4(d) Rule Limit 6
Proposed Evaluation and Pending Determination

Title of RMP:	Joint Hatchery and Genetic Management Plans for Dungeness River, Nooksack River, and Stillaguamish River Hatchery Early-Winter Steelhead
RMP Submitted by:	Washington Department of Fish and Wildlife Jamestown S'Klallam Tribe Lummi Nation Nooksack Tribe Stillaguamish Tribe Tulalip Tribe
ESU/DPSs:	Puget Sound Chinook Salmon ESU Hood Canal Summer Chum Salmon ESU Puget Sound Steelhead DPS
4(d) Rule Limit:	ESA 4(d) Rule Limit 6
NMFS Tracking Number:	WCR-2015-2024

1 BACKGROUND

NOAA's National Marine Fisheries Service (NMFS) issued a final Endangered Species Act (ESA) 4(d) Rule adopting regulations necessary and advisable to conserve Puget Sound Chinook salmon and Hood Canal summer-run chum salmon (50 CFR 223.203(b); 70 FR 37160, June 28, 2005). The 4(d) protective regulations adopted for the two salmon evolutionary significant units (ESU) were subsequently applied to the Puget Sound steelhead distinct population segment (DPS) in a separate final rule (73 FR 55451, June 25, 2008). Under limit 6 of the Rule, ESA section 9 take prohibitions for these listed salmonid species do not apply to hatchery activities that are undertaken in compliance with a resource management plan (RMP) developed jointly by the Tribes and the State of Washington that is consistent with the 4(d) Rule criteria. The Washington Department of Fish and Wildlife (WDFW) and Jamestown S'Klallam Tribe, Lummi Nation, Nooksack Tribe, Stillaguamish Tribe, and Tulalip Tribes as co-managers of the fisheries resource under *United States v. Washington* (1974) (hereafter referred to as "the co-managers"), have provided NMFS with three Hatchery and Genetic Management Plans (HGMP) for hatchery programs and associated monitoring and evaluation actions in the Dungeness, Nooksack, and Stillaguamish River watersheds that will affect ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon (Dungeness), and Puget Sound steelhead (Scott 2014; Scott 2015). The HGMPs provide the framework through which the Washington State and Tribal jurisdictions can jointly manage hatchery operations, monitoring, and evaluation activities, while meeting requirements specified under the ESA. The co-managers developed the plans jointly, and have provided the HGMPs for review and determination by NMFS as to whether they address the criteria of limit 6 of the 4(d) Rule. For the purposes of the proposed recommendation, NMFS considers the three joint HGMPs, submitted for consideration under limit 6, to be an RMP.

2 PROPOSED ACTION

The three HGMPs submitted to NMFS for consideration under limit 6 are designed to support recreational and tribal fishing and include associated monitoring and evaluation actions affecting listed Puget Sound Chinook salmon, Hood Canal summer chum salmon (Dungeness only), and Puget Sound steelhead within the Dungeness, Nooksack, and Stillaguamish River watersheds. Applications for ESA authorizations under the section 4(d) Rule, limit 6, must provide the necessary information described in 50 CFR part 222.308. The HGMPs were reviewed upon their final submittal in updated form, and NMFS determined that they were sufficient for NMFS to proceed in its evaluation of effects of the plans on ESA-listed fish (Jones 2014).

The hatchery programs, as described in the HGMPs, mitigate for impacts on tribal and recreational fishing caused by past and on-going human developmental activities in these watersheds, and from climate change. They provide hatchery fish to: (1) meet regional recreational fisheries objectives for the citizens of Washington State, and (2) meet tribal fishery harvest allocations that are guaranteed through treaties, as affirmed in *United States v. Washington* (1974). All three proposed hatchery programs would use only hatchery fish for broodstock. These fish are “early winter” (Chambers Creek hatchery-lineage) steelhead (WDFW 2014a; WDFW 2014b; WDFW 2014c)(Table 1) that are not included as part of the ESA-listed Puget Sound steelhead population.

The proposed programs would also include monitoring of program performance and effects in the Dungeness, Nooksack, and Stillaguamish Rivers, while applying measures that would minimize risks of adverse genetic, demographic, or ecological effects on ESA-listed fish and other natural populations. If determined to be in compliance with limit 6 of the 4(d) Rule, the early winter steelhead hatchery programs would operate in conjunction with on-going habitat restoration and harvest management actions, implemented consistent with the objectives of the recovery plans for Puget Sound and the individual watersheds (SSPS 2005a; SSPS 2005b; SSPS 2005c; SSPS 2007) until healthy, natural-origin salmonid populations, that would sustain fisheries, are restored.

Table 1. Proposed hatchery programs for Dungeness, Nooksack, and Stillaguamish River hatchery winter steelhead.

Hatchery Program	Operator
Dungeness River Hatchery early-winter Steelhead Program (Isolated) (WDFW 2014a)	WDFW
Kendall Creek Hatchery early-winter Steelhead Program (Isolated) (WDFW 2014b)	WDFW
Whitehorse Ponds early-winter Steelhead Program (Isolated) (WDFW 2014c)	WDFW

All hatchery program actions and associated monitoring and evaluation actions proposed by the co-managers for Dungeness, Nooksack, and Stillaguamish River watersheds are included in the HGMPs. Actions proposed in the HGMPs, including descriptions of the facilities where the majority of actions occur, are summarized below.

2.1 Dungeness River Hatchery Early Winter Steelhead

The HGMP actions and effects would occur in the Dungeness River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth. This area includes the Dungeness River Hatchery, Hurd Creek Hatchery, the portions of the Dungeness River watershed where fish produced by the programs would be released as juveniles and return as adults, and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles. The affected area would include all freshwater and estuary areas used by the extant populations of ESA-listed Chinook salmon, summer chum salmon, and steelhead originating from the Dungeness River watershed.

The proposed Dungeness hatchery steelhead program would be based at WDFW’s Dungeness River Hatchery, located adjacent to the Dungeness River at river mile (RM) 10.5 (Figure 1)(WDFW 2014a). Adult broodstock collection, spawning, rearing, and release occur at the Dungeness River Hatchery. As a satellite facility for Dungeness River Hatchery, Hurd Creek Hatchery (RM 0.2 on Hurd Creek, tributary to the Dungeness River at RM 2.7) would be used to support incubation and initial rearing of program fish. Surface water is withdrawn from the Dungeness River, Canyon Creek, and Hurd Creek to rear fish in the facilities. The Hurd Creek Hatchery also uses groundwater withdrawn from five wells to augment surface water sources for fish rearing. Hatchery facility effluent is released into the mainstem Dungeness River. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through Federal National Pollutant Discharge Elimination System (NPDES) permits issued where required to each facility.

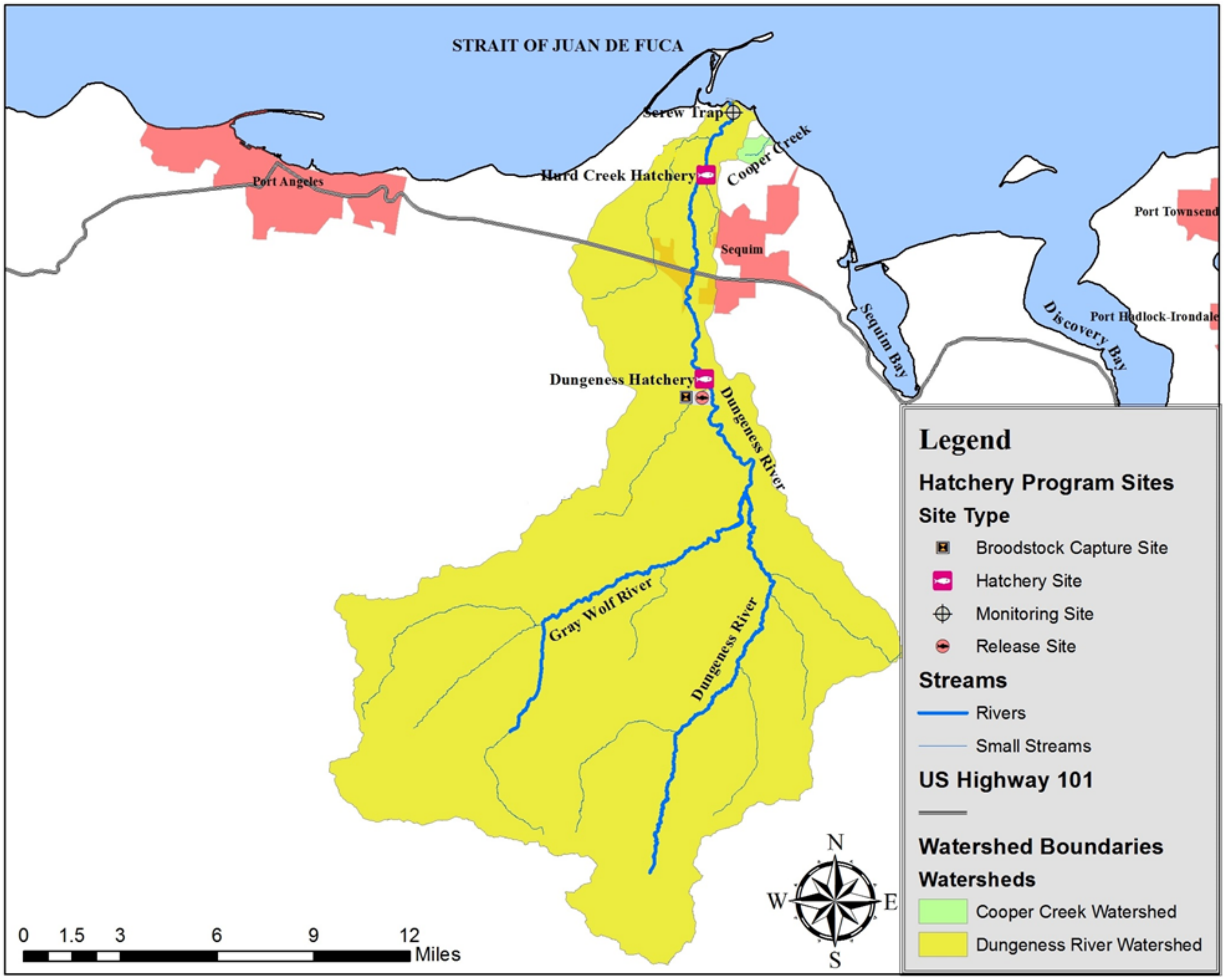

Figure 1. Action area for the proposed continued operation of the Dungeness Hatchery winter steelhead program in the Dungeness River watershed.

Monitoring and evaluation actions, associated with implementation of the proposed program, would include measures designed to assess hatchery program performance and effects.
All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for positive identification and assessment of smolt-to-adult survival rates and to determine origin of adult returns. Mass marking would also allow for differentiation of hatchery- from natural-origin adult fish escaping to the Dungeness River, and identification of steelhead by origin during the juvenile fish emigration periods. A juvenile out-migrant trap (screw trap) is operated annually at RM 0.5 on the Dungeness River (Figure 1) during the spring and summer months to estimate numbers of seaward migrating smolts, enabling estimation of productivity and survival rates for hatchery and naturally produced salmon and steelhead. This out-migrant trap is operated under a separate annual ESA take authorization afforded through ESA 4(d) rule limit 7 (NMFS permit # 19142, for 2015).

2.2 Kendall Creek Winter Steelhead

The HGMP actions and effects would occur in the Nooksack River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth (Figure 2). This area includes: the Kendall Creek Hatchery; McKinnon Pond; the portions of the Nooksack River watershed where fish produced by the programs would be released as juveniles and return as adults; and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles. The affected area would include all freshwater and estuary areas used by the extant populations of listed Chinook salmon and steelhead originating from the Nooksack River watershed.

The proposed Kendall Creek Hatchery steelhead program would be based at WDFW's Kendall Creek Hatchery, located at the mouth of Kendall Creek, tributary to the North Fork Nooksack River at RM 46 (Figure 2). Adult broodstock collection, spawning, rearing, and release occur at the Kendall Creek Hatchery. As a satellite facility for Kendall Creek Hatchery, McKinnon Pond (RM 4.4 on the middle fork Nooksack River) would be used to support rearing of program fish.

