HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Photo: Courtesy of hatchery staff

Hatchery Program:	Kendall Creek Winter Steelhead Hatchery Program (Segregated)
Species or Hatchery Stock:	Winter Steelhead (*Oncorhynchus mykiss*) Early Winter Stock
Agency/Operator:	Washington Department of Fish & Wildlife
Watershed and Region:	North Fork Nooksack River, Puget Sound
Date Submitted:	July 28, 2014
Date Last Updated:	July 26, 2014

Executive Summary

ESA Permit Status:
On March 31, 2004, the Washington Department of Fish and Wildlife (WDFW) submitted a Hatchery Genetic Management Plan (HGMP) for the Kendall Creek Hatchery early winter steelhead program as part of a joint state/tribal hatchery resource plan for consideration under the 4(d) rule. In a letter from NOAA Fisheries dated August 4, 2004, the co-managers were informed that NOAA Fisheries anticipated completing a draft Environmental Impact Statement (EIS) by the summer of 2005. NOAA noted that "A final EIS may then be completed by winter 2005-2006, after which time NOAA Fisheries will release ESA 4(d) Rule determinations for the hatchery plans." The letter concluded by stating that "Your work on these hatchery plans is important, and will substantially contribute to on-going salmon recovery efforts within the region." The WDFW provided updated HGMPs to NOAA Fisheries in August 2005.

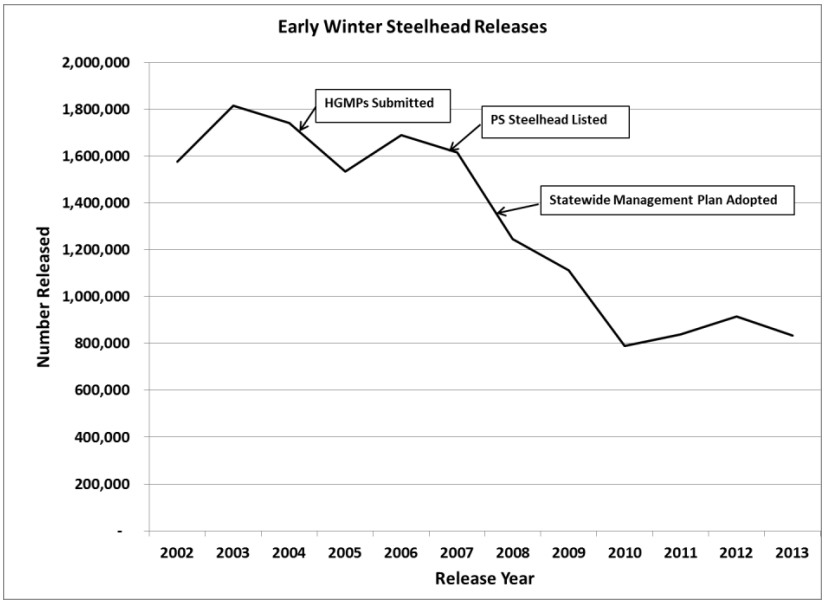
The WDFW is now re-submitting a co-manager agreed HGMP for the Nooksack Basin hatchery early winter steelhead program to further update the description of the program and incorporate new information and analyses.

The Puget Sound steelhead Distinct Population Segment (DPS) is listed as "Threatened" under the ESA, however, Nooksack basin hatchery early winter steelhead are not included in the ESA-listing. The Puget Sound Technical Recovery Team has preliminarily delineated one Demographically Independent Population of native winter steelhead (Nooksack River Winter) and one native summer population (SF Nooksack Summer) in the Nooksack basin.

Early Winter Steelhead - Additional Risk Reduction Measures:
The co-managers have implemented substantial additional risk reduction measures for early winter hatchery steelhead programs since the HGMPs were first submitted in 2004. The risk reduction measures were developed around the principles and recommendations of the co-managers' Resource Management Plans.

Across the Puget Sound Distinct Population Segment (DPS), these risk reduction measures include:

- >50% reduction in hatchery releases of early winter steelhead;
- >65% reduction in release locations;
- Elimination of cross-basin transfers, off-station releases, adult recycling, and fry releases into anadromous waters;
- Volitional smolt releases to minimize natural origin fish interactions;
- Hatchery broodstock collection by January 31st to enhance separation between hatchery and natural origin fish;
- Establishment of a network of wild stock gene banks; and
- Genetic monitoring of hatchery strays to natural spawning areas.



The developments of new genetic analysis techniques since July 2013 has provided significant new information to evaluate and, as necessary, modify hatchery programs.

Nooksack Basin Hatchery Early Winter Steelhead Program:
The purpose of the program is to produce Nooksack basin early winter steelhead for sustainable recreational and tribal fisheries. Program fish will be produced at the Kendall Creek Hatchery, located on Kendall Creek, a tributary to the North Fork Nooksack River. The program will release 150,000 yearling smolts into the Nooksack basin annually.

The early winter hatchery programs in the Nooksack River basin are designed to take into account potential risks of artificial propagation on listed species while still providing for some harvest by treaty tribes and recreational fisheries. Efforts to minimize potential risks of artificial propagation are described below. Likewise, to protect against overutilization of natural origin steelhead whose abundances have declined from historical levels, the NMFS Biological Opinion established a 4.2% harvest limit of the aggregate average harvest rate of natural origin steelhead in five basins: Skagit River, Snohomish River, Green River, Puyallup River, and Nisqually River. The factors driving the declining abundance of natural origin steelhead, however, have not been similarly restricted, including: 1) the present and increasing threat of destruction, modification and curtailment of natural origin steelhead freshwater, estuarine, and marine habitat; 2) predation and potentially disease, and 3) the inadequate existing regulatory mechanisms to protect natural origin steelhead habitat. The current harvest restriction severely limits the opportunities for both treaty and non-treaty fisheries on natural origin steelhead. The lack of adequate habitat protection and restoration places an unacceptable disparate burden on hatchery programs, the exercise of the tribes' treaty-secured rights, limits recreational fishing opportunities, and fails to conserve steelhead. The potential risks of this hatchery program are minimal compared to the risks of failed steelhead habitat protection and restoration measures.

The program will be operated as a "segregated" program with the intent for the hatchery population to represent a distinct population that is reproductively isolated from naturally-spawning populations. Segregation will be achieved operationally by using only adult hatchery-origin early winter steelhead (distinguished by an adipose fin-clip) returning to the Kendall Creek Hatchery trap, and by operating the program in a manner to limit gene flow to the natural origin population. Specific risk- reduction measures that have been implemented since 2004 for this program include:

- Hatchery traps now remain open through March 15 (or later as conditions allow) to provide the opportunity for all adult hatchery-origin fish to return to the hatcheries to reduce straying,
- All eggs are taken from hatchery-origin fish maturing prior to February 1 to maintain the temporal separation in spawn-timing between hatchery- and natural-origin steelhead, and
- Eggs are only collected from broodstock returning to Kendall Creek Hatchery trap to promote fidelity of homing to the hatcheries.

The genetic impact from this segregated hatchery program on natural-origin steelhead will be assessed through measures of introgression and the proportion of effective hatchery contribution derived directly from DNA, based on periodic tissue sampling of key demographic/tributary groups, and linked to other harvest and habitat actions in a Total Viability Analysis (TVA) that considers the effects on all viability parameters from "All H" actions. These performance indicators are estimated using genetic samples collected from the natural populations and hatchery-origin fish straying to natural spawning areas. Given the above improvements and more direct measures of introgression and gene flow, the revised hatchery program will result in significant reductions in genetic impacts on natural origin populations provided other factors affecting productivity remain neutral. Environmental and ecological effects that could contribute to the decline of steelhead viability are being addressed in ongoing monitoring efforts (smolt trapping, estuarine and nearshore marine monitoring done for more than 12 consecutive years) and new

monitoring efforts (e.g. Salish Sea Marine Survival Project with the co-managers and 15 other agencies and entities, SeaGrant juvenile fish monitoring project, new zooplankton monitoring, etc.). Risk control measures are also in place to address other potential hazards including ecological interactions, disease transmission, and facility effects.

An integrated TVA is needed to assess the risks of the proposed hatchery program relative to other risk factors and to develop management actions that are likely to lead to recovery. As noted by the Puget Sound Technical Recovery Team (2003), "Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..." The WDFW and Treaty tribes are now developing analytical tools to complete this task.

