheries Society Symposium 44:387-400.

Ford, M.J. (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.

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.

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. 1999. Salmonid habitat limiting factors - water resource inventory area 18 - final report. December, 27, 1999. Washington State Conservation Commission. Lacey, Washington. 202 p.

HRSG (Hatchery Scientific Review Group). 2005. Hatchery reform in Washington State: principles and emerging issues. Fisheries 30(6): 1-23.

HSRG. 2009a. Columbia River hatchery reform system wide report. Available from: http://www.hatcheryreform.us/hrp/reports/system/welcome_show.action

HSRG. 2009b. White Paper No. 11- introduction - predicted fitness effects of interbreeding between hatchery and natural populations of Pacific salmon and steelhead. (Prepared by the HSRG to

address topics relevant to hatchery reform - intended to provide background, documentation and explanations not included in the body of the HSRG's 2009a report.

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, Washington) and Fisheries and Oceans Canada (Vancouver, BC). xv + 61 pp. + Appendices.

Hiss, J. 1993. Recommended Instream Flows for the Lower Dungeness River. U. S. Fish and Wildlife Service, Western Washington Fishery Resource Office. Lacey, Washington.

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.

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.

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.

Jamestown S'Klallam Tribe. 2007. Protecting and Restoring the Waters of the Dungeness. A Watershed-Based Plan Prepared in Compliance with Section 319 of the Clean Water Act. July 2007.

Jamestown S'Klallam Tribe. 2012. Jamestown S'Klallam Tribe – the strong people. Web-site presenting enrollment and land base information: http://www.jamestowntribe.org/index.htm

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.

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.

Koski, K.V. 1975. The survival and fitness of two stocks of chum salmon (Oncorhynchus keta) from egg deposition to emergence in a controlled stream environment at Big Beef Creek. Ph.D. thesis. College of Fish., Univ. Washington. 212 p.

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.

Lacy, R.C. 1997. Importance of genetic variation to the viability of mammalian populations. Journal of Mammalogy, 78, 320-335.

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.

Marlowe, C., B. Freymond, R.W. Rogers, and G. Volkhardt. 2001. Dungeness River Chinook Salmon Rebuilding Project – Progress Report 1993-1998. Wash. Dep. Fish. & Wildl. Prog. Rpt. No. FPA 00-24. 94p.

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.

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.

Myers, J., and 10 co-authors. 1998. Status review of Chinook salmon from Washington, Idaho, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech Memo. NMFS-NWFSC-35.

NMFS (National Marine Fisheries Service). 2001a. Endangered Species Act - section 7 consultation - biological opinion and incidental take statement for programs administered by the Bureau of Indian Affairs and activities authorized by the U.S. Fish and Wildlife service supporting tribal salmon fisheries affecting listed Puget Sound Chinook and Hood Canal summer-run chum salmon evolutionarily significant units. January 23, 2001. NMFS West Coast Region, Sustainable Fisheries Division. Seattle, Washington. 29 p.

NMFS. 2001b. Environmental assessment application of ESA 4(d) options for Hood Canal summer-run and Columbia River evolutionarily significant units of chum salmon. NMFS West Coast Region, Sustainable Fisheries Division. Portland, Oregon.

NMFS. 2002a. Environmental assessment of a National Marine Fisheries Service action to consider hatchery and genetic management plans submitted by the Washington Department of Fish and Wildlife and the U.S. Fish and Wildlife Service pursuant to 50 CFR 223.203(b)(5) and finding of non-significant impact. February 26, 2002. NMFS West Coast Region, Sustainable Fisheries Division, Portland, Oregon.

NMFS. 2002b. Endangered Species Act section 7 consultation and Magnuson-Stevens Act essential fish habitat consultation. Biological Opinion on Artificial Propagation in the Hood Canal and Eastern Strait of Juan de Fuca Regions of Washington State. Hood Canal Summer Chum Salmon Hatchery Programs by the U.S. Fish and Wildlife Service and the Washington Department of Fish and Wildlife and Federal and Non-Federal hatchery programs producing unlisted salmonid species. February 26, 2002. NMFS West Coast Region, Sustainable Fisheries Division. Portland, Oregon.

NMFS. 2004. Salmon hatchery inventory and evaluation report for Ozette Lake sockeye salmon hatchery programs. (SHIER). NMFS West Coast Region, Sustainable Fisheries Division. Portland, Oregon. 28p.