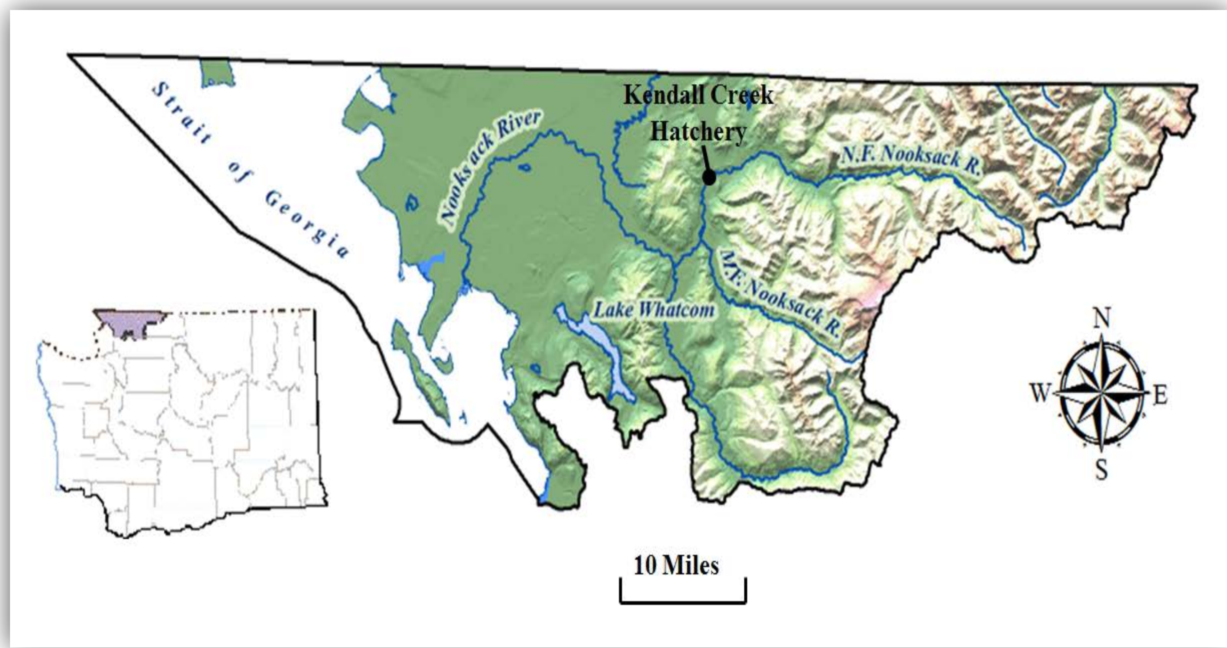

Figure 2. Action area for the proposed continued operation of the Kendall Creek Hatchery winter steelhead program in the Nooksack River watershed.

Surface water is withdrawn from Kendall Creek and from "Peat Bog Creek" (MF Nooksack tributary) for McKinnon Pond. The Kendall Creek Hatchery also uses groundwater withdrawn from five wells to augment surface water sources for fish rearing. Hatchery facility effluent is released into Kendall Creek and "Peat Bog Creek". Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through Federal National Pollutant Discharge Elimination System (NPDES) permits issued where required to each facility.

Monitoring and evaluation actions associated with implementation of the proposed program would include measures designed to assess hatchery program performance and effects. All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for positive identification and assessment of smolt to adult survival rates and to determine the origin of adult returns. Mass marking would also allow for differentiation of hatchery- from natural-origin adult fish escaping to the Nooksack River

2.3 Whitehorse Ponds (Stillaguamish River) Winter Steelhead Hatchery

The HGMP actions and effects would occur in the Stillaguamish River and its tributaries, extending from the upper-most reaches accessible to migrating steelhead and salmon in the watershed, downstream to the river mouth. This area includes the Whitehorse Ponds Hatchery, the portions of the Stillaguamish River watershed where fish produced by the programs would be released as juveniles and return as adults, and the estuary through which migrating hatchery-origin fish would pass as they enter the river as adults or exit the river as newly released juveniles (Figure 3). The affected area would include all freshwater and estuary areas used by the extant populations of ESA-listed Chinook salmon and steelhead originating from the Stillaguamish River watershed.

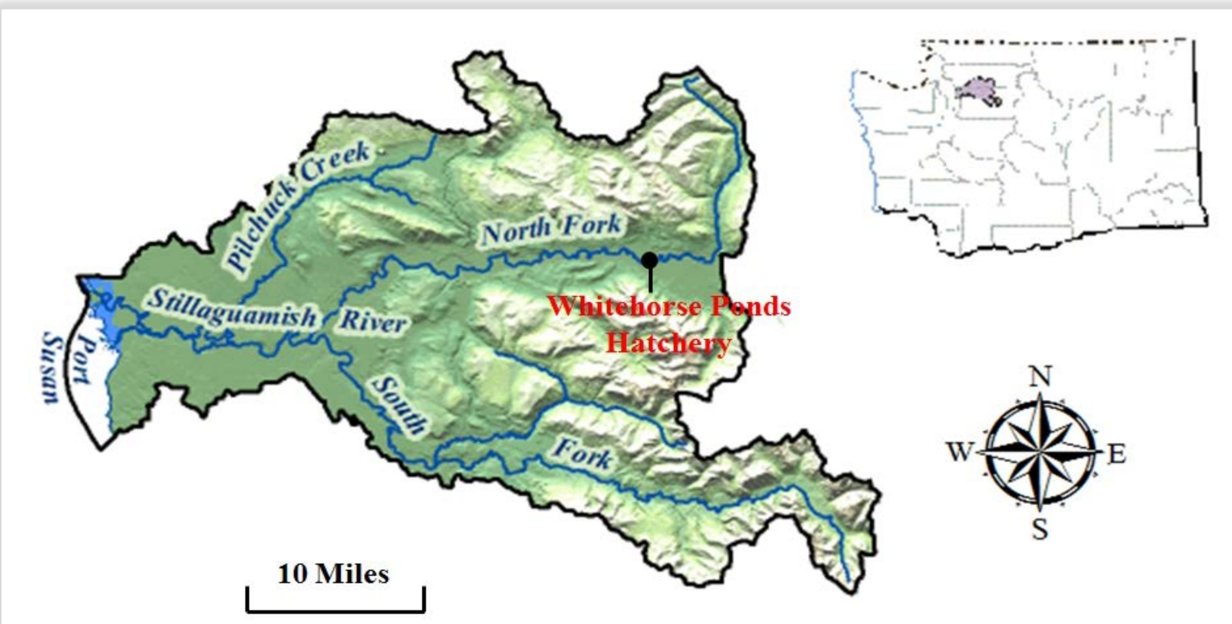

Figure 3. Action area for the proposed continued operation of the Whitehorse Ponds hatchery winter steelhead program in the Stillaguamish River watershed.

The proposed Whitehorse Ponds hatchery steelhead program would be based at WDFW's Whitehorse Ponds Hatchery, located at RM 1.5 of Whitehorse Springs Creek, a tributary to the

North Fork of the Stillaguamish River (RM 28)(WDFW 2014c)(Figure 3). Adult broodstock collection, spawning, rearing, and release all occur at the Whitehorse Ponds Hatchery.

Surface water is withdrawn from the spring-fed Whitehorse Spring Creek and ground water from a single on-site well. Hatchery facility effluent is released into lower Whitehorse Springs Creek. Effects on downstream aquatic life of effluent discharge at the facilities are regulated and monitored through a Federal National Pollutant Discharge Elimination System (NPDES) permit issued to the facility.

Monitoring and evaluation actions associated with implementation of the proposed program would include measures designed to assess hatchery program performance and effects. All hatchery-origin fish would be marked and/or tagged prior to their release into the natural environment to allow for assessment of smolt-to-adult survival rates and to determine origin of adult returns. Mass marking would also allow for differentiation of hatchery- from natural-origin adult fish escaping to the Nooksack River

3 EVALUATION

The final 4(d) Rule for salmon and steelhead states that the prohibitions of paragraph (a) of the rule (50 CFR 223.203(a)) do not apply to actions taken in compliance with a RMP jointly developed by the States of Washington, Oregon, and/or Idaho and the Tribes, provided that elements of the rule are met, including the following:

- The Secretary of Commerce (Secretary) has determined pursuant to 50 CFR 223.209(b) [the Tribal 4(d) Rule] and the government-to-government processes therein that implementing and enforcing the joint tribal/state plan will not appreciably reduce the likelihood of survival and recovery of affected threatened ESUs and DPSs.

- In making that determination for a joint plan, the Secretary has taken comment on how any HGMP addresses the criteria in §223.203(b)(5).

As per the Tribal 4(d) Rule, NMFS consulted with the Jamestown S’Klallam Tribe, the Lummi Nation, the Nooksack Tribe, the Stillaguamish Tribe, and the WDFW during the development of the three HGMPs through government-to-government and technical work group meetings. These occasions presented the opportunity to provide technical assistance, to exchange information and discuss what would be needed to conserve the ESA-listed species, and to be consistent with legally enforceable tribal rights and with the Secretary’s trust responsibilities to the treaty tribes.

The following discussion evaluates whether the submitted plans address the criteria in section 223.203(b)(5) of the 4(d) Rule for salmon and steelhead.

3.1 Limit 5 Criteria and RMP Evaluation

3.1.1 5(i)(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results.

Goals, performance objectives (standards), and performance indicators for the three hatchery winter steelhead programs are clearly described in sections 1.7, 1.9, and 1.10, respectively of each HGMP (WDFW 2014a; WDFW 2014b; WDFW 2014c).

The goals of the programs are: (1) meeting regional non-Indian recreational fisheries objectives, and (2) supporting values associated with Treaty-reserved fishing rights to meet Jamestown S'Klallam, Lummi, Nooksack, and Stillaguamish tribal commercial, ceremonial, and subsistence needs. The programs would mitigate for lost natural-origin fish production by producing hatchery-origin winter steelhead to provide commercial, ceremonial and subsistence fisheries by the Jamestown S'Klallam, Lummi, Nooksack, and Stillaguamish Tribes, and recreational harvest for Washington state citizens.

The HGMPs were designed to be consistent with the strategies and actions specified in the watershed recovery plans and the salmon recovery strategies for the basins (SSPS 2005a; SSPS 2005b; SSPS 2005c)

Performance standards derived from the Northwest Power Planning Council (NPPC) Artificial Production Review (APR) (NPPC 2001), and performance indicators that would be used to gauge compliance with each of the standards, are described for the three steelhead hatchery programs in section 1.11 of each HGMP (WDFW 2014a; WDFW 2014b; WDFW 2014c). Responsive monitoring and evaluation actions that would be implemented to collect information relevant to each indicator are also described in that section. Separate performance standards, indicators, and monitoring and evaluation actions are presented to track achievement of hatchery program performance relative to objectives, and monitor program effects on affected fish populations. The HGMPs are designed to determine: program consistency with proposed hatchery actions and intended results (e.g. juvenile fish release and adult return levels); measurement of the program's success or failure in attaining results; and, effects of the program on natural-origin fish populations in the Dungeness, Nooksack, and Stillaguamish River watersheds.

3.1.2 5(i)(B) The HGMP utilizes the concepts of viable and critical salmonid population thresholds, consistent with the concepts contained in the technical document entitled "Viable Salmonid Populations."

HGMPs proposed for consideration under the 4(d) Rule must use the concepts of viable and critical thresholds as defined in the NMFS Viable Salmonid Population (VSP) document (McElhany et al. 2000). Application of these VSP concepts is needed to assess the take of listed salmonids and to avoid jeopardizing any ESA-listed ESU or DPS.

The three HGMPs adequately address this criterion. The HGMPs establish that in the course of mitigating for losses to tribal and non-tribal fishers, the hatchery programs take ESA-listed salmon and steelhead within the watersheds where they occur. The term "take" means to harass, harm, pursue, hunt, shoot, would, kill, trap, capture, or collect, or to attempt to engage in any such conduct (ESA section 3(C)(18). So that take is verified and adequately limited, such that the hatchery programs do not jeopardize any ESA-listed ESU or DPS, a series of very specific standards and indicators are included in each HGMP (Table 1.8.1 and Section 1.10, List of "Performance Indicators", designated by "benefits" and "risks").

Performance standards and indicators related to effects of the programs on ESA-listed salmon and steelhead within each basin, would track achievement of these goals during the on-station operation of the programs and throughout the juvenile emigration and adult return timeframes. See section 3.1.1, 5(i)(D) below, for specific information on the proposed measures and protocols to be implemented to minimize effects on listed natural-origin salmon and steelhead.

The HGMPs also provide information related to the ESA-listed salmon and steelhead populations in the Dungeness, Nooksack, and Stillaguamish Rivers. The plans describe the viability goals (where developed) for the individual populations, as well as the recovery goals for each of the listed ESUs or DPSs that encompass the affected populations.

Puget Sound ESA-listed anadromous salmonid ESUs and DPSs:

Puget Sound Chinook (*Oncorhynchus tshawytscha*): Listed as *Threatened* on March 24, 1999 (64 FR 14308); *Threatened* status reaffirmed on June 28, 2005 (70FR37160); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). The Puget Sound Chinook salmon ESU is composed of 31 historically quasi-independent populations, of which 22 are believed to be extant. The ESU includes all naturally-spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, South Sound, North Sound and the Strait of Georgia in Washington (Ford 2011), as well as twenty-seven artificial propagation programs (NMFS 2013 78FR38270). In the Strait of Juan de Fuca region, the Technical Recovery Team (TRT) has identified demographically independent populations (DIPs) in the Dungeness and Elwha River basins (Ruckelshaus et al. 2006).

Hood Canal summer chum (*Oncorhynchus keta*): Listed as *Threatened* on Mar. 25, 1999 (64 FR 14507); *Threatened* status reaffirmed on June 28, 2005 (70FR37160); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). Final designation for Critical Habitat was published Sept. 2, 2005 (70FR52630), with effective date of Jan. 2, 2006. The ESU includes all naturally spawned populations of summer-run chum in Hood Canal and its tributaries, populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington (Ford 2011). The ESU also includes summer chum from four artificial propagation programs: Hamma Hamma Fish Hatchery, Lilliwaup Creek Fish Hatchery, Tahuya River and the Jimmycomelately Creek Fish Hatchery summer-run chum programs (NMFS 2013 78FR38270).

Puget Sound steelhead *(Oncorhynchus mykiss*): Listed as *Threatened* under the ESA on May 11, 2007 (72 FR 26722); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76 FR 50448). The DPS includes all naturally-spawned anadromous winter-run and summer-run *O. mykiss* (steelhead) populations, below natural migration barriers in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. This DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive) (Ford et al. 2011). Also includes steelhead from six artificial propagation programs: Green River Natural; White River Winter Steelhead Supplementation; Hood Canal Steelhead Supplementation Off-station Projects in the Dewatto, Skokomish, and Duckabush Rivers; and the Lower Elwha Fish Hatchery Wild Steelhead Recovery (NMFS 2013 78 FR 38270).