Harvest:
WDFW, the Lummi Nation, Nooksack Tribe prepare an annual Fisheries Management Plan for the harvest of Nooksack River winter steelhead produced from this program (WDFW et al. 2008 to present). Returning early winter steelhead adults provide for limited tribal commercial and subsistence use and provide a localized recreational sport fishery, mostly from November through mid-February each year. Tribal fisheries include net and hook and line fisheries, generally from early-December through mid-January. The sport fishery directed at hatchery-origin adults for the 2013-14 season was open October 16 to January 31, within selected stream reaches and until February 15 within the hatchery terminal area, with retention of two hatchery-origin steelhead over 20 inches allowed (WDFW Sport Fishing Rules 2013/2014).

Monitoring, Evaluation, and Adaptive Management:
WDFW, the Lummi Nation, and the Nooksack Tribe conduct annual spawning ground surveys in the Nooksack River mainstem, North Fork Nooksack River, Middle Fork Nooksack River, South Fork Nooksack River as well as selected tributaries. Survey data are used to track annual trends in natural population abundance and spatial distribution. WDFW is also implementing a genetic monitoring program to measure the proportion effective hatchery contribution and genetic introgression between segregated hatchery steelhead and natural origin populations in the Puget Sound DPS. These monitoring programs will provide input data to a TVA model that will provide information to adaptively manage the early winter hatchery programs relative to other "All-H Actions" and viability parameters.

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Kendall Creek Early Winter Steelhead Program.

1.2) Species and population (or stock) under propagation, and ESA status.

Kendall Creek Hatchery (Nooksack River) (Early Winter Hatchery Stock) Winter Steelhead (*Oncorhynchus mykiss*).

Not listed – The early winter steelhead hatchery stock is not considered part of the Puget Sound Distinct Population Segment (DPS) for Puget Sound Steelhead listed as *Threatened* under the ESA (National Marine Fisheries Service, May 11, 2007); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448).

1.3) Responsible organization and individuals

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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

Co-manager policies are in effect for all Puget Sound hatchery programs. The **Lummi Nation** and **Nooksack Tribe**, along with WDFW, prepare an annual fishery management plan for the harvest of Nooksack River system winter steelhead produced from this program.

Northwest Steelheaders – local chapter built and operates McKinnon Pond rearing site.

1.4) Funding source, staffing level, and annual hatchery program operational costs.

Funding Sources	Operational Information[1]
General Fund – State	Full time equivalent staff – 4.29
DJ – Federal	Annual operating cost (dollars) - $676,144
Federal Restoration program	
ALEA	
Local Restoration program	

[1]The above information for annual operating cost applies cumulatively to all species produced at the facility.

1.5) Location(s) of hatchery and associated facilities.

Broodstock Collection; Adult Holding; Spawning; Incubation Location:

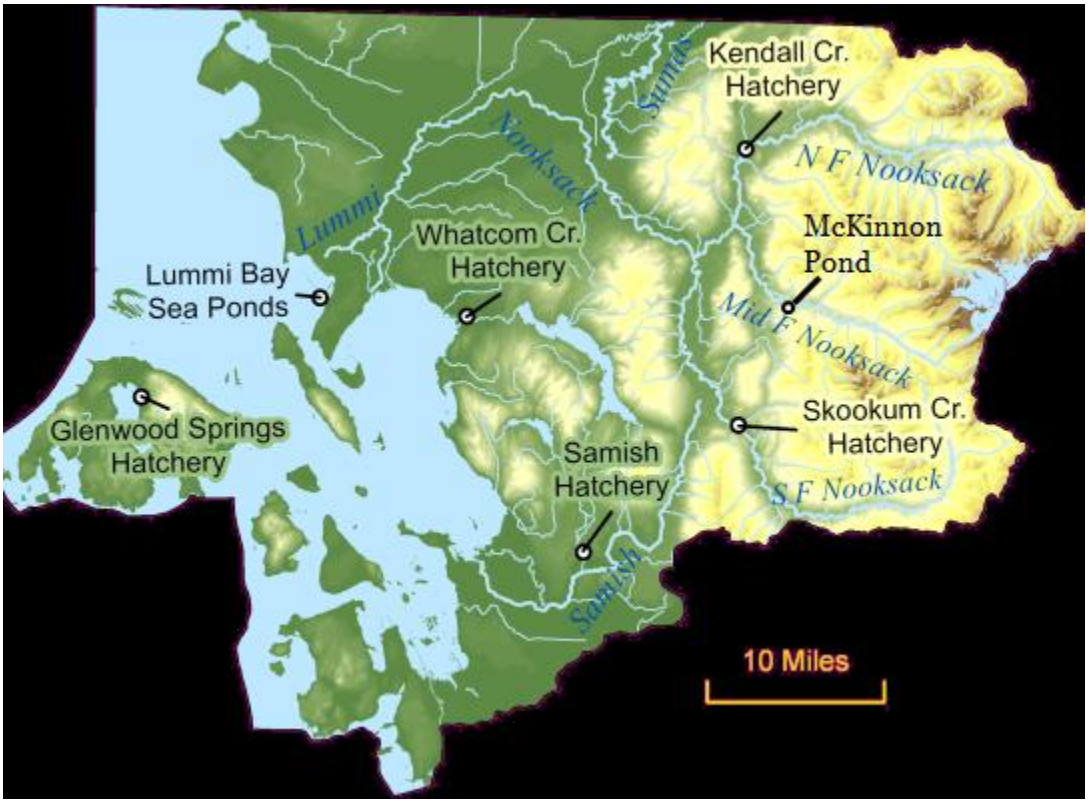
Kendall Creek Hatchery: Located at the mouth of Kendall Creek (WRIA 01.0406), tributary to the NF Nooksack River (WRIA 01.0120) at RM 46, Puget Sound, Washington

Rearing Location:

Kendall Creek Hatchery

McKinnon Pond: Located just downstream from the Mosquito Lake Road Bridge on the left bank of the river with water from and outlet to, a creek (WRIA 01.0352, known locally as "Peat Bog Creek"), which emanates from Peat Bog, tributary to MF Nooksack River (WRIA 01.0339) at RM 4.4.

Figure 1.5.1: Map of the Nooksack Complex and Associated Rearing, Acclimation and Release Facilities.



Source: WDFW GIS Staff.

1.6) Type of program.

Segregated Harvest.

1.7) Purpose (Goal) of program.

Harvest Augmentation.

1.8) Justification for the program.

The purpose of the program is to produce steelhead for sustainable fisheries for harvest in terminal recreational and tribal fisheries.

To minimize impacts on listed fish from facilities operations: the following Risk Aversions are included in further sections of this HGMP:

Table 1.8.1: Summary of risk aversion measures for the Kendall Creek winter steelhead program.

Potential Hazard	HGMP Reference	Risk Aversion Measures
Water Withdrawal	4.2	*Kendall Creek Hatchery*: Well water and surface water rights are formalized through trust water right permit #'s G1-10562c, G1-23261c and S1-00317. Water used in the hatchery is routed to Kendall Creek immediately below the hatchery. *McKinnon Pond*: Water rights are formalized through trust water right permit # S1-27351.
Intake Screening	4.2	*Kendall Creek Hatchery*: The Kendall Creek gravity water intake screens are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current Anadromous Salmonid Passage Facility Design criteria (NMFS 2011a). These screens are identified for replacement but are a lower priority than others as listed fish are not usually above the intake on Kendall Creek. In most years, the creek is very low or dry during the time of adult spring Chinook spawning (late July through mid-September). *McKinnon Pond*: Intake screens at McKinnon Pond meets the current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011a).
Effluent Discharge	4.2	*Kendall Creek Hatchery*: Effluent is regulated through NPDES permit # WAG 13-3007. *McKinnon Pond*: is under the 20,000 pounds limit set by WDOE for concern regarding hatchery effluent discharge effects and NPDES permit requirements.
Broodstock Management & Adult Passage	2.2.2, 2.2.3, 7.9	Steelhead are collected in a time period (late December to March) when spring Chinook are not yet present. If natural origin steelhead or bull trout are encountered, they are safely returned to the stream.
Disease Transmission	2.2.3, 7.7, 9.2.7	The *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) details hatchery practices and operations designed to stop the introduction and/or spread of any diseases.
Competition & Predation	2.2.3, 10.11	Fish are released as smolts between April 15 and the end of May to foster rapid migration to marine waters, to allow juvenile listed fish to grow to a size that reduces the potential for predation, and at a time which often corresponds to a period of high, turbid flows in the Nooksack River. Additional collaborative monitoring efforts include Salish Sea Marine Survival Project, and new SeaGrant study, (see section 11.1.1).