NMFS. 2005. Puget Sound Chinook Harvest Resource Management Plan. Final EIS. NMFS West Coast Region, Sustainable Fisheries Division, with Assistance from the Puget Sound Treaty Tribes and Washington Department of Fish and Wildlife. Seattle, Washington.

NMFS. 2006. Puget Sound Chinook salmon recovery needs report. Puget Sound Domain Team. NMFS West Coast Region, Sustainable Fisheries Division. Seattle, Washington. 50p.

NMFS. 2007. Final Supplement to the Shared Strategy's Puget Sound Salmon Recovery Plan. NMFS West Coast Region, Sustainable Fisheries Division, Portland, Oregon. 47 p.

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 West Coast Region, Sustainable Fisheries Division. Seattle, Washington. 244p.

NMFS. 2012a. Effects of Hatchery Programs on Salmon and Steelhead Populations: Reference Document for NMFS ESA Hatchery Consultations. Craig Busack, Editor. March 7, 2011. NMFS West Coast Region, Sustainable Fisheries Division. Portland, Oregon.

NMFS 2012b. Endangered Species Act (ESA) Section 7 Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat (EFH) Consultation. Elwha Channel Hatchery Summer/Fall Chinook salmon Fingerling and Yearling, Lower Elwha Fish Hatchery Steelhead, Lower Elwha Fish Hatchery Coho Salmon, Lower Elwha Fish Hatchery Fall Chum Salmon, and Elwha River Odd and Even Year Pink Salmon Programs. NMFS Consultation Number - NWR-2012-9426. December 10, 2012. NMFS West Coast Region. Portland, Oregon.

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.

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. 2005. Cohen's Handbook of Federal Indian Law, 2005 edition. LexisNexis Matthew Bender Publications, San Francisco, California.

NWIFC (Northwest Indian Fisheries Commission). 2013. Tribal Policy Statement for Salmon Hatcheries in the Face of Treaty Rights at Risk. Northwest Indian Fisheries Commission, Lacey, 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. Spreadsheet accessed as "Escapements to Inland Fisheries and Spawning Areas (Review Appendix B) (Excel)" available at: http://www.pcouncil.org/salmon/background/document-library/historical-data-of-ocean-salmon-fisheries/

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). 2004. Puget Sound Chinook salmon hatcheries, a component of the comprehensive Chinook salmon management plan. March 31, 2004. Northwest Indian Fisheries Commission. Lacey, Washington.

PSIT and WDFW. 2010a. Comprehensive Management Plan for Puget Sound Chinook: Harvest Management Component. April 12, 2010. Northwest Indian Fisheries Commission. Lacey, Washington. 237 p.

PSIT and WDFW. 2010b. Puget Sound Steelhead Harvest Management Plan. January 7, 2010. Northwest Indian Fisheries Commission. Lacey, Washington. 224 p.

Ruckelshaus, M.H., K.P. Currens, W.H. Graeber, R.R. Fuerstenberg, K. Rawson, N.J. Sands, and J.B. Scott. 2006. Independent Populations of Chinook salmon in Puget Sound. U.S. Dept. Commer. NOAA Tech. Memo. NMFS-NWFSC-78.

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.

Sands, N. J., K. Rawson, K. Currens, W. Graeber, M. H. Ruckelshaus, R. Fuerstenberg, J. Scott. 2009. Determination of independent populations and viability criteria for the Hood Canal summer chum salmon evolutionarily significant unit. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-101, 58 p.

Schreiner, J.U. 1977. Salmonid outmigration studies in Hood Canal, Washington. M. S. Thesis. Univ. Washington. 91 p.

Scott, J.B., Jr. and W.T. Gill, eds. 2006. Oncorhynchus mykiss: assessment of Washington State's anadromous populations and programs. Draft report. Washington Department of Fish and Wildlife, Olympia, Washington.

SSPS (Shared Strategy for Puget Sound). 2005. Dungeness Watershed Profile. WRIA 18. 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. 11 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.

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.

Topping, Pete, G. Volkhardt, and L. Kishimoto. 2006. 2005 Dungeness River Juvenile Salmonid Production Evaluation. IN: 2005 Juvenile Salmonid Production Evaluation Report - Green River, Dungeness River and Cedar Creek. Report #FPA 06-10. Fish Program, Science Division, Washington Department of Fish and Wildlife. Olympia, Washington. 101 p.