Below is a summary, by watershed, of the current information, relating to viability, for each of the listed populations that would be affected by the continued operation of the three hatchery winter steelhead programs.

3.1.2.1 Dungeness River

Section 2.2.2 of the Dungeness River Hatchery winter steelhead HGMP describes the status of the listed Dungeness Chinook salmon, summer chum salmon and steelhead populations relative to "critical" and "viable" population thresholds.

The population viability goals, where available, were incorporated by WDFW and the Jamestown S'Klallam Tribe in planning and guiding the proposed implementation of the Dungeness River Hatchery steelhead program (WDFW 2014a). The viability goals would be used as reference points for identifying the status of the listed salmon and steelhead populations during implementation of the hatchery programs. The goals would be used to gauge the program performance and risk reduction objectives specified in the HGMP, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery programs for winter steelhead would be implemented, so as not to reduce the viability status of those listed salmon and steelhead populations, are provided in section 3.1.4 of this document.

Dungeness Chinook Salmon

The Dungeness Chinook salmon population is one of 22 populations of Chinook salmon in the region delineated by NMFS as part of the Puget Sound Chinook salmon ESU (Ruckelshaus et al. 2006). The Dungeness Chinook salmon population is grouped with one other population – Elwha - in the Strait of Juan de Fuca biogeographical region for Puget Sound Chinook salmon ESU recovery planning purposes (SSPS 2005a; NMFS 2007). Under NMFS recovery and delisting criteria for the listed Chinook salmon ESU, two or more populations within the biogeographical region need to be recovered to a low extinction risk status for the ESU to be considered recovered and delisted (NMFS 2007). Hatchery-origin Chinook salmon produced through the Dungeness

River Hatchery program are included with the natural-origin component of the Dungeness Chinook salmon population as part of the ESA-listed ESU (70 FR 37160, June 28, 2005). Hatchery fish with a level of genetic divergence relative to the local natural population(s) that is no more than what occurs within the ESU are considered part of the ESU (70 FR No. 123, June 28, 2005, 37204).

The extant Dungeness Chinook salmon population is considered a spring/summer-run timed (or “early”) population, based on spawn timing (WDF and WWTIT 1993). Weir operations in 1997 and 2001 indicate that most adult Chinook salmon enter the river by early August (PSIT and WDFW 2010a). Spawning occurs from mid-August to mid-October (WDF and WWTIT 1994). Spawning begins about two weeks earlier in the upper Dungeness River and in the Gray Wolf River than in the main stem below its confluence with the Gray Wolf River (WDF and WWTIT 1994; Ruckelshaus et al. 2006). The area of spawning extends to a falls just above the mouth of Gold Creek at RM 18.7. Chinook salmon also spawn in the lower 6.1 miles of the Gray Wolf River, although the river is accessible to migrating anadromous fish to RM 8.0 (WDF and WWTIT 1994; Haring 1999). Chinook salmon 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). Myers et al. (1998) reported that Dungeness Chinook adults mature primarily at age four (63%), with age 3 and age 5 adults comprising 10% and 25%, of the annual returns, respectively. Recent scale analyses data collected for Dungeness Chinook salmon indicate that adult hatchery-origin fish return to the river at the following age class proportions: for fish released as subyearlings: Age 2 (8%), 3 (36%), 4 (48%), 5 (8%), and 6 (0%); for fish released as yearlings: Age 2 (1%), 3 (17%), 4 (56%), 5 (23%), and 6 (3%). The Dungeness Chinook salmon natural population is predominantly an ocean-type life history trajectory (95 to 99 percent of the total emigrating population, with juveniles emigrating seaward as subyearlings from mid-February through the end of July (Myers et al. 1998; Topping and Kishimoto 2008; Topping et al. 2008). A very small portion of the population emigrates seaward as yearlings (Marlowe et al. 2001; SSPS 2005a). 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 peaks during mid-March for fry (average individual size of 39 mm fl) and early June for subyearling smolts (average size is 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).

For recovery planning purposes, goals for the four viability parameters—abundance, diversity, spatial structure, and productivity—were developed for each natural population in Puget Sound (Table 2) (SSPS 2005a; WDFW 2014a).

Table 2. Minimum viability spawning abundance, abundance at equilibrium or replacement, and spawning abundance and productivity at maximum sustainable yield for a recovered state for the Dungeness Chinook salmon population and for the entire Puget Sound Chinook salmon ESU.

Population - Region	TRT Minimum Viability Abundance [e]	Status Under Properly Functioning Conditions (PFC)			NMFS Escapement Thresholds	
		Equilibrium Abundance	Spawners at MSY	Productivity at MSY	Critical [a]	Rebuilding [b]
Dungeness	4,700	4,700	1,000	3	200 [c]	925 [d]
ESU	261,300	307,500	70,948	3.2	261,300	261,300

Source: (Ford et al. 2011; WDFW 2014a).
[a] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).
[b] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).
[c] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).
[d] Based on alternative habitat assessment. The TRT minimum viability abundance for the two Strait of Juan de Fuca populations, was the equilibrium abundance or 17,000, whichever was less.

Dungeness Chinook salmon Abundance - The current abundance of Dungeness Chinook salmon is substantially reduced from historical levels (SSPS 2005a). The historic equilibrium abundance level[1] for the Dungeness population is 8,100 fish (Ruckelshaus et al. 2002). From 1986 through 2000, the average total escapement, natural and hatchery-origin fish combined, in the watershed was 153 fish. Between 2000 and 2011, the estimated average total annual naturally spawning Chinook salmon escapement, natural-origin and hatchery fish combined, was 559 fish (Figure 4;), with hatchery-origin Chinook salmon making 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 2014a). The recent year Chinook salmon abundance measured as natural spawning escapement to the river is 6.9% of the historic equilibrium abundance for the population. Under current habitat conditions, the Dungeness River can support 699 Chinook salmon spawners. The Gray Wolf River is underutilized (SSPS 2005a). Chinook salmon produced in the Dungeness River Hatchery are included as part of the Dungeness population, and listed with natural-origin fish as threatened (NMFS 2003). When hatchery fish are included in an ESU they are also included in assessing the ESU's status , however, "natural populations are the best indicator of a species' health" (70 FR 37204 June 28, 2005). A captive broodstock program initiated to preserve and rebuild the population was, by design, terminated after the 2003 brood (2006 return year), and escapements correspondingly decreased in return years 2007 through 2009. The highest observed hatchery-origin escapements (2001-2006) reflect years when adult fish progeny of captive broodstock Chinook salmon returned to spawn (PSIT and WDFW 2010a). Reinitiation of a hatchery program intended to supplement natural spawning with hatchery fish,

1 "Historic 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.

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

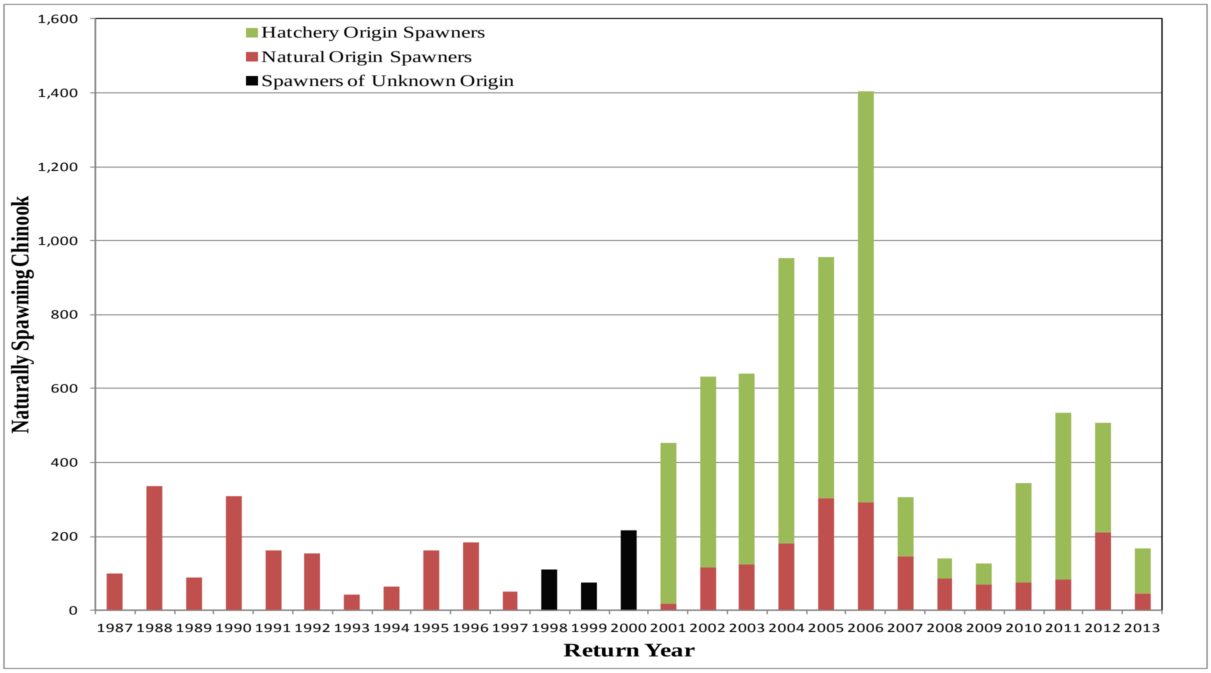

Figure 4. Estimated annual naturally spawning Chinook salmon escapement abundance in the Dungeness River for 1987 – 2013. Data sources: (PSIT and WDFW 2010a; WDFW 2014a) WDFW unpublished data 2014, accessed via: https://fortress.wa.gov/dfw/score/score/species/population_details.jsp?stockId=1240

Table 3. Natural origin Freshwater Production Estimates for Chinook in the Dungeness River 2005-2012.

Outmigration Year	**Chinook Sub-yearling**			
	Freshwater Production	CV	Fry[a]	Parr[a]
2005	72,040	5.26%	19,084	52,911
2006	136,724	12.79%	74,319	62,405
2007	109,445	7.23%	27,740	81,705
2008	11,506	7.79%	3,400	8,108
2009	20,196	5.77%	3,904	16,292
2010	9,674	8.01%	1,801	7,873
2011	10,222	NA	1,451	8,771
2012	70,697	5.60%	24,636	46,062
Average	55,063		19,542	35,516

Source: (WDFW 2014a).

[a] Fry and parr are both sub-yearling Chinook migrants, but represent different freshwater rearing strategies; fry ≤ 45 mm fork length.

Dungeness Chinook salmon Productivity - Productivity for Dungeness Chinook salmon has remained relatively stable but at very low levels since the Puget Sound Chinook ESU was listed in 1999. Although the most recent NMFS status review for the ESU found a slightly positive trend in productivity from 1982 through 2006, as measured by recruit per spawner and spawner to spawner rates, spawner returns are well below replacement levels (Table 4 (Table 3 from Ford et al. 2011).

Table 4. 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 et al. 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.

Dungeness Chinook salmon Diversity - Indices of diversity have not been developed at the population level (Ford et al. 2011). Genetic diversity of the Dungeness Chinook salmon population has likely 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, are likely to 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 and 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 (Marlowe et al. 2001; Ruckelshaus et al. 2006). The Puget Sound Chinook salmon TRT concluded that the late-returning life history in the Dungeness River was a significant 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 populations or major components of the life history diversity of the remaining 22 extant independent populations (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 significant 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 historic levels, represents a risk to remaining ESU diversity.

Dungeness Chinook salmon Spatial Structure - Indices of spatial structure have not been developed at the population level (Ford et al. 2011). Spatial structure for the Dungeness Chinook population has also been affected over time relative to historical levels. A weir spanning the full width of the river at RM 10.8 was a barrier to Chinook salmon migration beginning in the 1930s. The weir served to collect broodstock for the Dungeness River Hatchery program but it also 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 2005a). The weir was removed in the 1980s. Although Chinook salmon continue to have access to their historic 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 2005a).

Human development actions in the watershed have degraded available spawning and migration areas for adult fish and refugia for rearing juvenile salmon to the detriment of Chinook salmon survival (Haring 1999). 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. 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. Water withdrawals for agricultural and municipal uses have substantially reduced flows needed during the adult salmon upstream migration and spawning periods, resulting in spawning redds being constructed in poor habitat that is extremely susceptible to sediment scour and deposition (Haring 1999; SSPS 2005a). Dungeness River Summer-Run Chum Salmon

Hood Canal Summer Chum Salmon

The Hood Canal summer-run chum salmon ESU was listed a threatened species under the ESA in 1999 (64 Fed. Reg. 14508, March 25, 1999) and reconfirmed in 2005 (70 Fed. Reg. 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 Fed. Reg. 52630, September 2, 2005).

The Puget Sound Recovery Implementation Technical Team (RITT) assembled viability goals for Hood Canal summer-run chum salmon that are part of the Strait of Juan de Fuca population (Sands et al. 2009); see Table 5). No specific viability goals were developed for the summer chum salmon spawning aggregation in the Dungeness River because the numbers of summer chum adults returning to the watershed are so low that they may not represent a self-sustaining stock. However, the Dungeness River is considered an important watershed for restoring the diversity of the Strait of Juan de Fuca summer chum salmon population component of the listed ESU (Sands et al. 2009).

Table 5. Population viability parameters for the Strait of Juan de Fuca (JDF) summer chum salmon population of Hood Canal summer chum salmon.