1.9) List of program "Performance Standards".

See HGMP section 1.10.

1.10) 1.10) List of program "Performance Indicators", designated by "benefits" and "risks."

1.10.1) "Performance Indicators" addressing benefits.

Table 1.10.1.1: "Performance Indicators" addressing benefits.

Benefits		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.1 Program contributes to fulfilling tribal trust responsibility mandate and treaty rights as described in applicable agreements (*U.S. v Washington*).	Contributes to co-manager harvest.	Participate in annual coordination between co-managers to identify and report on issues of interest, coordinate management, and review programs (EBD process, annual fisheries management plans).
3.1.2 Program contributes to mitigation requirements.	Number of fish released by program, returning, or caught, applicable to given mitigation requirements	Annually estimate survival and contribution to fisheries for each brood year released. This program provides mitigation for lost fish production due to development within the Nooksack basin and contributes to sport and tribal fisheries.
3.1.3 Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	HGMP updated and re-submitted to NOAA with significant changes or under permit agreement.
3.2.1 Fish produced for harvest are propagated and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while adequately minimizing by-catch of non-target species and populations.	Annual number of fish produced by program caught in all fisheries.	Annually mass-mark hatchery steelhead releases to differentiate hatchery from natural-origin fish and record estimates of mark rate. The external mark enables mark-selective fisheries, which can reduce directed harvest mortality on natural-origin fish. Agencies monitor harvests and hatchery returns to provide up-to-date information. Estimate survival and contribution to fisheries for each brood year released.
3.5.5 Juveniles are released at fully-smolted stage to benefit juvenile to adult survival rates, and reduce the likelihood for residualism and negative ecological interactions with natural-origin fish.	Level of smoltification (size, appearance, behavior, etc.) at release compared to WDFW rearing and release guidelines (Tipping 2001). Release type (forced, volitional, or direct).	Monitor fish condition in the hatchery throughout all rearing stages. Annually monitor and report size, number, and date of release.
3.5.6 The number of adults returning to the hatchery that exceeds broodstock needs is declining.	Program is properly sized to meet harvest objectives; program fish are fully utilized in target fisheries.	Monitor harvests and hatchery returns throughout the run.
3.6.1 The hatchery program uses	Apply basic monitoring	Collect annual run timing, age,

standard scientific procedures to evaluate various aspects of artificial propagation.	standards in the hatchery: feed conversion rates, growth trajectories, mark/tag rates, weight distributions (coefficient of variation (CV)).	and sex composition data upon adult return. Annually monitor and report growth rates, mark rate and size at release and release dates.
3.8.3 Non-monetary societal benefits for which the program is designed are achieved.	Contributes to cultural and recreational benefits to the general population. Also contributes ceremonial and subsistence (C&S), and recreational benefits for PNW Native Americans. Surplus (food-grade quality) fish contribute ceremonial and subsistence (C & S) benefits for PNW Native Americans and provides contributions to local charitable organizations. Recreational fishery angler days, length of season, number of licenses purchased.	Assess annual sport harvest of hatchery fish based on Catch Record Card (CRC) estimates. Annually record and report number of surplus fish donated to local charitable organizations.

1.10.2) "Performance Indicators" addressing risks.

Table 1.10.2.1: "Performance Indicators" addressing risks.

Risks		
Performance Standard	**Performance Indicator**	**Monitoring & Evaluation**
3.1.3 Program addresses ESA responsibilities.	Program complies with Federal ESA-listed fish take authorizations for harvest and hatchery actions.	HGMP is updated to reflect any major changes in program and resubmitted to NOAA fisheries. Program risks have been addressed in this HGMP through best available science and hatchery management actions. Monitor juvenile hatchery fish size, number, date of release and mass-mark quality; monitor contribution of hatchery adult fish to fisheries and hatchery escapement.
3.2.1 Fish produced for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while adequately minimizing by-catch of non-target species and populations.	Annual number of fish produced by this program caught in all fisheries, including estimates of fish released.	Annually mass-mark hatchery steelhead releases (adipose fin-clip) to differentiate hatchery from natural-origin fish, and record estimates of mark rate. The external mark enables state agencies to initiate mark-selective fisheries, which can reduce directed harvest mortality on natural-origin fish. Harvest is regulated to meet appropriate biological

		assessment criteria. Agencies monitor harvests and hatchery escapements to provide up-to-date information.
3.4.3 Life history characteristics of the natural population do not change as a result of this hatchery program.	Life history patterns of juvenile and adult NOR are stable.	Spawn timing through redd surveys and smolt monitoring.
3.5.1 Patterns of genetic variation within and among natural populations do not change significantly as a result of artificial production.	Within and between populations, genetic structure is not significantly affected by artificial production.	Conduct genetic monitoring of the hatchery and natural populations (see HGMP section 11.1).
3.5.2 Collection of broodstock does not adversely impact the genetic diversity of the naturally-spawning population.	Total number of natural-origin spawners (if any) reaching the collection facility. Timing of collection compared to overall run timing - broodstock-separated timing of earlier hatchery fish from later natural origin spawners to minimize potential spawning overlap	All hatchery production is identifiable by adipose fin clip. Broodstock is collected from fish volitionally returning to the hatchery adult holding trap. Segregated program - only marked hatchery fish are used for broodstock purposes; fish are matured before February 1. Collect annual run timing, origin, and age and sex composition data. Examine returning fish for the fin-mark at the hatchery. Annually monitor and report numbers of estimated hatchery (marked) and natural (unmarked).
3.5.3 Hatchery-origin adults in natural production areas do not exceed appropriate proportion of the total natural spawning population.	The ratio of observed and/or estimated effective hatchery contribution on natural spawning grounds, to total number of naturally-produced fish (PEHC).	Collect tissues for DNA analysis from key demographic/tributary groups in each watershed subbasin sampling and refine DNA analysis to better understand the genetic composition of steelhead DIPs and monitor for signals for hybridization with hatchery fish Input introgression data to TVA analysis and attempt to scale programs accordingly
3.5.4 Juveniles are released on-station, or after sufficient acclimation to maximize homing ability to intended return locations.	Location of release (on-station, acclimation pond, direct plant). Release type (forced, volitional or direct stream release).	Annually monitor and report release information (location, method and age class) in WDFW Hatcheries Headquarters Database.
3.5.5 Juveniles are released at fully-smolted stage.	Level of smoltification at release. Release type (forced, volitional or direct).	Juveniles are released volitionally fully smolted. Juveniles not leaving volitionally will be planted in to isolated waters, subject to the

		disease policy. Fish will be releases only from Kendall Crek hatchery.
3.5.6 The number of adults returning to the hatchery that exceeds broodstock needs is declining.	Program is sized appropriately for harvest goals. Numbers of surplus hatchery returns are calculated annually.	Annually monitor and report numbers of adults returning to the hatchery, broodstock collected, and surplus returns.
3.7.1 Hatchery facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols (IHOT, PNFHPC, the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006), INAD, MDFWP).	Annual reports indicating levels of compliance with applicable standards and criteria. Periodic audits indicating level of compliance with applicable standards and criteria.	Pathologists from WDFW's Fish Health Section monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites and/or pathological changes, as needed. The program is operated consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
3.7.2 Effluent from hatchery facility will not detrimentally affect natural populations.	Discharge water quality compared to applicable water quality standards by NPDES permit. WDOE water rights permit compliance.	Flow and discharge reported in monthly NPDES reports.
3.7.3 Water withdrawals and in-stream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	Water withdrawals compared to NMFS, USFWS and WDFW applicable passage and screening criteria for juveniles and adults.	Barrier and intake structure compliance assessed and needed fixes are prioritized.
3.7.4 Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens. Follow the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).	Necropsies of fish to assess health, nutritional status, and culture conditions.	WDFW Fish Health Section inspects adult broodstock yearly for pathogens and monitor juvenile fish on a monthly basis to assess health and detect potential disease problems. As necessary, WDFW's Fish Health Section recommends remedial or preventative measures to prevent or treat disease, with administration of therapeutic and prophylactic treatments as deemed necessary. A fish health database will be maintained to identify trends in fish health and disease and implement fish health management plans based on findings.
	Release and/or transfer exams	Examine fish 1 to 6 weeks prior