Topping, P. and L. Kishimoto. 2008. 2006 Dungeness River Juvenile Salmonid Production Evaluation. IN: 2006 Juvenile Salmonid Production Evaluation Report - Green River, Dungeness River and Cedar Creek. Report #FPA 08-05. Fish Program, Science Division, Washington Department of Fish and Wildlife. Olympia, Washington. 136 p.

Tynan, T. 1997. Life history characterization of summer chum salmon populations in the Hood Canal and eastern Strait of Juan de Fuca regions. Report #H97-06. Assessment and Development Division, Hatcheries Program. Washington Department of Fish and Wildlife. Olympia, Washington.

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 (9th Cr. 1975, cert. denied), 423 U.S. 1086 (1976), Seattle, Washington.

U.S. Department of Commerce. 1995. American Indian and Alaska Native Policy of the U. S. Department of Commerce. Ronald H. Brown, Secretary of Commerce Date: March 30, 1995. U.S. Department of Commerce. Washington, D.C. 5p.

USGCRP (U.S. Global Change Research Program). 2009. Global Climate Change Impacts in the United States. Cambridge University Press, New York. Available at: 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 Clallam County. March 15, 2012.

Wampler, P., and J. Hiss. Fish habitat analysis for the Dungeness River using the instream flow incremental methodology. 1991. U. S. Fish and Wildlife Service, Western Washington Fishery Resource Office. Lacey, Washington.

Waples, R.S. 1999. Dispelling some myths about hatcheries. Fisheries. 24(2): 12-21.

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. 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. 2012a. Accessed on March 4, 2013 on WDOE website at https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?wria=20.

WDOE. 2012b. Online well log viewer. Available at: http://apps.ecy.wa.gov/welllog/ (accessed March 4, 2013).

WDOE. 2013. Dungeness Water Management - Chapter 173–518 WAC - Water Resources Management Program. Accessed on March 4, 2013 on WDOE website at: http://www.ecy.wa.gov/programs/wr/instream-flows/dungeness.html

WDFW (Washington Department of Fish and Wildlife). 2013a. Hatchery and genetic management plan (HGMP) - Dungeness River Hatchery spring Chinook (integrated) - spring Chinook (Oncorhynchus tshawytscha) - Dungeness River. January 18, 2013. Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501- 1091. 52 p.

WDFW. 2013b. Hatchery and genetic management plan (HGMP) Dungeness River pink (fall-run) salmon hatchery program (integrated) - January 17, 2013. Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501- 1091. 47 p.

WDFW. 2013c. Hatchery and genetic management plan (HGMP) - Dungeness River coho hatchery program (segregated). January 18, 2013. Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501- 1091. 45 p.

WDFW and PNPTT (Point No Point Treaty Tribes). 2000. Summer chum salmon conservation initiative - Hood Canal and Strait of Juan de Fuca region. Fish Program, Washington Department of Fish and Wildlife. Olympia, Washington.

WDFW and WWTIT (Western Washington Treaty Indian Tribes). 1994. 1992 Washington State Salmon and Steelhead Stock Inventory (SASSI). Appendix One, Puget Sound stocks. Hood Canal and Strait of Juan de Fuca. Internal Report to Washington Dept. Fish Wildlife. 424 p.

WDFW and WWTT. 1997. Wild Salmonid Policy. Adopted by Washington Fish and Wildlife Commission, Olympia, Washington.

WFWC (Washington Fish and Wildlife Commission). 2009. Hatchery and Fishery Reform Policy (POL C3619). Effective November 6, 2009. Washington Department of Fish and Wildlife, 600 Capitol Way N., Olympia, WA 98501- 1091.

Weitkamp, L. A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. U.S. Dept. of Commerce, NOAA Tech. Memo., NMFS-NWFSC-24, 258 p.

Willi,Y., J. Van Buskirk, and M. Fischer. 2005. A threefold genetic allee effect: population size affects cross-compatibility, inbreeding depression and drift load in the self-incompatible ranunculus reptans. Genetics 169: 2255–2265 (April 2005).

Whitlock, M.C. 2000. Fixation of new alleles and the extinction of small populations: drift load, beneficial alleles, and sexual selection. Evolution. 2000 Dec; 54(6):1855-61.

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.