<table>
<tr><th rowspan="2">Population - Region</th><th colspan="2">Spawner Abundance</th><th rowspan="2">Spatial Structure</th><th rowspan="2">Diversity</th><th rowspan="2">Productivity</th></tr>
<tr><th>TRT</th><th>HCCC</th></tr>
<tr><td>Dungeness</td><td>-</td><td>-</td><td rowspan="2">Most spawning aggregations within 20 km of adjacent aggregations; Major spawning aggregations not more than 40 km apart</td><td rowspan="2">SJF population has one or more persistent spawning aggregations from the Dungeness & Sequim/Admiralty diversity units</td><td rowspan="2">≥ 1.0</td></tr>
<tr><td>Strait of JDF</td><td>4,500 – 6,400</td><td>2,080</td></tr>
</table>

Source: (PNPTT and WDFW 2003; Sands et al. 2009)

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 and WWTIT 1993). Summer chum salmon 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; WDFW 2014a). 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 salmon adults 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 10.5) (WDFW and PNPTT 2000; NMFS 2002). 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 39-40 mm (fl) immediately, without delay in freshwater, to marine waters (Koski 1975; Schreiner 1977; Salo 1991).

The effects of continued operation of the Dungeness River steelhead program on the ESA-listed summer Chum salmon ESU were previously evaluated by NMFS through a separate ESA section 7 consultation process (NMFS 2002). Considering the effects of all salmon and steelhead hatchery programs in the Strait of Juan de Fuca and Hood Canal regions, NMFS determined that the hatchery actions were not likely to jeopardize the continued existence of the listed Hood Canal summer chum salmon ESU or result in the destruction or adverse modification of their designated critical habitat (NMFS 2002).

Hood Canal Summer-Run Chum Salmon Abundance - Although escapement estimates for summer chum are lacking, extensive monitoring of adult salmon spawning during August through October in the Dungeness River has occurred since at least 1986. 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 total spawning abundance for the Strait of Juan de Fuca population in 2004 and 0.02% in 2005 (Sands et al. 2009). But survey conditions are typically rated as “poor to fair” during spawner surveys in the Dungeness River and the emphasis on other species 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-count surveys ranging between 0 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 (historical) conditions for the species (Sands et al. 2009).

Primary factors that contributed to declines in summer chum salmon abundance were habitat degradation, logging, over-harvest in fisheries, and climate effects (NMFS 2006b). The specific factors responsible for the current, 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.

Hood Canal Summer-Run Chum Salmon Productivity

Table 6. Short and long term population trend and growth rate estimates for the Strait of Juan de Fuca population of the Hood Canal Summer Chum ESU.

Population	Years	rend Nat Sp w/CI	Hatchery Fish Success =0		Hatchery Fish Success =1	
			Lambda w/CI	p>1	Lambda w/CI	p>1
Strait of Juan de Fuca	1995-2009	1.184 (1.06 - 1.324)	1.139 (0.242 - 5.365)	0.76	1.009 (0.255 - 3.989)	0.53
	1971-2009	1.013 0.984 - 1.043)	1.028 (0.872 - 1.211)	0.65	0.99 (0.867 - 1.129)	0.43

Source: Ford et al. 2011 in (WDFW 2014a). These are based on analyses reported by Ford et al. (2011) that are not necessarily agreed to by WDFW and the Tribes. “Lambda” is a measure of population growth rate. See Ford et al. (2011) for explanation of the columns.

Other Hood Canal Summer-Run Chum Salmon Viability Parameters (diversity, spatial structure) - There are no other population viability data available for summer chum salmon in the Dungeness River due to the species’ sporadic and low level of occurrence in the Dungeness River watershed.

Dungeness River Steelhead

The Puget Sound Steelhead Technical Recovery Team (PSSTRT) 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 (Myers et al. 2014). 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 reported that the summer-run race in the Dungeness River is still extant (Scott and Gill 2008a). Although, the population delineated recently by the PSSTRT 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 (Myers et al. 2014). Under DPS viability criteria developed by the PSSTRT, at least one winter-run and one summer-run population of the six populations including Dungeness River 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 (Hard et al. 2014). Final viability criteria are not yet developed for the Puget Sound steelhead DPS, including for the Dungeness population. See Table

7 for the interim abundance goals developed by the PSTRT. Hatchery-origin steelhead released from Dungeness River Hatchery are not derived from the native Dungeness River winter-run population, and are not included as part of the listed DPS.

Table 7. Puget Sound TRT Interim DIP (and DPS) abundance goals for steelhead in Puget Sound

Population Basin				**Quasi Extinction Threshold**	**Low Abundance**	**Viable**	**Capacity**
Population Name	Area km^2	Mean Elevation (m)	Total Stream Length (m)		1% SAS	5% SAS	20% SAS
Dungeness R	564	978	306,740	30	246	1,232	4,930
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2014 in (WDFW 2014a).

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 declining trend over much of the DPS (Ford et al. 2011; NMFS 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 2014a). 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 et al. 2011). The co-managers' identify a critical threshold for winter-run steelhead escapement of 125 fish, reflecting the estimated escapement level needed to maintain an effective population size, or number of successful breeders, that would not be lower than 50, assuming a ratio of effective breeders to spawner census number of at least 0.40. 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, ranges from 500 to 750 natural-origin fish, annually (PSIT and WDFW 2010b).

Dungeness Steelhead Abundance - Due to difficult environmental conditions, the ability to conduct spawner surveys is limited. The Jamestown S'Klallam Tribe has conducted spawner surveys in each year beginning in 2010. Surveys in 2010, and particularly in 2012, were cut short due to high water levels associated with spring rain and snow runoff; however escapement estimates can be obtained through the use of timing curves from other comparable river systems. The Jamestown S'Klallam Tribe has completed estimates of spawners for the entire season for 2011 and 2013. An estimated 410 fish spawned in 2011, and an estimated 564 fish spawned in 2013 after March 10. Prior to 2010, the last escapement estimate for Dungeness winter steelhead was in the 2000/2001 season with an estimated escapement of 183 based on index areas.

An estimate of the intrinsic potential-based spawner capacity indicates that the Dungeness River watershed could support the production of 2,465 to 4,930 natural-origin steelhead (Myers et al. 2014).

Dungeness Steelhead Productivity - With an estimated mean population growth rate of -0.096 ($\lambda = 0.908$) and process variance of < 0.001, Ford et al. (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 year ranges and percentages of decline, there is less certainty about the precise level of risk to the population (Ford et al. 2011). WDFW juvenile outmigrant trapping at the Dungeness River mouth from 2005 to 2012 showed an average annual production of natural-origin winter-run steelhead of 10,953 smolts (Table 8). Annual steelhead smolt productivity appears to be trending upwards based on these short term annual observations.

Table 8. Natural origin Freshwater Production Estimates for steelhead in the Dungeness River 2005-2012.

Outmigration Year	**Steelhead Smolts**	
	Freshwater Production	CV
2005	9,192	n/a
2006	6,125	16.96%
2007	11,445	7.80%
2008	8,155	16.59%
2009	10,101	20.72%
2010	17,486	14.70%
2011	19,600	14.54%
2012	5,521	11.04%
Average	10,953	14.62%

Source: (WDFW 2014a).

Dungeness Steelhead Diversity - Available data indicate that steelhead diversity in the Dungeness River watershed has declined relative to historic 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 and hatchery practices, have reduced the diversity of the species in general relative to historic levels. In a review of Puget Sound steelhead population status, NMFS indicated that genetic diversity for the native winter-run population was likely reduced by releases of non-native Chambers Creek steelhead from Dungeness River Hatchery (Ford et al. 2011), although there are currently no published genetic data indicating that introgression associated with planting of the non-native stock has occurred (WDFW 2014a). Recent analyses by WDFW indicate that any effects associated with Dungeness River hatchery early winter steelhead production on native winter-run Dungeness steelhead genetic diversity have been unsubstantial (Hoffmann 2014).

Dungeness Steelhead Spatial structure - The Dungeness River winter-run steelhead population includes fish spawning in the mainstem Dungeness and Gray Wolf Rivers (Myers et al. 2014). The extent of spawning is confined to areas downstream of naturally impassable barriers to migration on the Dungeness River and the Gray Wolf River. Dungeness River 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 also 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.

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 (i.e., the weir was removed in advance of the steelhead upstream migration). Summer-run steelhead distribution in the watershed may have been adversely affected by the weir when it was in operation over that period.

3.1.2.2 Nooksack River

Section 2.2.2 of the Kendal Creek Hatchery winter steelhead HGMP describes the status of the ESA-listed Nooksack Chinook salmon and steelhead populations relative to "critical" and "viable" population thresholds.

The population viability goals, where available, were incorporated by WDFW, the Lummi Nation, and the Nooksack Tribe in planning and guiding the proposed implementation of the Kendall Creek Hatchery winter steelhead programs (WDFW 2014b). The viability goals would be used as reference points for identifying the status of the ESA-listed salmon and steelhead populations during implementation of the hatchery programs. The goals would be used to gauge the program performance and risk reduction objectives specified in the HGMPs, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery programs for winter steelhead would be implemented so as not to reduce the viability status of those listed salmon and steelhead populations are provided in Section 3.1.5 of this document.

Nooksack Chinook Salmon

Nooksack Chinook salmon are included in the Georgia Basin Recovery Region for the ESA-listed Puget Sound Chinook salmon ESU. The Nooksack River basin contains two Chinook salmon populations – North Fork Nooksack (also referred to as North/Middle Fork Nooksack early Chinook) and South Fork Nooksack. Both of these populations are early-returning or spring run-timing Chinook salmon. These are the only Chinook salmon populations within the Georgia Basin Bio-geographic Region (BGR) (SSPS 2005d; NMFS 2006a). Abundance of Nooksack River basin Chinook salmon is a fraction of historical levels (SSPS 2005d), with the South Fork at critical status and the North Fork near critical (critical status for the last five years where data are available)(Table 9). Supportive breeding programs are operated as a means to preserve and help restore both populations using native fish as broodstock. As NMFS has stated "Hatchery programs, under certain circumstances can provide short-term benefits to the abundance, productivity, spatial structure, and diversity of an ESU" (70 FR 37204 June 28, 2005). Fish produced by the two conservation programs – Kendall Creek Hatchery Program, and Skookum Creek Hatchery Spring-run Program—are ESA-listed and protected with the natural populations (79 FR 20802, April 14, 2014). Table 9 identifies critical and recovery target abundance and productivity goals for Nooksack Chinook salmon.

Table 9. Critical Escapement Thresholds and Recovery Abundance and Productivity targets for Nooksack Chinook Salmon Populations.

Region	Population	NMFS Escapement Thresholds		Recovery Planning Abundance Target in Spawners (productivity)[3]
		Critical[1]	Rebuilding[2]	
Georgia Basin	NF Nooksack SF Nooksack	200[4] 200[4]	- -	3,800 (3.4) 2,000 (3.6)

[1] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000)
[2] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).
[3]Source for Recovery Planning productivity target is the final supplement to the Puget Sound Salmon Recovery Plan (NMFS 2006a); measured as recruits/spawner associated with the number of spawners at Maximum Sustained Yield under recovered conditions.
[4] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

Nooksack Chinook Salmon Abundance - A supportive breeding hatchery program for the North Fork population has operated at the Kendall Creek Hatchery since 1981 (PSIT and WDFW 2010a). Peak production included up to 142,500 unfed fry, 2.3 million fingerlings, and 348,000 yearlings. The program has evolved through time and now releases a total 750,000 sub-yearlings divided between three release locations: Kendall Creek, Boyd Creek (tributary to the North Fork at RM 63), and McKinnon Pond (tributary to the Middle Fork at RM 4.75 (WDFW 2014b). During the most recent five years the South Fork population has averaged only 56 natural-origin spawners (13% of the naturally spawning Chinook) (PSIT and WDFW 2013; 2014). Due to low abundance a captive broodstock-based hatchery recovery program was established in 2006 (PSIT and WDFW 2010a) . The program is now transitioning to a more conventional smolt release program designed to supplement the number of natural spawners. Hatchery programs like this one can "conserve the genetic resources of depressed natural populations, reduce their risk of extirpation, and thereby mitigate the immediacy of an ESU's extinction risk" (70 FR 37204 June 28, 2005). The hatchery program is based at the Lummi Nation's Skookum Creek Hatchery, located on the SF Nooksack River.

As with most Puget Sound Chinook populations, the Nooksack Chinook populations are well below escapement levels identified as required for recovery (Table 9) Recent escapement levels

(2005-2013) have averaged 1,427 total natural spawners, with 86% being hatchery-origin, in the North Fork Nooksack River DIP and 70 (2000-2013) total natural spawners, with 84% being hatchery-origin, for the South Fork Nooksack River DIP (WDFW 2014b). Longer term estimates are summarized in Table 10 below.

Table 10. Estimates of Geometric Mean Total Escapement, Natural-origin Escapement Levels, Productivity, and Average % Hatchery-origin spawners for Run-years 1999 through 2011

Region	**Population**	**1999 to 2011 Geometric mean Escapement (Spawners)**		**Average % hatchery fish in escapement 1999-2011 (min-max)[3]**
		Natural[1]	Natural-Origin (productivity[2])	
Georgia Basin	NF Nooksack	1,638	211 (0.3)	86 (74-94)
	SF Nooksack	399	53 (1.7)	84 (62-96)

[1] Includes naturally spawning hatchery fish.
[2] Source for 1999-2011 productivity is Abundance and Productivity Tables (tab Cohort RR) from Puget Sound TRT database; measured as the mean of observed recruits/observed spawners over the 1999-2011 period (1995-2007 brood years)
[3] Estimates of the fraction of hatchery fish in natural spawning escapements are from the Puget Sound TRT database and co-manager postseason reports on the Puget Sound Chinook Harvest Management Plan (WDFW and PSTIT 2005; WDFW and PSTIT 2006; WDFW and PSTIT 2007; WDFW and PSTIT 2008; WDFW and PSTIT 2009; WDFW and PSTIT 2010; WDFW and PSTIT 2011) and the 2010-2014 Puget Sound Chinook Harvest Management Plan (PSIT and WDFW 2010a) .