	for pathogens and parasites.	to transfer or release, in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
	Inspection of adult broodstock for pathogens and parasites.	At spawning, lots of 60 adult broodstock are examined for pathogens , in accordance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
	Inspection of off-station fish/eggs prior to transfer to hatchery for pathogens and parasites.	Controls of specific fish pathogens through eggs/fish movements are conducted in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).
3.7.5 Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal and federal carcass distribution guidelines.	All applicable fish disease policies are followed. See HGMP sections 7.5 and 7.8.	Controls of specific fish pathogens through eggs/fish movements in accordance to the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Record and report disposition of carcasses in the WDFW Hatcheries Headquarters Database
3.7.6 Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally-produced population.	Spatial and temporal spawning distribution of natural populations above and below weir/trap currently compared to historic distribution.	Trap is checked regularly. When natural-origin steelhead are mixed in with hatchery fish, they are safely returned to the river. Natural origin steelhead have not recruited to the trap in the past 12 years.
3.7.7 Weir/trap operations do not result in significant stress, injury or mortality in natural populations.	Mortality rates in trap. Pre-spawning mortality rates of captured fish in the hatchery and/or after release.	Trap checked regularly. Annually monitor and report abundances and observation natural- and hatchery-origin fish at hatchery facilities.
3.7.8 Predation by artificially produced fish on naturally – produced fish does not significantly reduce numbers of natural fish.	Hatchery juveniles are raised to smolt-size and released from the hatchery at a time that fosters rapid migration downstream, (see also HGMP section 2.2.3).	Hatchery smolt release size and time are monitored to quantify/minimize predation effects on naturally-produced listed fish (Sharpe et al. 2008, Pflug et al. 2013), (see also HGMP section 2.2.3).
3.8.1 Cost of program operation does not exceed the net economic value of fisheries in dollars per	Total cost of operation.	Compare annual operational cost of program to calculated sport fishery contribution value

fish for all fisheries targeting this population.		(Wegge 2009).

1.11) Expected size of program.

1.11.1) Proposed annual broodstock collection level (maximum number of adult fish).

Up to 50 pairs of adult fish are collected annually.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location.

Table 1.11.2.1: Annual fish release levels.

Life Stage	Release Location	Annual Release Level
Yearling	Kendall Creek/NF Nooksack R. (WRIA 01.0120)	150,000[a]

Source: Future Brood Document 2013

[a] Up to 50,000 are transferred to McKinnon Ponds where they are reared for a period of time (December-March 1) and transferred back to Kendall Creek Hatchery for release.

1.12) Current program performance, including estimated smolt-to-adult survival rates, adult production levels, and escapement levels. Indicate the source of these data.

Due to a lack of coded-wire tag (CWT) studies and limitations that not all fish can be accounted for as being harvested or as back-to-rack counts, smolt-to-adult survival rates (SAR) are likely underestimated. Based on the average smolt-to-adult survival of 0.52 % for brood years 1998-2009 and a current program release goal of 150,000 yearlings, the estimated adult production (goal) level would be 780, (see also HGMP section 3.3.1).

Table 1.12.1: Kendall Creek Hatchery winter steelhead escapement 2001-2013.

Return Year	Hatchery Escapement
2001/2002	193
2002/2003	7
2003/2004	73
2004/2005	376
2005/2006	219
2006/2007	66
2007/2008	159
2008/2009	36
2009/2010	96
2010/2011	158
2011/2012	156
2012/2013	55
Average	**133**

Source: WDFW Hatcheries Headquarters Database 2013.

1.13) Date program started (years in operation), or is expected to start.

Transfers and releases to the Nooksack system have been on-going since the 1930s. A full-cycle steelhead propagation program at Kendall Creek Hatchery began with releases in 1998. The first year of on-site broodstock collection was in 2001.

1.14) Expected duration of program.

Ongoing.

1.15) Watersheds targeted by program.

Mainstem and NF Nooksack River (WRIA 01.0120) Puget Sound, Washington.

1.16) Indicate alternative actions considered for attaining program goals, and reasons why those actions are not being proposed.

Alternative 1: Reduce winter steelhead release numbers as a measure to decrease genetic and ecological risks to natural-origin steelhead. This alternative was not pursued because further reductions to the proposed program size would gain negligible ecological benefits while imposing harsh consequences on harvest; this alternative would not meet enhancement or harvest objectives for the program and would not meet the goals of any of the Co-Managers, including providing recreational, ceremonial and subsistence, commercial and non-commercial benefits, nor be compatible with Treaty Indian fishing rights (*U.S. v Washington*) for sustainable fisheries.

Alternative 2: Discontinue the program. The Co-Managers did not pursue this alternative because 1) program is projected to meet standards; and 2) it would not meet enhancement or harvest objectives for the program and would not meet the goals of tribal Co-Managers, which include providing recreational, cultural and subsistence, ceremonial, religious, nor be compatible with Treaty Indian fishing rights (*U.S. v Washington*) for sustainable fisheries. The co-managers may eliminate, modify, or replace the segregated program after competing additional analyses and discussions (see Alternative 3).*Alternative 3: Replace segregated program with an integrated program.* To meet conditions of the incidental take statement in NOAA's recent Biological Opinion (NMFS 2011b), the average terminal harvest rate for Skagit, Snohomish, Green, Puyallup and Nisqually fisheries measures and harvest impacts are not to exceed those implemented in the recent seasons. Changing broodstock strategy from segregated to integrated would place the various fisheries on top of the peak natural origin run, and would be expected to exceed impacts from recent years.

SECTION 2. PROGRAM EFFECTS ON NMFS ESA-LISTED SALMONID POPULATIONS. (USFWS ESA-Listed Salmonid Species and Non-Salmonid Species are addressed in Addendum A)

2.1) List all ESA permits or authorizations in hand for the hatchery program.

This HGMP was previously submitted to NOAA Fisheries in August of 2005 but was not acted on at the time. This updated HGMP is submitted to NOAA Fisheries for ESA consultation, and determination regarding compliance of the plan with ESA Limit 6 of the 4(d) rule criteria for joint state/tribal hatchery resource management plans affecting listed species.

2.2) Provide descriptions, status, and projected take actions and levels for NMFS ESA-listed natural populations in the target area.

2.2.1) Description of NMFS ESA-listed salmonid population(s) affected by the program.

- Identify the NMFS ESA-listed population(s) that will be directly affected by the program.

None.

- Identify the NMFS ESA-listed population(s) that may be incidentally affected by the program.

Puget Sound Chinook (*Oncorhynchus tshawytscha*): Listed as *Threatened* on March 24, 1999 (64FR14308); *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 currently. 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 Nooksack basin, the Technical Recovery Team (TRT) has identified demographically independent populations (DIPs) in the North/Middle Fork Nooksack and South Fork Nooksack River (Ruckelshaus et al. 2006).

Puget Sound steelhead *(Oncorhynchus mykiss*): Were listed as *Threatened* under the ESA on May 11, 2007 (72FR26722); reaffirmed *Threatened* by five-year status review, completed August 15, 2011 (76FR50448). 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 2011). It 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 78FR38270). In the Nooksack Basin, the TRT has preliminarily delineated one DIP of winter steelhead in the Nooksack River and one DIP of summer steelhead in the South Fork Nooksack River (PSSTRT 2013).

2.2.2) Status of NMFS ESA-listed salmonid population(s) affected by the program.

- Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds.

Kendall Creek Hatchery spring Chinook in the Puget Sound Chinook ESU. NMFS (1999) considered this hatchery stock to be part of the ESU, and listed with natural-origin Chinook salmon that are part of the North Fork Nooksack population (70 FR 37160. June 28, 2005; NMFS SHIEER 2004). The population rebuilding program was started with natural-origin fish from the North Fork Nooksack River native population. Since that time, the program has relied totally on volunteer returns to the hatchery. In the past, hatchery and natural origin Chinook were not entirely differentiated with distinguishing marks, so it was possible that natural origin fish contributed to the broodstock prior to data collection on this. The proportion of natural-origin fish typically used in the broodstock is quite low, as population productivity due to existing habitat conditions limit abundances of natural origin Chinook.