Nooksack Chinook Salmon Productivity - Abundance of Nooksack River basin Chinook salmon is a fraction of historical levels (SSPS 2005d), with the South Fork at critical status and the North Fork near critical (critical status for the last five years where data are available). The most recent NMFS status review estimates of escapement, hatchery contribution, and productivity for the Nooksack Basin populations are summarized in Table 11.

Table 11. Recent Abundance and Productivity Trends for Nooksack River Chinook Salmon.

Region	**Population**	**Natural Escapement Trend[1] (1990-2011)**	**Growth Rate (1990-2008)**	
			Return (Recruits)	Escapement (Spawners)
Strait of Georgia	NF Nooksack (early)	1.18	1.07	1.04
	SF Nooksack (early)	1.06	1.04	1.03

[1] Long-term, reliable data series for natural-origin contribution to escapement are limited in many areas. Escapement trend is calculated based on all spawners (i.e., including both natural origin spawners and hatchery-origin fish spawning naturally) to assess the total number of spawners passed through the fishery to the spawning ground.

Nooksack Chinook Salmon Diversity - Indices of diversity have not been developed at the population level, though diversity at the ESU level is declining (Ford et al. 2011). The Nooksack River may have lost some the Chinook salmon population diversity that once occurred, as historical evidence suggests that a later-returning life history was once present (Ruckelshaus et al. 2006). Williams et al. (1975) in (Ruckelshaus et al. 2006) describe a summer-fall Chinook salmon which entered the river starting in July, with spawning occurring in mid-September through October. The presence of a summer-fall return timing component likely reflects adult returns and straying resulting from long term propagation of non-native Green River lineage stock at several hatcheries in the Nooksack River basin and immediately adjacent areas. The extant Nooksack early-run Chinook salmon represent a much-reduced and important life-history element of the ESU. The disproportionate loss of early-run life history diversity represents a particularly significant loss of the evolutionary legacy of the historical ESU. As two of the remaining six populations of early and moderately-early run-time Chinook salmon in Puget Sound, the substantially reduced abundance of the Nooksack spring-run populations, relative to historic levels, represents a risk to remaining ESU diversity.

Nooksack Chinook Salmon Spatial Structure - Indices of spatial structure have not been developed at the population level (Ford et al. 2011). The North Fork population spawns from late-July through September in the North Fork from the confluence with the South Fork (RM 36.6) to Nooksack Falls (RM 65), and in the lower Middle Fork to RM 7.2 (where a diversion dam blocks migration), as well as in numerous larger tributaries including: Deadhorse, Boyd, Thompson, Cornell, Canyon, Boulder, Maple, Kendall, MacDonald, Racehorse, and Canyon Lake creeks (WRIA 1 Salmon Recovery Board 2005, and following). The highest spawning densities are in the North Fork from RM 45.2 to RM 63. The South Fork population spawns from mid-August through September in South Fork from the confluence with the North Fork (RM 0) to Sylvester's Falls (RM 25), and in many years spawning occurs upstream of the 11 to 12 foot falls to RM 30.4. The highest spawning densities are typically between RM 8.5 and RM 20.7. Spawning also occurs in the larger tributaries including: Hutchinson, Skookum, Deer, and Plumbago creeks.

Nooksack Steelhead

The Nooksack River basin includes two steelhead DIPs: Nooksack winter-run and South Fork Nooksack summer-run (PSSTRT 2013). The DPS viability criteria developed by NMFS (Hard et al. 2014), require that at least 40 percent of the steelhead populations within each MPG achieve viability (restored to a low extinction risk), as well as at least 40 percent of each major life history type (e.g., summer-run and winter-run) historically present within each MPG achieve viability. There are no hatchery-origin steelhead produced in basin hatcheries that are included as part of the listed DPS. WDFW had previously identified three winter-run stocks: North Fork/Mainstem, South Fork, and Middle Fork; and one summer-run stock, South Fork (WDF and WWTIT 1993).

Table 12. Interim DIP abundance goals for Nooksack steelhead and the Puget Sound DPS.

Population Basin				Quasi Extinction Threshold	Low Abundance	Viable	Capacity
Population	**Area Km^2**	**Mean Elevation (m)**	**Total Stream Length (m)**		**1% SAS**	**5% SAS**	**20% SAS**
Nooksack River	1,982	619	1,257,480	73	2,205	11,023	44,091
SF Nooksack River	172	926	99,347	27	114	568	2,273
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2014

Nooksack Steelhead Abundance - Suspended sediment due in part to the glacial hydrology makes it difficult to monitor steelhead spawners in this system. Adult spawner data has only been collected for Nooksack winter steelhead in recent years and when conditions allow. These data suggest that population abundances are relatively stable. For summer steelhead, water conditions (low visibility) make spawning ground surveys difficult to impossible and thus there are no abundance trend data for SF Nooksack summer steelhead and their status remains unknown (SaSI, (WDFW 2014b)). Based on a habitat-based intrinsic potential (IP) analysis by the PSSTRT (2013), the estimated historic capacity for winter steelhead in this system was between 22,045 and 44,091 fish and between 114 and 2,273 fish for summer steelhead.

Table 13. Nooksack River winter steelhead escapement 2004-2012.

Return Year	Escapement
2004	1,574
2005	NA
2006	NA
2007	NA
2008	NA
2009	NA
2010	1,901
2011	1,774
2012	1,747
2013	1,805
Average	1,760

Source: SaSI (WDFW 2014b)

Nooksack Steelhead Productivity - For all but a few putative PS steelhead populations, estimates of mean population growth rates obtained from observed spawner or redd counts are declining—typically 3 to 10 percent annually—and extinction risk within 100 years for most populations in the DPS is estimated to be moderate to high. Most populations within the DPS continue downward trends in estimated abundance, a few sharply so (Ford et al. 2011).

Nooksack Steelhead Diversity - Data are not available to evaluate changes in the diversity of steelhead in the Nooksack River basin. However, it is likely that the degradation and loss of habitat in the watershed, and past harvest practices that disproportionately affected the earliest returning fish, have reduced the diversity of the species relative to historical levels. In a review of Puget Sound steelhead population status, NMFS indicated that genetic diversity for the native winter-run population may have been adversely affected by releases of non-native Chambers Creek steelhead from Kendall Creek Hatchery (Ford et al. 2011). Hatchery fish that are not genetically similar to the native natural population "reduce the fitness of the natural population if they or their progeny spawn naturally and interbreed with the natural population" (70 FR 37204, June 28, 2005). Although there are currently no published genetic data indicating that introgression associated with planting of the non-native stock has occurred (WDFW 2014b) , there is evidence of hatchery fish interbreeding with fish from the local natural population. Recent analyses by WDFW indicate that any effects associated with Kendall Creek Hatchery early winter steelhead production on native Nooksack River steelhead genetic diversity have been unsubstantial (Warheit 2014).

Nooksack Steelhead Spatial Structure - Human developmental activities in the Nooksack River basin have reduced steelhead population spatial structure. Scott and Gill (2008b) reported that the distribution of winter-run steelhead in the basin had been reduced from 1% to 14% (currently 407 miles) from the pre-development distribution of 411 to 474 miles of riverine habitat. Winter-run steelhead spawn throughout the mainstem, South Fork, North Fork, and Middle Fork, as well as in side-channels and the larger tributaries (e.g., Skookum, Kenny, Racehorse, Kendall, Maple, Boulder, Canyon, Cornell, Thompson, and Deadhorse creeks).

Little is known about the South Fork summer-run steelhead population. Their primary spawning habitat is thought to be quite limited and upstream of a partial barrier at RM 25. Summer steelhead also access spawning habitat upstream of RM 30.4 on the South Fork, where there is a flow/velocity barrier to winter-run steelhead migration. Spawning has been observed upstream of Wanlick Creek (RM 34.1) in March.

3.1.2.3 Stillaguamish River

Section 2.2.2 of the Whitehorse Ponds winter steelhead HGMP describes the status of the listed Stillaguamish Chinook salmon and steelhead populations relative to "critical" and "viable" population thresholds.

The population viability goals, where available, were incorporated by WDFW and the Stillaguamish and Tulalip Tribes in planning and guiding the proposed implementation of the Whitehorse Ponds hatchery winter steelhead program (WDFW 2014b). The viability goals would be used as reference points for identifying the status of the listed salmon and steelhead populations during implementation of the hatchery programs. The goals would be used to gauge the program performance and risk reduction objectives specified in the HGMPs, and for determining the need for adjustment of the hatchery actions. General descriptions of how the proposed hatchery program for winter steelhead would be implemented to not reduce the viability status of those listed salmon and steelhead populations are provided in Section 3.1.5 of this document.

Stillaguamish Chinook Salmon

In the Stillaguamish basin, the Technical Recovery Team (TRT) has identified DIPs of Chinook salmon in the North Fork Stillaguamish and South Fork Stillaguamish River (Ruckelshaus et al. 2006). Both Stillaguamish River basin populations are ocean-type Chinook salmon with 98 to 100 percent of juveniles emigrating seaward as sub-yearlings (Stillaguamish Implementation Review Committee [SIRC] 2005; Griffith et al. 2009; Griffith and Van Arman 2010; Scofield and Griffith 2013). A natural stock restoration hatchery program for the North Fork population was initiated in 1986 (Stillaguamish Tribe 2003). The maximum release is 220,000 sub-yearlings from the Whitehorse Hatchery (Stillaguamish Tribe 2003). NMFS (1999a) included Whitehorse Ponds hatchery summer Chinook salmon in the Puget Sound Chinook ESU. This broodstock was founded recently from the natural population inhabiting the same area. There has been ongoing exchange between the hatchery and natural components since the time of founding (NMFS 2003).

Table 14. Stillaguamish Chinook minimum viability spawning abundance, abundance at equilibrium or replacement, and spawning Abundance and Productivity at MSY.

Region and population	**TRT minimum viability abundance**	**Under properly functioning conditions (PFC)**			**NMFS Escapement Thresholds**	
		Equilibrium abundance	Spawners at MSY[1]	Productivity at MSY[1]	Critical[2]	Rebuilding[3]
NF Stillaguamish	17,000	18,000	4,000	3.4	300	552
SF Stillaguamish	15,000	15,000	3,600	3.3	200[4]	300
ESU	**261,300**	**307,500**	**70,948**	**3.2**	**3,875**	**2,785**

Source: Ford 2011; NMFS 2011b in (WDFW 2014b).

[1] Determined by EDT analyses of properly functioning conditions and expressed as a Beverton-Holt function. The TRT minimum viability abundance was the equilibrium abundance or 17,000, whichever was less.

[2] Critical natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000) .

[3] Rebuilding natural-origin escapement thresholds under current habitat and environmental conditions (McElhany et al. 2000; NMFS 2000).

[4] Based on generic VSP guidance (McElhany et al. 2000; NMFS 2000).

Stillaguamish Chinook Salmon Abundance - In the North Fork Stillaguamish River, the total Chinook salmon spawning escapement from 1986 through 2013 ranged from 486 fish (1992) to 1,408 fish (2000); averaging 937 fish. Natural-origin spawners during this period (where estimates are available) ranged from 214 fish (2007) to 1,132 fish (2004); averaging 629 fish. The proportion of hatchery-origin spawners in the total escapement of natural spawners has ranged from 62 percent (2007) to 5 percent (1992). During the most recent five years, the North Fork population has averaged 490 natural-origin spawners (52% of the naturally spawning Chinook) (WDFW and PSTIT 2013; WDFW and PSTIT 2014). The North Fork natural-origin escapement has declined in recent years, despite the ongoing hatchery program (WDFW and PSTIT 2013).

The abundance of South Fork Stillaguamish River basin Chinook salmon is a fraction of historical levels and is at critical status (SSPS 2005d). The total number of spawners has been below 200 adults for nine of the last eleven years (2003 through 2013) and has ranged from 20 (2010) to 353 (2002); averaging 179. During the most recent five years the South Fork population has averaged only 87 naturally spawning Chinook salmon (WDFW and PSTIT 2013; WDFW and PSTIT 2014).

Stillaguamish Chinook Salmon Productivity - The most recent estimates of productivity for the Stillaguamish Basin populations are summarized in Table 15. Both the North and South Fork populations have escapement trends at or slightly below 1 and calculated growth rates, for both recruits and for spawners at or below 1 (Table 15). The inability of the North Fork stock restoration program to rebuild natural abundance is of great concern to resource managers and is caused by poor and likely deteriorating freshwater and estuarine habitat conditions (WDFW and PSTIT 2013).

Table 15. Recent Abundance and productivity trends for the Stillaguamish River Chinook populations. Green, yellow and red highlights indicate increasing, stable and declining trends.