Nooksack spring Chinook in the Puget Sound Chinook ESU. Recent escapement levels (2005-2013) have averaged 1,427 natural spawners in the North Fork Nooksack River DIP and -70 (2000-2013) for the South Fork Nooksack River DIP.

Puget Sound Chinook salmon: Updated Risk Summary. All Puget Sound Chinook populations are well below the TRT planning range for recovery escapement levels. Most populations are also consistently below the spawner recruit levels identified by the TRT as consistent with recovery. Across the ESU, most populations have declined in abundance somewhat since the last status review in 2005, and trends since 1995 are mostly flat. Many of the habitat and hatchery actions identified in the Puget Sound Chinook recovery plan are expected to take years or decades to be implemented and longer yet to produce significant improvements in natural population attributes, and these trends are consistent with these expectations. Overall, the new information on abundance, productivity, spatial structure and diversity since the 2005 review does not indicate a change in the biological risk category since the time of the last BRT status review (Ford 2011).

See North/Middle Fork Nooksack River Chinook HGMP for Chinook Viability Criteria.

Nooksack Steelhead in the Puget Sound Steelhead DPS. 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. The limited recent years when populations escapement estimates were determined suggest population abundances are relatively stable. There are no abundance trend data for SF Nooksack summer steelhead; this stock is not monitored and it is difficult to monitor. The status remains unknown in 2012 (SaSI, WDFW 2012). 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 2,205 to 44,091 fish and between 114 to 2,273 for summer steelhead in the South Fork Nooksack.

*Puget Sound steelhead: Updated Risk Summary***.** The number of winter steelhead spawners has increased for many populations in Puget Sound since 2009. The number of spawners for 16 Puget Sound winter steelhead populations, relative to the average number of spawners for each population in the four year period up to the listing in 2007, increased from an average of 51% in 2009 to 141% in 2013.

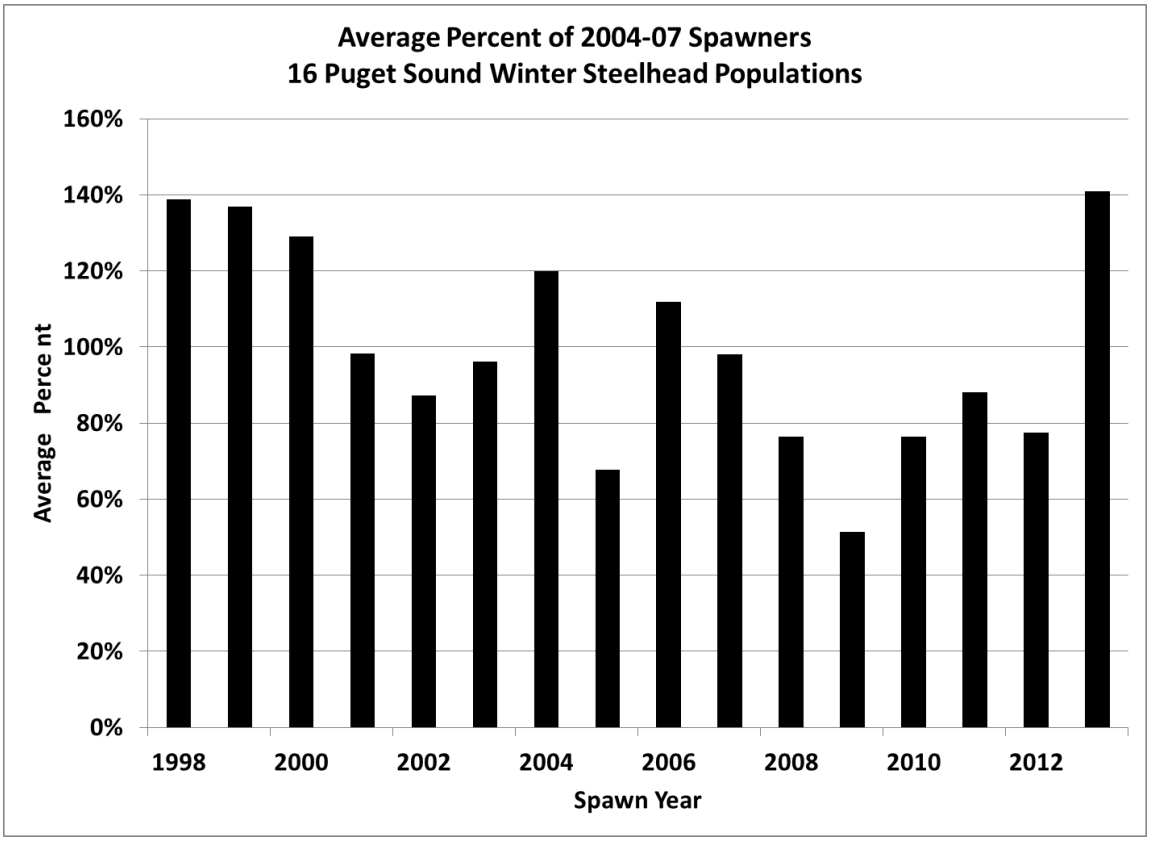


Figure 2.2.2.1: Relative to average percent of 2004-2007 spawners for 16 Puget Sound winter steelhead populations.

These recent, short-term increases in spawners are a positive development, but do not negate the long-term risks facing Puget Sound steelhead DPS. Using spawner data collected through 2008 or 2009, Ford (2011) concluded that the status of the listed Puget Sound steelhead DPS has not changed substantially since the 2007 listing, and that steelhead in the Puget Sound DPS remain at

risk of extinction throughout all or a significant portion of their range in the foreseeable future but are not currently in danger of imminent extinction.

Table 2.2.2.1: Interim DIP abundance goals for steelhead in Puget Sound, based on a four-year average. Abundance goals for summer-run fish *(italics*) are still under review. QET, quasi extinction threshold; SAS, smolt to adult survival. Minimum abundance = 100 (Low Abundance), 250 (Viable).

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
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

- Provide the most recent 12 year (e.g. 1988-present) progeny-to-parent ratios, survival data by life-stage or other measures of productivity for the listed population.

See North/Middle Fork Nooksack River Chinook HGMP for Chinook Productivity Data.

Nooksack System steelhead (*Oncorhynchus mykiss*): Current Co-manager smolt monitoring for Chinook and coho productivity incidentally captures some natural origin steelhead smolts, but due to the evasive ability of steelhead smolts in large systems, no methodology has been developed to estimate total productivity.

- Provide the most recent 12 year (e.g. 1988-1999) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

See North/Middle Fork Nooksack River Chinook HGMP for Chinook Escapement Data.

Nooksack System Steelhead (*Oncorhynchus mykiss*): Suspended sediment conditions have limited past spawner surveys throughout the Nooksack watershed. A combination of aerial and ground survey have been conducted during clear water conditions to track abundance.

Table 2.2.2.2: 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 2014)

- Provide the most recent 12 year (e.g. 1988-1999) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

See North/Middle Fork Nooksack River Chinook HGMP for estimates.

Nooksack winter steelhead (*Oncorhynchus mykiss*):

The early winter hatchery programs in the Nooksack River basin are designed to take into account potential risks of artificial propagation on listed species while still providing for some harvest by treaty tribes and recreational fisheries. Efforts to minimize potential risks of artificial propagation are described below. Likewise, to protect against overutilization of natural origin steelhead whose abundances have declined from historical levels, the NMFS Biological Opinion established a 4.2% limit of the aggregate average harvest rate of natural origin steelhead in five basins: Skagit River, Snohomish River, Green River, Puyallup River, and Nisqually River. The factors driving the declining abundance of natural origin steelhead, however, have not been similarly restricted, including: 1) the present and increasing threat of destruction, modification and curtailment of natural origin steelhead freshwater, estuarine, and marine habitat; 2) predation and potentially disease, and 3) the inadequate existing regulatory mechanisms to protect natural origin steelhead habitat. The current harvest restriction severely limits the opportunities for both treaty and non-treaty fisheries on natural origin steelhead. The lack of adequate habitat protection and restoration places an unacceptable disparate burden on hatchery programs, the exercise of the tribes' treaty-reserved rights, limits recreational fishing opportunities, and fails to conserve steelhead. The potential risks of this hatchery program, therefore, have to be considered in the context of failure to implement steelhead habitat protection and restoration measures commensurate with those measures imposed on steelhead hatchery and harvest programs that result in diminished fishing opportunities.

An integrated Total Viability Analysis (TVA) is needed to assess the risks of the proposed hatchery program relative to other risk factors and to develop management actions that are likely to lead to recovery. As noted by the Puget Sound Technical Recovery Team (2003), "Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..." Rather than simplistic single sector analysis and management actions, our challenge is to develop a suite of integrated recovery actions that lead to increased production and viability of natural origin steelhead. The WDFW and Treaty tribes are now developing analytical tools to initiate this task.

Analyses of a single hatchery parameter or application of a universal standard is unlikely to lead to an informed decision regarding the potential risk of a hatchery program or to the identification of appropriate management actions. We used four analyses to evaluate the potential genetic effects of the early winter steelhead programs on natural origin steelhead. The analyses are complementary - they use multiple sources of information and address multiple questions.

1) Genetic Introgression. Introgression is the accumulation of hatchery-origin genetic changes in natural origin populations, and starts with hybridization, here between hatchery and natural origin individuals. We estimate the relative number of F1 hybrids (i.e. first generation hybrids) as a proxy for genetic introgression to address the question "How have past early winter hatchery program practices affected the genetic characteristics of natural origin steelhead?" Since our analysis relies on tissue samples from natural-origin steelhead collected in the Nooksack River, it

provides a direct measure of the identity of the parents of individuals sampled, and depending on what year the individuals were sampled, may represent the effects of former early winter hatchery programs. However, it may also reflect some practices that have now ended (e.g., off-station plants, recycling of returning adults, larger number of fish released).

2) Projected Genetic Introgression. We developed a simple, heuristic model to project how genetic introgression might change in the future based on the assumptions discussed below and the model structure.

3) Proportion Effective Hatchery Contribution. The proportion effective hatchery contribution (PEHC) is the proportion of natural spawners that are genetically related to the early winter hatchery stock and includes both hatchery-natural origin hybrids and pure natural-origin hatchery-lineage fish. We estimated the PEHC from an analysis of the genetic ancestry of tissue samples from natural-origin steelhead from the Nooksack River (Warheit 2014). Since the PEHC includes pure hatchery-lineage fish that have the potential to generate hybrid offspring, it addresses a broader question than would genetic introgression alone: "How may early winter hatchery program practices affect the potential for genetic introgression, given the limitations to that projection as described below Table 2.2.2.3?" Like the analysis of introgression, PEHC relies on tissue samples from natural-origin steelhead collected in the Nooksack River, and provides a direct measure of the effects of the early winter hatchery program.

4) Gene Flow. Whereas genetic introgression is a cumulative state, gene flow is the process that leads to genetic introgression. Gene flow may vary each year in response to hatchery program characteristics such as the number and location of fish released, the nature and extent of the early winter steelhead on the spawning grounds and the number of natural-origin spawners. We asked the question "What was the historical gene flow and what do we anticipate gene flow will be with the new proposed program?" We calculated a potential range of gene flow from the early winter hatchery program to the natural origin populations based on the assumptions of hatchery steelhead fitness, the overlap in spawn timing of hatchery and natural origin steelhead, and stray rate assumptions for early winter steelhead (see next section and Hoffmann 2014).

The results are summarized in Table 2.2.2.3 and discussed in greater detail in the following sections. Introgression from the early winter steelhead program was estimated at less than 0.01 in both the Nooksack River Winter and SF Nooksack River Summer populations. The estimated PEHC for the proposed programs ranged from 0 to 0.03 and gene flow was projected to be less than 2%. Several key assumptions and uncertainties of the analyses are discussed briefly below (see Warheit (2014) and Hoffmann (2014) for a more detailed discussion):

1) Uncertainty in Estimates. Although we report most statistics as point estimates, the estimates have variance associated with sampling the population and measuring biological attributes. Because of variability inherent in natural systems, and our sampling programs, we can expect substantial inter-annual variability in our point estimates, even if the true value is constant.

2) Effects of Variations in Population Abundance. Our projections for the proposed program assume that the abundance of the natural origin population remains constant relative to when the samples were taken. Increases in population abundance will result in lower values of introgression, PEHC, and gene flow even if the hatchery programs do not change. Conversely, decreases in natural origin population abundance will result in higher values of introgression, PEHC, and gene flow than projected.

3) Time Lags. The effects of changes in hatchery programs may not be evident for 2-5 years after the changes have been made. This time lag reflects: a) the multiple years of ocean residence between smolt release and the return of adult fish; b) the multiple ages at return for adult steelhead; and c) the presence of hatchery-natural origin hybrids from previous generations that can continue to contribute to the genetic characteristics of the population.

4) Neutral Markers. The genetic analysis was based on SNP loci that were presumably neutral to natural selection. These markers were used to categorized fish as pure early winter hatchery lineage, natural origin lineage, and hybrid between the hatchery and natural origin lineages. If a hatchery program is terminated, the amount of time it takes a natural origin population to purge itself of alleles that categorize a fish as being a hatchery or hybrid fish is a function of the frequency of the alleles and the effective size of the natural origin population.

Genetic Introgression. We evaluated genetic introgression through F1 hybridization resulting from the early winter hatchery program through an analysis of tissue samples from steelhead in the Nooksack River (Warheit 2014).

Table 2.2.2.3. Estimates of F1 hybridization, PEHC, and gene flow from early winter hatchery programs to steelhead populations in the Nooksack River basin for past practices and proposed programs. Ranges in gene flow reflect the minimum and maximum values for parameter values from cases 1-6 (Table 2.2.2.7).

Population	F1 Hybridization	PEHC	Gene Flow
Nooksack River Winter			
Past Practice	0.00%	0.00%	0.04% - 0.46%
Proposed Program [1/]		0.00%	0.05% - 0.57%
SF Nooksack River Summer			
Past Practice	0.00%	0.00%	-
Proposed Program		0.00%	-

[1/] PEHC and gene flow estimates for the proposed program shown were scaled to reflect changes in program size and elimination of off-station releases.

Projected Genetic Introgression. We constructed the heuristic simulation model to develop insights regarding the sensitivity of introgression to variables, the time lag between when actions are taken and when changes in introgression might become evident, and variability in the estimates of introgression that might result. The model is not intended, structured, or parameterized to provide specific predictions on past or future levels of introgression, nor does it address the need for an "All-H" viability analysis as discussed above.

The base parameter values in the model included a 20% stray rate and a 45% overlap in the timing of natural origin and hatchery-origin (including hybrid) spawners. The numbers of natural origin spawners and hatchery releases were scaled to result in an introgression rate of approximately 6%. In the model, we initiated a hatchery program at time 0 with both on-station and off-station smolt releases, we eliminated the off-station releases after year 10, and eliminated all hatchery production after year 20. Our preliminary results are summarized below:

1) The model indicates a lag of 3-5 years may occur between when a hatchery management action is implemented and when the introgression level reaches a new equilibrium (Fig. 2.2.2.2). In the model, this results from both a) the multiple years of ocean residence between smolt release and returns of adult cohorts and b) the presence of a reservoir of hatchery-natural origin hybrids from previous generations that continue to contribute to the genetic characteristics of the natural origin population.
2) With a sample size of 100 fish, estimates of introgression are likely to have substantial uncertainty when the introgression rate is relatively low (Fig. 2.2.2.2). This is a result of a small sample size and the inherent variability in an estimate of an infrequent event.
3) We conducted a preliminary analysis of the sensitivity of introgression to the abundance of natural-origin steelhead, the stray rate, and the overlap in timing of hatchery and natural-origin spawners (Table 2.2.2.4). We increased or decreased the value of each variable by 50% and assessed the effect upon the estimated introgression. Estimates of introgression were most sensitive to the straying rate and changes in the abundance of the natural origin spawners.

Table 2.2.2.4. Preliminary analysis of the sensitivity of introgression to the abundance of natural-origin spawners, straying rate, and overlap of the spawn timing of hatchery and natural-origin steelhead.