Region	Population	Natural Escapement Trend[1] (1990-2011)	Growth Rate[2] (1990-2008)	
			Return (Recruits)	Escapement (Spawners)
Whidbey Basin	NF Stillaguamish R. (early)	1.01	0.96	1.00
	SF Stillaguamish R[3] (moderately early)	0.95	0.91	0.96

[1] Long-term, reliable data series for natural-origin contribution to escapement are limited in many areas. Escapement trend is calculated based on all spawners (i.e., including both natural origin spawners and hatchery-origin fish spawning naturally) to assess the total number of spawners passed through the fishery to the spawning ground.
[2] Growth rate (λ) is calculated based on natural-origin production assuming the reproductive success of naturally spawning hatchery fish is equivalent to that of natural-origin fish (for populations where information on the fraction of hatchery fish in natural spawning abundance is available) (Abundance and Productivity Tables-Puget Sound TRT database).
[3] Estimate of the fraction of hatchery fish in time series is not available for use in λ calculation, so trend represents that in hatchery-origin + natural-origin spawners.

Stillaguamish Chinook Salmon Diversity - Indices of Diversity have not been developed at the population level (Ford et al. 2011). Age composition of returning Stillaguamish summer Chinook salmon from 1985 to 1991 indicates that the majority of Chinook salmon return at age-4 (PSIT and WDFW 2010a). Age distributions for summer Chinook population are: age-2 (5%), age-3 (32%), age 4 (55%), age-5 (8%), and age-6 (<1%) (Stillaguamish 2007). Adult summer Chinook salmon return to the Stillaguamish River from June through August (Myers et al. 1998). Spawning starts in late-August, peaking in mid-September, and extending into mid-October (Stillaguamish 2007).

A natural stock restoration hatchery program for the North Fork population was initiated in 1986 (Stillaguamish 2007). The maximum release of hatchery fish is 220,000 sub-yearlings from the Whitehorse Hatchery (Stillaguamish 2007). The North Fork natural-origin escapement has declined in recent years, despite the ongoing hatchery program (WDFW and PSTIT 2013) and this fact is of great concern to resource managers. Artificial propagation "is not a substitute for addressing factors responsible for a species decline" (65 FR 56916; September 20, 2000), and this decline is caused by poor and likely deteriorating freshwater and estuarine habitat conditions (WDFW and PSTIT 2013).

In the South Fork Stillaguamish, due to a low effective population size, a decreasing abundance trend, low productivity, straying and potential interbreeding with non-native Chinook salmon and North Fork early Chinook salmon, and degraded freshwater and estuarine habitat conditions the population is at a high risk of extirpation (Stillaguamish 2007), a captive broodstock hatchery program was initiated in 2007 preserve the population until the factors for decline are rectified (WDFW and PSTIT 2013).

Stillaguamish Chinook Salmon Spatial Structure - Indices of Spatial Structure have not been developed at the population level (Ford et al. 2011). Spawning occurs in the mainstem North Fork (RM 0.0 to 34.4), with the highest density of spawning between RM 14.3 and 30.0. The Boulder River and Squire Creek are the two tributaries with the highest density of spawners. Summer Chinook salmon also spawn in French, Deer, and Grant Creeks. For fall Chinook salmon, spawning takes place in the mainstem Stillaguamish River and South Fork Stillaguamish Rivers, and Jim, Pilchuck, and lower Canyon creeks.

Stillaguamish Steelhead

The Stillaguamish Basin includes three steelhead DIPs: Stillaguamish River winter-run; Deer Creek summer-run; and Canyon Creek summer-run (PSSTRT 2013). In addition, there is a non-native summer-run population (Skamania hatchery-origin) which spawns above Granite Falls in the South Fork Stillaguamish River. The South Fork Stillaguamish summer-run population is not part of the DPS. The DPS viability criteria developed by NMFS (Hard et al. 2014), require at least 40 percent of the steelhead populations within each MPG to achieve viability (restored to a low extinction risk). At least 40 percent of each major life history type (e.g., summer-run and winter-run) historically present within each MPG must also be restored to a low extinction risk for the DPS to be considered viable. Interim abundance goals have been developed for the Stillaguamish steelhead populations (Table 16).

Ford (2011) used spawner data collected through 2008 and concluded the following: "Steelhead counts in the Stillaguamish River have declined steadily since the 1980s. The estimated probability that this steelhead population would decline to 10% of its current estimated abundance (i.e., to 37 fish) is high—about 90% within 60 years. With an estimated mean population growth rate of −0.071 (λ = 0.931) and process variance of 0.016, NOAA was highly confident (P < 0.05) that a 90% decline in this population will not occur within the next 15 years, and that a 99% decline will not occur within the next 30 years. However, a 50% decline is highly likely within 100 years. Beyond the next 30−40 years, NOAA was highly uncertain about the precise level of risk."

Table 16. Interim abundance goals for steelhead in the Stillaguamish River Basin.

Population Basin				**Quasi Extinction Threshold**	**Low Abundance**	**Viable**	**Capacity**
Population Name	**Area km^2**	**Mean Elevation (m)**	**Total Stream Length (m)**		**1% SAS**	**5% SAS**	**20% SAS**
Stillaguamish R	1,230	398	927,234	67	1,912	9,559	38,236
Deer Creek	180	761	105,313	31	157	786	3,144
Canyon Creek	100	864	47,716	24	100 (12)	250 (60)	243
Puget DPS Total				1,462	30,449	153,194	613,662

Source: Hard et al. 2014 (WDFW 2014c).

Stillaguamish Steelhead Abundance - Ford (2011) used spawner data collected through 2008 and concluded the following: "Steelhead counts in the Stillaguamish River have declined steadily since the 1980s. The number of natural-origin winter steelhead has increased in the last five years. From a low point in 2008-2009 of 487 fish, the number of natural-origin spawners for the Stillaguamish River winter population increased to average 1,452 for years 2010-2012 (Table 17).Very little data is available on the status of summer-run steelhead in Deer and Canyon Creeks. Based on low juvenile densities, the Deer Creek population was considered to be depressed in 2002, while the status of the Canyon Creek population is currently unknown (SaSI, WDFW).

Table 17. Recent Stillaguamish River Natural Origin Winter Steelhead Escapement 2001-2012.

Year	Index Escapement	Total Escapement
2001	630	2,556
2002	354	1,436
2003	660	2,678
2004	740	3,002
2005	462	1,874
2006	676	2,743
2007	NA	NA
2008	306	1,241
2009	120	487
2010	372	1,509
2011	362	1,469
2012	340	1,379
Average	457	1,852

Source: WDFW 2014c

Table 18. Recent Stillaguamish River Steelhead smolt trap catches.

Year	Natural origin Steelhead[1]	Hatchery Steelhead[1]
2011	416	427
2010	395	321
2009	436	836
2008	248	268
2007	247	30
2006	378	370
2005	NA[2]	NA[2]

Source: Stillaguamish Tribe 2006-2012 (Griffith et al. 2006-2012) (WDFW 2014c)

[1] Steelhead numbers are total season catches on the Stillaguamish Tribe's Smolt Trap.
[2] Prior to 2006, Trapping operations did not separate natural origin and hatchery steelhead.

Stillaguamish Steelhead Productivity - Although information on the DIPs within the Northern Cascades MPG is extremely limited, abundance varies greatly among the populations (Table 19) with the Skagit and Snohomish populations comprising the majority of steelhead in the MPG. Mean growth rates are declining for all populations within the MPG except for the Tolt River, and its abundance is very low. Risk assessment by the PSSTRT indicated three populations are at high risk of extinction and four are at low risk (Table 19). However, more populations are at lower risk in this MPG than the other MPGs in the DPS.

Table 19. Abundance and trend information for DIPs within the Northern Cascades MPG for which information is available. Populations within the action area are bolded.

Population (Run Timing)	**2000 to 2011 Geometric mean Escapement (Spawners)[1,2]**	**1985-2009 Mean Growth Rate in Abundance**	**Extinction Risk (probability of reaching QET within 100 yrs)[4]**
Samish (winter)	703	0.964	Low (30%)
Skagit (summer/winter)	5,095	0.964	Low (10%)
Stillaguamish (winter)	**420**	**0.931**	**High (90%)**
Snohomish/Skykomish (winter)	1,684	0.976[5]	Low (40%)
Tolt (summer)	92	0.961	High (80%)
Pilchuck (winter)	535	[5]	Low (40%)
Snoqualmie (winter)	995	[5]	High (70%)

[1] Source: A. Marshall for Samish, Skagit, and Stillaguamish populations.
[2] Source: WDFW escapement database for Snohomish/Skykomish, Tolt, Pilchuck, and Snoqualmie DIPs (no data available for N.F. Skykomish).
[3] Source: (Ford et al. 2011).
[4] Source: (Hard et al. 2014)
[5] Overall estimate for Snohomish system winter-run steelhead including Skykomish/Snohomish, Pilchuck, and Snoqualmie DIPs.

Stillaguamish Steelhead Diversity and Spatial Structure - No new estimates of spatial structure and diversity of Puget Sound steelhead have been made available since the 2007 review. Loss of diversity and spatial structure were judged to be “moderate” risk factors due to reduced complexity and diminishing connectivity among populations, interbreeding with non-native hatchery programs and the low numbers of summer steelhead populations in the Puget Sound DPS (Hard et al. 2007). Although there are currently no published genetic data indicating that introgression associated with planting of early winter steelhead produced by the Whitehorse Ponds program has occurred (WDFW 2014c), the concern exists because hatchery and natural-origin fish are interbreeding. Recent analyses by WDFW indicate that any effects associated with Whitehorse Ponds early winter steelhead production on native Stillaguamish River steelhead genetic diversity have been unsubstantial (Warheit 2014).

Because these three HGMPs, considered here as an RMP, apply VSP criteria that are incorporated, as standards and indicators for program effects, into the monitoring objectives, it is consistent with this 4(d) rule criterion.

3.1.3 5(i)(C) Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities.

Broodstock collection actions proposed for the three programs reflect appropriate priorities to safeguard ESA-listed fish populations. No natural-origin, ESA-listed fish are collected as broodstock for these programs. All broodstock used by the programs would be early winter steelhead, localized to the hatchery release sites, that are not listed under the ESA and are not part of the Puget Sound steelhead DPS.

The HGMPs describe measures that are applied to safeguard the health and abundance of listed salmon and steelhead in the Dungeness, Nooksack, and Stillaguamish Rivers that may be affected incidentally by broodstock collection activities associated with the proposed winter steelhead hatchery programs.

3.1.4 5(i)(D) The HGMP includes protocols to address fish health, broodstock collection, broodstock spawning, rearing and release of juveniles, deposition of hatchery adults, and catastrophic risk management.

The HGMPs for the three winter steelhead programs include detailed descriptions of protocols and operational element related to this criterion. This criterion is primarily focused on the adequacy of HGMPs for programs that utilize ESA-listed fish in the hatchery program and the need to operate the program in a manner that adequately safeguards listed fish while under propagation. The proposed isolated hatchery winter steelhead programs do not include the spawning, rearing, or acclimation and release of ESA-listed steelhead. Additionally, the issue of catastrophic risk management, focused on the risk to ESA-listed fish while under propagation, is not included in the HGMPs, except as related to safeguarding non-listed program fish. Below are the elements where the proposed program HGMPs identify protocols or "best management practices" (BMP) to address potential incidental effects on ESA-listed fish relating to: Fish Health, Broodstock collection, Release of juveniles, and disposition of hatchery adults.

Fish Health

BMPs addressing fish health, including fish health maintenance and hatchery sanitation procedures applied during broodstock collection, mating, fish incubation, rearing, and release, are detailed in performance standard and indicator, adult management, and fish rearing and release sections of each HGMP. Fish health monitoring and evaluation measures are also described in those HGMP sections.

The hatchery programs would be operated in compliance with "Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State" protocols (NWIFC and WDFW 2006). The co-manager policy delineates Fish Health Management Zones and defines inter and intra-zone transfer policies and guidelines for eggs and fish that are designed to limit the spread of fish disease pathogens between and within watersheds (NWIFC and WDFW 2006). They would also comply with standard fish health diagnosis, maintenance and hatchery sanitation practices referenced in the policy (as per PNFHPC (1989) and AFS (1994)AFS (1994) guidelines) to reduce the risks of fish disease pathogen amplification and transfer within the hatchery and to fish in the natural environment. For all of the steelhead hatchery programs, fish health specialists and pathologists from the WDFW Fish Health Section would provide fish health management support and diagnostic fish health services (WDFW 2014a; WDFW 2014b; WDFW 2014c).

BMPs for monitoring the health of fish in hatcheries specified in the co-managers' fish health policy (NWIFC and WDFW 2006) help reduce the likelihood of fish disease pathogen transmission from hatchery salmonids to naturally produced fish. When implemented, these BMPs would help contain any fish disease outbreaks in the hatcheries, minimizing the release of diseased fish from the hatcheries, and reducing the risks of fish disease pathogen transfer and amplification to natural-origin fish (NMFS 2012).

Broodstock Collection

Sections 6 and 7 of the HGMPs describe BMPs for broodstock selection and collection, carrying forth steelhead production goals and objectives for the hatchery programs, and addressing adult fish capture, transport, holding, and handling practices.

Steelhead collected for use as hatchery broodstock are adult early winter-run, hatchery-origin fish returning to the Dungeness River Hatchery, Kendall Creek Hatchery, and Whitehorse Ponds Hatchery. There are no broodstock collected that are part of the Puget Sound Steelhead DPS. All winter steelhead collected for broodstock are from the extant, non-listed, early winter hatchery steelhead stock. The proposed WDFW hatchery programs function to produce early winter hatchery fish for fishing. All broodstock voluntarily enter hatchery traps during a time period (December through March) when other listed species, Chinook salmon and summer chum salmon (Dungeness R.) are not typically present. The adult traps associated with the three proposed programs are located in adjacent locations to the primary rivers where they operate, requiring fish to volitionally recruit into them. ESA-listed Puget Sound steelhead may be incidentally trapped during broodstock collection activities.