Variable	Estimated Introgression
Abundance of Natural-Origin Spawners	
+50%	0.025
Base	0.034
-50%	0.051
Stray Rate	
10%	0.016
Base (20%)	0.034
30%	0.056
Spawn-Timing Overlap	
22.5%	0.027
Base (45%)	0.034
67.5%	0.038

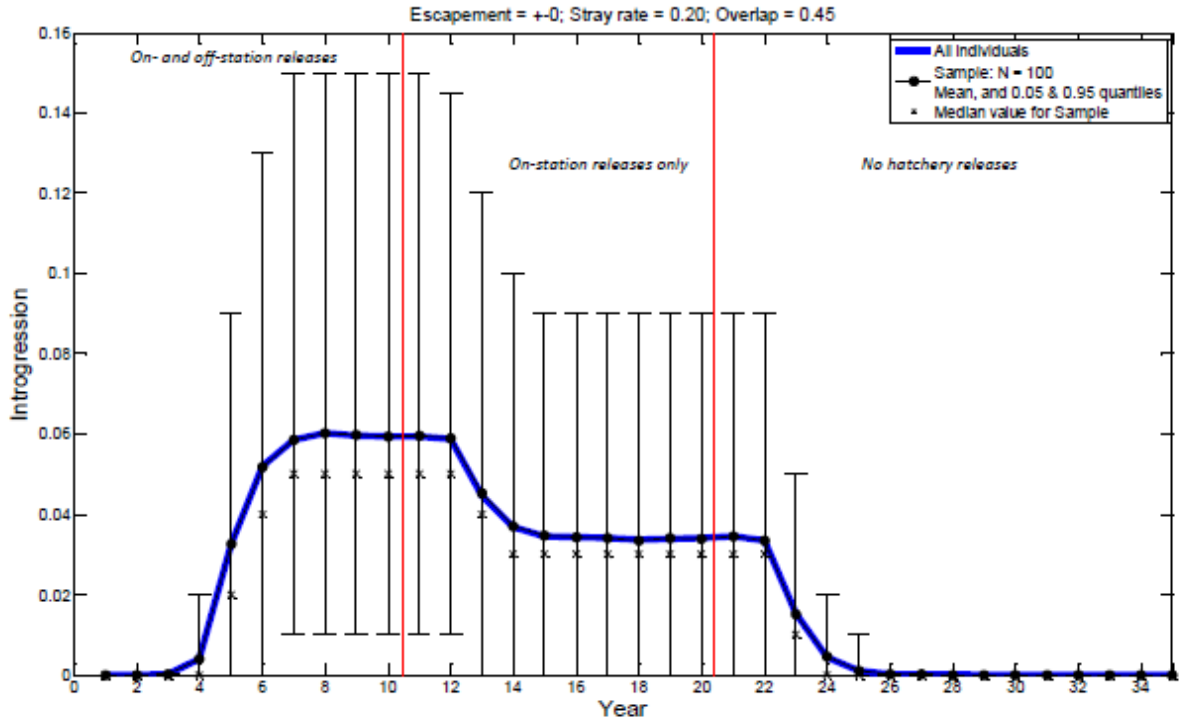


Figure 2.2.2.2. Preliminary simulation analysis of introgression including lag times in response to hatchery actions and uncertainty of estimates.

Proportion Effective Hatchery Contribution. We estimated the PEHC from the early winter hatchery program from a genetic analysis of juvenile and adult steelhead (Warheit 2014). The estimated PEHC was 0.00 for the Nooksack River Winter Population and for the SF Nooksack River Summer population. More detailed analysis is presented below for the Nooksack River Winter population and SF Nooksack River Summer population.

Nooksack River Winter. The PEHC was estimated as 0.00 from an analysis of 157 samples from the Nooksack River Winter population (Warheit 2014). The genetic samples were taken from adults collected from 2011-2013 and juveniles collected in 2009 and 2010. We assumed that most of the juveniles were sampled as age 0, and that the primary age of natural origin adults was age 4. The estimated PEHC reflects the previous hatchery practices that affected the juvenile and adult fish in the years when the samples were collected. The average number of juvenile fish released in the period affecting these samples was 157, 675 (Table 2.2.2.5). We projected the PEHC for the proposed program of 150,000 smolts, using methods in Hoffmann (2014), to remain at 0.00.

Table 2.2.2.5. Genetic samples and associated hatchery releases of early winter steelhead affecting the Nooksack River Winter population.

Sample	Life Stage	Sample Collection Year	Primary Spawn Year	Primary Release Year	Releases
NF Nooksack Nooksack	Juvenile Adult	2009 2013	2009	2007	160,000
NF Nooksack	Juvenile	2010	2010	2008	164,000
Nooksack	Adult	2011	2007	2005	141,700
Nooksack NF Nooksack SF Nooksack	Adult Adult Adult	2012	2008	2006	165,000

South Fork Nooksack River Summer. The PEHC was estimated as 0.000 from an analysis of 59 samples from adults collected in 2010 and 2011. No adjustment for program size was necessary because no early winter presence was detected in the samples from the South Fork Nooksack Summer population.

Gene Flow. We estimated the gene flow from stray rates for on-station and off-station releases (Hoffmann 2014). We used a stray rate of 100% for off-station releases and stray rates of 20% and 30% for on-station releases.

We estimated gene flow using the methods of Scott and Gill (2008) and the following sources for parameter estimates:

Spawn Timing of Hatchery-Origin Spawners (o_H). The spawn timing of early winter hatchery steelhead (Hoffmann 2014) was estimated from: a) the spawn timing at the Tokul Creek Hatchery; and b) entry timing of winter steelhead into the Kendall Creek Hatchery.

Spawn Timing of Natural-Origin Spawners (o_N). The spawn-timing of natural-origin fish in the Nooksack River populations (Hoffmann 2014) was estimated from: a) the range of values from Scott and Gill (2008) to bracket the likely spawn timing; and b) the spawn-timing observed for natural populations in the Nooksack River Winter population.

Relative Fitness of HxH Crosses (k_1). The early winter hatchery programs are operated with a segregated, nonlocal broodstock that has been domesticated over a period of more than 60 years. Unlike well run integrated hatchery programs, we can anticipate that the relative fitness will be low for fish produced from this type of program. We used a range of values (0.02 to 0.13) for relative fitness drawn from the empirical studies for steelhead programs that use nonlocal broodstock (Araki et al. (2008)). These studies were not conducted with Puget Sound steelhead populations. The co-managers are committed to continuing research and monitoring to refine estimates of fitness and overlap in spawning to better understand gene flow between early winter steelhead hatchery and natural origin steelhead.

Relative Fitness of HxW Crosses (k_2). We used a value of 0.54 which is halfway between the average value for HxH crosses (0.084) and a relative fitness of 1.0.

Proportion of Total Natural Spawners of Hatchery-Origin (q). We estimated the proportion of hatchery-origin spawners using the assumed stray rate of 100% for off-station releases and 20% or 30% for on-station releases.

Combinations of parameter values used for the six cases analyzed are summarized in Table 2.2.2.6.

The estimated gene flow for six cases of alternative parameter values are provided in table 2.2.2.7.

Table 2.2.2.6. Parameter values for six alternative cases for estimating PEHC and gene flow.

Parameter	Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
o_H	Spawn timing of early winter steelhead at Tokul Creek Hatchery.	Spawn timing of early winter steelhead at Tokul Creek Hatchery.	Entry timing of hatchery steelhead at Kendall Creek Hatchery.	Spawn timing of early winter steelhead at Tokul Creek Hatchery.	Spawn timing of early winter steelhead at Tokul Creek Hatchery.	Entry timing of hatchery steelhead at Kendall Creek Hatchery.
o_N	Spawn timing of natural origin steelhead in Snow Creek.	Spawn timing of natural origin steelhead in Clearwater River.	Spawn timing of natural origin steelhead for the population analyzed.	Spawn timing of natural origin steelhead in Snow Creek.	Spawn timing of natural origin steelhead in Clearwater River.	Spawn timing of natural origin steelhead for the population analyzed.
Stray Rate	0.20	0.20	0.20	0.30	0.30	0.30
k_1	0.02, 0.13	0.02, 0.13	0.02, 0.13	0.02, 0.13	0.02, 0.13	0.02, 0.13
k_2	0.54	0.54	0.54	0.54	0.54	0.54

Table 2.2.2.7. Estimated proportion effective hatchery-origin spawners contributing to the natural origin steelhead populations for the Nooksack River Winter steelhead population under six alternative cases**.** No estimates of Nooksack River Winter spawners are available prior to 2009-2010, except for 2004.