At the Dungeness Hatchery, WDFW (2014a) indicates that an average of four adult natural-origin steelhead, between the years 2006-2012, have been inadvertently trapped, handled, and released during program operations, with no observed trap related injury or mortality. The Kendall Creek and Whitehorse Pond HGMPS (WDFW 2014b; 2014c), respectively, indicate that there has been no natural-origin steelhead observed in the traps, during program operations, over that last 12 years. Operational protocols are in place to return natural-origin fish back to the stream system as quickly as possible when and where encounters inadvertently occur.

Release of Juveniles

BMPs for hatchery steelhead rearing and release are described in sections 9 and 10 of the HGMPs. Rearing and release practices proposed for implementation would help ensure that hatchery fish releases are healthy seawater-ready smolts that emigrate downstream rapidly after release, leading to high juvenile fish survival rates to adult return. Potential effects of ecological interactions between newly released hatchery-origin steelhead and natural-origin salmon and steelhead in the action area are described in the Section 2.0 of the HGMPs.

Reducing the risk of adverse ecological effects on natural-origin salmon and steelhead from the release of juvenile hatchery steelhead is an important objective. Post-release interactions of concern include competition between hatchery-origin steelhead and natural-origin salmon and steelhead for food and space, and hatchery fish predation on natural-origin fish. See section 3.1.5 for the specific BMPs proposed to minimize the risk of competition and predation in the Dungeness, Nooksack, and Stillaguamish watersheds. These BMPs also promote high juvenile hatchery fish to adult return survival rates consistent with meeting proposed program harvest augmentation objectives.

Disposition of Hatchery Adults

Protocols for the disposition of adult hatchery steelhead are described in section 7.5 of the HGMPs. Weirs and traps at the hatcheries would remain open for the entire early winter steelhead migration period (November through March). This measure would be implemented to maximize removal of early winter adult steelhead and thus minimize the number of hatchery-origin fish that escape to spawn naturally. Fish collected above broodstock needs (surplus) would be removed from the system; no recycling of adult early winter steelhead trapped at the hatcheries back into the natural environment occurs. If available, food-grade surplus fish may be donated to approved charitable organizations and local tribes for ceremonial and subsistence purposes. Nonfood-grade carcasses would be distributed in local streams for nutrient enhancement, if approved by the Fish Health Specialist.

3.1.5 5(i)(E) The HGMP evaluates, minimizes, and accounts for the propagation programs' genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by straying of hatchery fish.

The three early winter steelhead HGMPs provide evaluations of genetic and ecological effects on listed Chinook salmon, summer chum salmon, and steelhead in section 2.0. Additionally, each HGMP includes risk minimization measures (in Sections 6-10) that would reduce the risks of adverse disease transfer, competition, predation, and genetic introgression effects. What follows is a summary of the effects of the three hatchery programs, relating to genetic and ecological effects, as well as the proposed risk minimization measures.

Genetic Effects

Because hatchery steelhead cannot interbreed with the ESA-listed Chinook and summer chum salmon species, there would be no genetic effects on these species in the Dungeness, Nooksack, and Stillaguamish River basins. The ESA-listed steelhead populations in these basins, however, may be adversely effected depending on the level of gene flow between hatchery and natural-origin fish and on the risk level for the natural population's viability parameters, in particular diversity, productivity, and abundance. Adult hatchery steelhead returning to freshwater streams, unless harvested or removed by some other means, may spawn naturally and thus contribute genetically to the next generation of natural-origin fish. Potential genetic risks to listed steelhead populations, which may be associated with Dungeness River Hatchery, Kendall Creek Hatchery, and Whitehorse Ponds hatchery winter steelhead HGMP implementation are: loss of within-population diversity, outbreeding effects, and hatchery-influenced selection ("domestication") (NMFS 2012).

Loss of Within-Population Diversity

Loss of within-population genetic diversity (variability) is defined as the reduction in quantity, variety and combinations of alleles in a population (Busack and Currens 1995). Quantity is defined as the proportion of an allele in the population and variety is the number of different kinds of alleles in the population. Genetic diversity within a population can change from random genetic drift and from inbreeding. Random genetic drift occurs because the progeny of one generation represents a sample of the quantity and variety of alleles in the parent population. Since the next generation is not an exact copy of the parent generation, rare alleles can be lost, especially in small populations where a rare allele is less likely to be represented in the next generation (Busack and Currens 1995).

The hatchery programs under consideration produce steelhead that are not included as part of the ESA-listed Puget Sound steelhead DPS (Jones 2011). Adult fish produced are not intended to spawn naturally nor contribute to the viability of any Puget Sound steelhead population as part of an integrated recovery effort. Only early winter steelhead produced by the programs (identified by early return timing and presence of an adipose fin clip mark) will be used as broodstock, and no natural-origin steelhead will be collected and spawned.

Within-population diversity of the natural steelhead populations may be affected by hatchery-origin fish, from the proposed programs, spawning with natural-origin steelhead. Effective size changes are generally a concern only when the relative abundance of hatchery-origin fish on the spawning grounds far exceeds that of natural-origin fish. Risk to the within-population diversity of natural steelhead populations is much more of a concern in integrated programs than in isolated programs such as those in the Proposed Action. Within-population diversity is influenced strongly by the effective size of the population. Population effective size could either increase or decrease from hatchery-origin fish spawning in the wild, depending on the effective number of breeders that produced the hatchery-origin and natural-origin fish, the relative spawning success of the hatchery-origin and natural-origin fish, and the background level of diversity in the natural-origin and hatchery-origin fish. As with the genetic risk of outbreeding depression and hatchery-influenced selection (described below), risks posed to within-population diversity of natural populations of steelhead are further mitigated through measures that reduce the number of naturally spawning hatchery-origin fish, in general, and in particularly those fish that would overlap spatially and temporally with natural-origin spawners (See *Risk minimization of genetic effects* below).

Outbreeding Depression and Hatchery-Influenced Selection

Gene flow from early winter steelhead hatchery fish into natural populations could have effects due to outbreeding depression and to hatchery-influenced selection. The relative contribution of the two types of effects cannot be determined, but the expected effect is the same: reduction in fitness. Additionally, the measure to reduce both types of risk is the same, minimizing gene flow opportunities.

As reviewed in NMFS (2012), outbreeding depression is a loss in fitness after interbreeding with another population. Outbreeding depression can be a simple loss of adaptation caused by changes in allele frequency or by the introduction of new alleles. It can also result in the disruption of co-adapted gene complexes. Outbreeding depression is a concern whenever the hatchery-origin and natural-origin fish are from different populations. This is the case with the proposed, early winter hatchery steelhead and the natural steelhead populations in the basins of operation. The early winter hatchery steelhead are considered so diverged genetically from natural steelhead that they are not considered part of any steelhead DPS (NMFS 2003). The basis of this is the fact that they have been subjected to many years of intense artificial selection for early smolting, which has resulted not only in smolting predominantly at one year of age, but also earlier spawning time (Crawford 1979).

Hatchery-influenced selection (commonly called “domestication”) results in fitness loss and phenotypic change caused by differences between the hatchery and natural environments (includes intentional selection and relaxation of selection), and sampling “errors” during fish culture (includes advertent or inadvertent selection of traits for fish under propagation). Hatchery-induced selection may lead to changes in quantity, variety, and the combination of alleles between a hatchery population and its source population that are the result of selection in the hatchery environment (Busack and Currens 1995). This hazard is also defined as the selection for traits that favor survival in a hatchery environment and that reduce survival in natural environments NMFS (2012). The concern is that hatchery-induced selection effects will decrease the performance of hatchery fish and their descendants when exposed to natural selection conditions in the wild.

For both effects, risks to natural-origin steelhead populations are controlled by measures that reduce the number of naturally spawning hatchery-origin fish, in general, and in particularly those fish that would overlap spatially and temporally with natural-origin spawners. Genetic effect analyses included with the HGMPs indicate that adult early winter steelhead produced by the programs, as previously implemented, have contributed very few fish to the associated naturally spawning populations in the watersheds where the fish are released (Hoffmann 2014; Warheit 2014). Specifically, for these three proposed programs, the two analyses indicate that gene flow from early winter hatchery steelhead to native steelhead populations is under 2% in all the natural-origin steelhead populations affected by the programs. As indicated in Warheit (2014), the Ford (2002) model was used to evaluate the hatchery-influenced selection risk of early winter isolated steelhead programs, and concluded that isolated hatchery programs posed less risk than integrated native-stock programs at pHOS levels below 2%, but greater risk at levels above 2% (Scott and Gill 2008a). WDFW’s statewide steelhead management plan states that segregated programs will result in average gene flow levels of less than 2% (WDFW 2008). Based on the present level of empirical and theoretical information currently available on the subject, WDFW concludes that gene flow levels of 2% from early winter steelhead into the associated natural-origin populations would not pose unacceptable risks to fitness (WDFW 2008). Cumulatively, in compliance with this criterion, these findings indicate the proposed early winter steelhead programs would not pose fitness risks through gene flow to listed Dungeness, Nooksack, or Stillaguamish river steelhead populations that would impair the survival or recovery of these populations.

Risk minimization of Potential Genetic Effects

The HGMPs address genetic effects posed by the continued operation of these programs, in Sections 1.10.2, 2.2.3, 6.3, 7.9, and 11.1.1. The plans propose a series of general operational elements to minimize the likelihood of non-harvested adult hatchery steelhead interacting reproductively with natural-origin listed steelhead in the Dungeness, Nooksack, or Stillaguamish River basins. These include:

- All eggs are collected from broodstock returning to each of the individual hatchery facilities to promote fidelity of homing to the hatchery.
- All eggs are taken from hatchery fish returning to the facilities prior to January 31, of each year, to promote and maintain a temporal separation in the spawn-timing of hatchery and natural origin fish.
- To reduce the potential number of non-harvested, returning adult steelhead remaining in the rivers, all hatchery traps now remains open through March 31 to provide opportunity for all adult hatchery fish to return to the hatchery for removal.

The HGMPs also describe proposed protocols for minimizing the number and rate of program smolts released that fail to emigrate from the system and potentially “residualize” in the rivers, presenting not only risks of competition and predation (addressed below, Ecological Effects) but an additional, although minimal, vector for interbreeding with natural listed populations of steelhead. See BMPs applied in the Competition and Predation sections below.

Measuring and Monitoring for Genetic Effects

The HGMPs propose to measure and monitor for genetic effects from the proposed hatchery steelhead programs. This involves estimating the level of genetic introgression or “gene flow” from the hatchery steelhead population into the natural listed steelhead populations, in each of the basins where these fish are proposed for release. WDFW refers to this as proportionate effective hatchery contribution or PEHC. WDFW has proposed to manage their isolated steelhead programs to minimize PEHC to no more than a 2% rate. They propose several methods (Hoffmann 2014; Warheit 2014) to estimate these gene flow rates, and validate whether gene flow remains under 2%. This will be accomplished by a significant, annual sampling effort to obtain thorough and representative tissue samples from both juvenile and adult wild steelhead in each of the basins (Anderson et al. 2014a) (Table 20).

Table 20. Genetic sampling plans for Nooksack, Stillaguamish, and Dungeness steelhead

Basin	Sample site	Life stage	N	Population(s) sampled
Nooksack	Mainstem Nooksack R.	Smolts	≤ 100 annually	Nooksack (W) and (S)
	SF Nooksack R.	Adults	≤ 50 every third year	SF Nooksack (S)
Stillaguamish	Mainstem Stillaguamish R.	Smolts	≤ 100 annually	Stillaguamish (W), Canyon Cr. (S), Deer Cr. (S)
	Deer Cr.	Adults	≤ 50 every third year	Deer Cr. (S)
Dungeness	Mainstem Dungeness R.	Smolts	≤ 100 annually	Dungeness (S/W)

Ecological Effects

As called for under this criterion, the ecological effects resulting from implementation of the HGMPs are also evaluated, minimized (through application of operational practices), and accounted for in the HGMPs (section 2.0 in WDFW 2014a; 2014b; 2014c). Ecological effects of concern include fish disease pathogen transfer, resource competition, and predation effects on listed Chinook salmon, summer chum salmon, and steelhead that may result from implementation of the three steelhead HGMPs.

Disease

The three HGMPs address general threats from disease transfer in section 2.0 of each plan. Fish disease transfer and amplification risk reduction measures are more specifically addressed for broodstock selection and collection actions in sections 6.0 and 7.0; incubation and rearing actions in section 9; and for fish release actions in section 10.0. Within these sections, the plans describe fish disease pathogen issues of concern and actions that would be implemented to minimize risks of fish disease pathogen transfer and amplification. As noted in the plans, all hatchery actions would be implemented in accordance with the “Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State (NWIFC and WDFW 2006). Protocols described in the policy and applied through the programs would help reduce risks of fish disease to propagated and natural fish populations through regular fish health monitoring and reporting, and application of best management practice measures to reduce fish health risks. The health of steelhead under propagation would be monitored and managed consistent with fish health policy practices. Under the fish health plan, professional fish pathologists from the WDFW Fish Health Section would visit the hatchery rearing locations monthly, or as needed to perform routine monitoring of adult and juvenile fish, advise hatchery staff on disease findings, and recommend disease treatments when appropriate. All fish monitored for fish health assessment purposes would be sampled consistent with co-manager policy, and procedures referenced in the policy, to minimize the proportion of the total rearing population exposed to handling and non-lethal and lethal sampling. In addition, all WDFW hatchery personnel are trained in standard fish propagation and fish health maintenance methods to help ensure that fish under propagation are adequately protected from catastrophic loss due to poor hatchery practices, adverse water quality conditions, or fish health issues associate with poor water quality or inadequate water quantity.

Competition

Release of hatchery–origin species into a listed species' habitat, or where they may access the habitat of listed species, may harm listed species and therefore constitutes a "take" under the ESA (NMFS 1999b). Among the mechanisms of potential harm is competition (Tatara and Berejikian 2012). Competition occurs when the demand for a resource by two or more organisms exceeds the available supply. If the resource in question (e.g., food or space) is present in such abundance that it is not limiting, then competition is not occurring, even if both species are using the same resource. Adverse impacts of competition may result from direct interactions, whereby a hatchery-origin fish interferes with the accessibility to limited resources by naturally produced fish, or through indirect means, as when utilization of a limited resource by hatchery fish reduces the amount available for naturally produced fish (SIWG 1984). Specific hazards associated with adverse competitive impacts of hatchery salmonids on listed naturally produced salmonids may include food resource competition, competition for juvenile rearing sites, and, to a lesser extent, competition for spawning sites NMFS (2012). For these competition risks between fish origins or fish species to occur, substantial levels of spatial and temporal overlap, and limited resources shared by the fish must exist (Tatara and Berejikian 2012). The relative sizes of juvenile hatchery early winter steelhead and natural-origin salmon and steelhead (and size-determined diet preference differences) and their relative densities in migration reaches, would also determine competition risks in freshwater areas where the groups overlap spatially and temporally.

The co-managers have included hatchery BMPs in the proposed HGMPs designed to avoid or reduce competition in freshwater between fish from natural populations and hatchery-origin steelhead:

- All hatchery steelhead produced by the programs for release in the action area watersheds would be released as seawater-ready smolts as a measure to foster rapid emigration seaward. This expected to reduce the duration of interaction with natural-origin steelhead and salmon that are at a life stage vulnerable to competition for food or space.
- Fish Size: Release groups will meet the minimum size criteria of 10 fpp established by Tipping (2001) in (WDFW 2014a; WDFW 2014b; WDFW 2014c).
- Hatchery- and natural-origin juvenile steelhead and salmon emigration timing and abundance would be monitored each year through operation of WDFW and tribal juvenile outmigrant trapping programs to evaluate the potential for harmful ecological interactions. Alternate hatchery steelhead release timings or other mitigation measures would be developed to avoid or limit such interactions.
- All hatchery-origin steelhead released from Kendall Creek Hatchery and Whitehorse Ponds Hatchery would be released volitionally, as migration-ready smolts that would move downstream rapidly to the estuary where they would disperse seaward, thus minimizing the potential for residualization. Dungeness River Hatchery early winter steelhead would be forced released, but juvenile out-migrant trapping data, in the Dungeness River, have

indicated most of the hatchery fish leave freshwater for the estuary in under 14 days (Topping et al. 2006, Topping and Kishimoto 2008, Topping et al. 2008). Any non-migrating steelhead, at the Kendall Creek and Whitehorse Ponds hatcheries, would be planted into landlocked lakes to enhance recreational fishing opportunities.

Predation

Risks to naturally produced salmon and steelhead attributable to direct predation (direct consumption) or indirect predation (increases in predation by other predator species due to enhanced attraction) can result from hatchery salmonid releases NMFS (2012). Hatchery-origin fish may prey upon juvenile naturally produced salmonids at several stages of their life history. Newly released hatchery steelhead smolts have the potential to consume naturally produced fry and fingerlings that are encountered in freshwater during downstream migration. Hatchery smolts that do not emigrate and instead take up stream residence near the point of release (residuals) have the potential to prey on rearing natural-origin juvenile fish over a more prolonged period. In general, naturally produced salmonid populations will be most vulnerable to predation when naturally produced populations are depressed and predator abundance is high, in small streams, where migration distances are long, and when environmental conditions favor high visibility NMFS (2012).

Hatchery-origin steelhead smolt predation on natural-origin juvenile fish is dependent upon three factors: 1) the hatchery fish and their potential natural-origin prey must overlap temporally; 2) the hatchery fish and their prey must overlap spatially; and, 3) the prey should be less than 1/3 the length of the predatory fish NMFS (2012).

The proposed WDFW steelhead hatchery programs would reduce temporal and spatial overlap and the potential for predation on listed juvenile salmon and steelhead through application of the following measures:

- All hatchery steelhead produced by the programs for release in the action area watersheds would be released as seawater-ready smolts as a measure to foster rapid emigration seaward. This expected to reduce the duration of interaction with natural-origin steelhead and salmon that are at a life stage vulnerable to competition for food or space.
- Fish Size: Release groups will meet the minimum size criteria of 10 fpp established by Tipping (2001) in (WDFW 2014a; WDFW 2014b; WDFW 2014c).
- Hatchery- and natural-origin juvenile steelhead and salmon emigration timing and abundance would be monitored each year through operation of WDFW and tribal juvenile outmigrant trapping programs to evaluate the potential for harmful ecological interactions. Alternate hatchery steelhead release timings or other mitigation measures would be developed to avoid or limit such interactions.
- All hatchery-origin steelhead released from Kendall Creek Hatchery and Whitehorse Ponds Hatchery would be released volitionally, as migration-ready smolts that would move downstream rapidly to the estuary where they would disperse seaward, thus minimizing the

potential for residualization. Dungeness River Hatchery early winter steelhead would be forced released, but juvenile out-migrant trapping data, in the Dungeness River, have indicated most of the hatchery fish leave freshwater for the estuary in under 14 days (Topping et al. 2006; Topping and Kishimoto 2008; Topping et al. 2008.). Any non-migrating steelhead, at the Kendall Creek and Whitehorse Ponds hatcheries, would be planted into landlocked lakes to enhance recreational fishing opportunities.

3.1.6 5(i)(F) The HGMP describes interrelationships and interdependencies with fisheries management.

The three HGMPs describe the relationship of the proposed actions with fisheries management in section 3.0 of each plan. The HGMPs indicate that all WDFW-managed hatchery programs in the Puget Sound region, including the three proposed programs, would operate consistent with the *U.S.* v. *Washington* (1974) fisheries management framework. This legal framework sets forth required measures for coordinating State and tribal implementation of agreed hatchery programs, defining artificial production objectives, and maintaining treaty-fishing rights through the court-ordered Puget Sound Salmon Management Plan (PSSMP 1985). This fisheries resource co-management process requires that both the State of Washington and the Puget Sound Tribes develop salmon hatchery program goals and objectives, and reach agreement on the function, purpose, and fish production strategies for all Puget Sound hatchery programs.

The NMFS evaluation and authorization for 'take' of ESA-listed steelhead, associated with fisheries in the Nooksack, Stillaguamish and Dungeness rivers is described in (NMFS 2014).

3.1.7 5(i)(G) Adequate artificial propagation facilities exist to properly rear progeny of naturally spawned broodstock, to maintain population health and diversity, and to avoid hatchery-influenced selection and domestication.

The criteria under limit 5 of the 4(d) Rule was intended to address programs that include ESA-listed fish and therefore do not apply to the proposed hatchery programs. The three hatchery programs rear steelhead that are not included in the ESA-listed Puget Sound steelhead DPS (Jones 2011).

3.1.8 5(i)(H) Adequate monitoring and evaluation exist to detect and evaluate the success of the hatchery program and any risks potentially impairing the recovery of the listed ESU.

Adequate monitoring and evaluation actions are proposed in the three HGMPs to evaluate the performance of each program in meeting program implementation requirements and performance objectives, including verification of the effects on ESA-listed species (Anderson et al. 2014b). These actions are summarized in Section 1.10, and are further described in Section 11.0 of each HGMP (“Monitoring and Evaluation of Performance Indicators”) and in Anderson et al. (2014b).

Included in section 1.10 are descriptions of monitoring and evaluation measures that would be implemented to assess hatchery program performance indicators.

In addition to the monitoring and evaluation proposed within the HGMPs, the WDFW and Puget Sound Tribal staffs engage in annual monitoring activities (approved through separate ESA authorizations) directed at the status of listed Chinook salmon, summer chum salmon (Dungeness R.), and steelhead would occur in each of the affected watersheds. These include:

- Annual surveys to census steelhead spawning abundance, count redds, and sample carcasses to identify fish origin in natural spawning areas, adult fish abundance, and distribution.
- Annual scale sampling of returning adult fish and fish carcasses for age composition analysis.
- Annual operation of a downstream juvenile outmigrant traps in the mainstem Dungeness, Nooksack, and Stillaguamish rivers that would provide annual estimates of natural-origin smolt production and emigration rates for hatchery-origin fish, and for assessment of the natural spawning success of the steelhead populations.
- Collection of adult steelhead return abundance, timing, sex ratio, mark status, disposition, holding mortality, and fish health condition data at all hatchery facilities to monitor the effects of the programs.
- Juvenile outmigrant trapping programs and carcass sampling in natural spawning areas would provide sources of tissue samples that would be analyzed to determine gene flow levels between early winter steelhead and associated natural-origin populations. Within the Dungeness River watershed, adult genetic samples would be collected opportunistically and analyzed to compare the number of hybrid and hatchery-ancestry fish observed from smolt sampling. Within the Nooksack River watershed, genetic sampling of adults, would occur. Within the Stillaguamish River watershed, adult genetic sampling would be conducted in the Deer Creek and Canyon Creek subbasins on a rotating basis every three years.

The proposed monitoring and evaluation of hatchery implementation requirements (e.g., maximum smolt release levels), hatchery performance and the verification of hatchery effects on ESA-listed species, along with annual, natural population status and trends monitoring, will enable the co-managers to detect and evaluate the success of the proposed programs as well as deleterious effects of the programs on the listed species.

3.1.9 5(i)(I) The HGMP provides for evaluating monitoring data and making any revisions of assumptions, management strategies, or objectives that data show are needed.

The HGMPs provide for regular monitoring and reporting and adaptive management. This is a key provision in the HGMPs – a requirement to ensure the implementation of BMPs, to monitor and evaluate performance, and to adjust the hatchery programs accordingly. Each of the three proposed HGMPs identify objectives and actions needed to determine hatchery program performance in meeting stated production objectives for the specific species that are the focus of each HGMP (HGMP sections 1.10), and effects on non-target natural-origin fish populations in the Dungeness, Nooksack, and Stillaguamish River watersheds. In compliance with this 4(d) Rule criterion, the HGMPs would apply adaptive management and risk management approaches in their implementation of hatchery actions.

Under the HGMPs, data collected relating to hatchery program performance and effects would be evaluated by WDFW and the Jamestown S'Klallam, Lummi, Nooksack, and Stillaguamish Tribes to determine whether the three steelhead programs were meeting their respective objectives. As identified in Sections 1.10 and 11 of the HGMPs, monitoring and evaluation results would be used to determine whether performance standards addressing program benefits and risks (performance and effects) were met. The co-managers indicate in the HGMPs that funding and staff resources would be committed to monitor and evaluate the programs through review by the WDFW Fish Program and Jamestown S'Klallam, Lummi, Nooksack, and Stillaguamish tribal technical staffs.

3.1.10 5(i)(J) NMFS provides written concurrence of the HGMP which specifies the implementation and reporting requirements.

After completion of the public review and comment period for this proposed evaluation and pending determination document, NMFS will consider the comments it received and determine whether implementation of the HGMPs would ether appreciably reduce the likelihood of survival and recovery of the ESA-listed species, and whether the HGMPs address all of the criteria specified in limit 6 of the 4(d) Rule.

3.1.11 5(i)(K) The HGMP is consistent with plans and conditions set within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

These HGMPs were developed by WDFW and the Jamestown S'Klallam, Lummi Nation, Nooksack, Stillaguamish, and Tulalip Tribes pursuant to the *United States v. Washington* (1974) fisheries and hatchery management framework.

There are no other plans or conditions set within Federal court proceedings, including memorandums of understanding, court orders or other management plans, that direct operation of the proposed steelhead hatchery programs.

4 NOTICE OF PENDING RECOMMENDATION

As required by limit 6 of the 4(d) Rule, the Secretary is seeking comment from the public on the pending determination as to whether or not the HGMPs would appreciably reduce the likelihood of survival and recovery of ESA-listed species. As required in (6)(iv) of section 223.203 of the 4(d) Rule for salmon and steelhead, the Secretary will publish notice of the determination together with a discussion of the biological analysis underlying that determination.

5 PENDING DETERMINATION

NMFS has reviewed three HGMPs provided by WDFW, the Jamestown S'Klallam, Lummi Nation, Nooksack, Stillaguamish, and Tulalip Tribes, pursuant to limit 6 of the 4(d) Rule, and evaluated them together against the requirements of the 4(d) Rule. Based on this review and evaluation, NMFS' pending determination, subject to information provided during public comment, is that activities implemented as described in the three plans would not appreciably reduce the likelihood of survival and recovery of ESA-listed Puget Sound Chinook salmon, Hood Canal summer chum salmon, or Puget Sound steelhead.

6 REEVALUATION CRITERIA

NMFS will reevaluate this determination if: (1) the actions described by the HGMPs are modified in a way that causes an effect on the listed species that was not previously considered in NMFS' evaluation; (2) new information or monitoring reveals effects that may affect listed species in a way not previously considered; or (3) a new species is listed or critical habitat is designated that may affect NMFS' evaluation of the HGMPs.

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