Spawn Year	**Case 1** Natural: Snow Creek Hatchery: Tokul Creek Stray Rate = 0.20		**Case 2** Natural: Clearwater R. Hatchery: Tokul Creek Stray Rate = 0.20		**Case 3** Natural: Nooksack Hatchery: Kendall Stray Rate = 0.20		**Case 4** Natural: Snow Creek Hatchery: Tokul Creek Stray Rate = 0.30		**Case 5** Natural: Clearwater R. Hatchery: Tokul Creek Stray Rate = 0.30		**Case 6** Natural: Nooksack Hatchery: Kendall Stray Rate = 0.30	
	K_1= 0.02	K_1= 0.13	K_1= 0.02	K_1= 0.13	K_1= 0.02	K_1= 0.13	K_1= 0.02	K_1= 0.13	K_1= 0.02	K_1= 0.13	K_1= 0.02	K_1= 0.13
2001-2002	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2002-2003	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2003-2004	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2004-2005	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2005-2006	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2006-2007	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007-2008	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2008-2009	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2009-2010	0.06%	0.13%	0.03%	0.15%	0.07%	0.19%	0.10%	0.22%	0.05%	0.26%	0.13%	0.33%
2010-2011	0.10%	0.22%	0.05%	0.27%	0.13%	0.34%	0.17%	0.38%	0.09%	0.46%	0.22%	0.58%
2011-2012	0.10%	0.22%	0.05%	0.27%	0.13%	0.34%	0.17%	0.38%	0.09%	0.46%	0.22%	0.58%
Through 2011	0.08%	0.17%	0.04%	0.21%	0.10%	0.27%	0.13%	0.30%	0.07%	0.36%	0.17%	0.46%
All Years	0.09%	0.19%	0.04%	0.23%	0.11%	0.29%	0.14%	0.33%	0.08%	0.40%	0.19%	0.50%
No Offstation	0.09%	0.19%	0.04%	0.23%	0.11%	0.29%	0.14%	0.33%	0.08%	0.40%	0.19%	0.50%
Release 150,000	0.10%	0.22%	0.05%	0.27%	0.13%	0.34%	0.17%	0.37%	0.09%	0.46%	0.22%	0.57%

2.2.3) Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of NMFS listed fish in the target area, and provide estimated annual levels of take.

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.

Broodstock Trapping/Holding: The trapping facility at Kendall Creek Hatchery is a hatchery outlet to a small tributary entering the N.F. Nooksack River. Broodstock collection of winter steelhead takes place between November and January 31; however the trap is operated until March 15 or later as conditions allow to insure that any hatchery-origin adults are captured and removed from the system. Chinook runs from previous years have terminated by this time in the Nooksack River Basin natural origin steelhead, if encountered and identified by presence of an adipose fin, would be are returned back to the river and specifically avoided for use as broodstock. However no natural origin steelhead have been encountered in the trap over the past 12 years. Sorting at collection facilities and release may result in some physical damage but little or no mortality has been observed by staff as no natural origin steelhead have recently recruited to the hatchery. Additionally, a majority of the natural origin escapement occurs later in the season (WDFW Spawner Survey Database).

Broodstock Spawning/Pathology Sampling: Only hatchery-origin steelhead (AD-clip only) are spawned for the Kendall Creek program. After spawning, moribund females or fresh pond mortalities may be kidney/spleen sampled for thorough pathogen screening per the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington* (WDFW and WWTIT 1998 and updated 2006). No listed fish are included in this program.

Rearing Program: Only hatchery steelhead are reared on-station. Listed steelhead are not reared in this program.

Residualism:

Rearing and release strategies are key components to minimizing risks from hatchery programs on outmigrating salmonids. Ideally, hatchery steelhead are released when fish are smolting to encourage rapid outmigration to minimize the opportunity for predation or residualism risks (Fuss et al. 1999 and Snow et al. 2013) of hatchery fish on natural outmigrants. Studies conducted on predation risks to natural-origin Chinook (Sharpe et al. 2008) and steelhead (Naman and Sharpe 2012; Pflug et al. 2013) have shown predation risks to be minimal. Short outmigrating travel times have also been shown to minimize opportunity for negative interactions (9 days Moore et al. 2013 Puget Sound wide; 16.4 days Goetz et al. 2014, Green River).
Our protocol is based on 30 years of staff observations and the studies conducted to evaluate predation and residualization risks. The current protocol as described incorporates the following risk aversion factors into best practices to reduce risks to ESA-listed populations while meeting management goals.

- FISH UNIFORMITY: Monitor population uniformity of hatchery steelhead through CVs (CV = coefficient of variation for length and weight) and condition factors prior to release to ensure release criteria are met (uniform size, condition, etc).
- FISH SIZE: Release groups will meet the minimum size criteria of 10 fpp established by Tipping 2001.
- RELEASE TIMING: Releases of hatchery smolts will occur on or after April 15 to minimize predation risks on out-migrating natural-origin listed fry in the freshwater system so long as the first two criteria of fish uniformity and fish size are met (Tynan 2012 analysis-unpublished; Iverson and Missildine 2013 unpublished).

- VOLITIONAL RELEASE: Releases of hatchery smolts will be volitional to minimize residualization risks.
    - Volitional release will begin after April 15 when steelhead display cues of outward physical signs and behaviors of active smoltification, such as loss of parr marks, banding of tail, actively cruising pond edges, inflow, and outflow areas.
    - Hatchery Staff will pull screens to provide the opportunity for steelhead smolts ready to emigrate to leave the pond(s) or raceway(s).
    - Steelhead that have not volitionally left the holding area by the end of the release period (approximately one month (Fuss 1999; Tipping 2001)) will be transferred to non-anadromous lakes for angling opportunities.

  For more information on predation and competition risks see HGMP 2.2.3 *Competition/Niche-Displacement* and *Predation* sections below.

Operation of Hatchery Facilities: Potential facility operation impacts on listed fish include; water withdrawal, hatchery effluent, and intake compliance or barrier blockages. The intake screens at Kendall Creek are in compliance with state and federal guidelines (NMFS 1995, 1996), but do not meet the current "Anadromous Salmonid Passage Facility Design" criteria (NMFS 2011a). Monitoring and maintenance of hatchery facilities is conducted regularly. Effluent at outfall areas is rapidly diluted with mainstem flows and operation is within permitted guidelines (see HGMP sections 4.1 and 4.2). All permit requirements are followed in order to minimize the potential indirect 'Take" associated with the operations of these facilities. Kendall Creek water flow significantly diminishes in the summer months, resulting in the hatchery relying primarily on well water to maintain adequate flow. Because of the low summer water conditions, very limited sustainable spawning habitat exists above the hatchery weir. No take of listed fish has been reported by staff during the hatchery operation.

Genetic Introgression: Genetic introgression is the result of gene flow between hatchery and natural origin populations and occurs when hatchery origin adults that stray into natural spawning grounds successfully spawn with natural origin fish (H x W crosses). When hatchery adults spawn in the wild, both temporal and spatial separation of hatchery and natural origin steelhead spawning play a role in the amount of potential impact to genetic introgression. Run timing for natural origin winter steelhead stocks in Puget Sound systems range from November to June with the current existing peak spawn time in most populations from mid-April through May (SaSI, WDFW 2012). Where native summer steelhead stocks are present, run timing occurs from April to December with peak spawn time believed to be approximately one month earlier than the winter stock (SaSI, WDFW 2012). The native summer steelhead populations in the Nooksack system may have been historically small and limited by their habitats.

Releases to various locations in the system occurred in the past, but have been eliminated and program fish are currently released on-station (100% mass marked) and with no out of basin transfers. On-station releases improve homing and thus reduce straying potential. For the early winter steelhead stocks in Puget Sound, eggs will not be taken from fish that mature later than January 31 in order to reduce potential overlap of hatchery fish with the existing natural-origin winter steelhead peak spawning. In the Nooksack system, the natural-origin winter run steelhead spawning generally occurs from early March through June.

The expected gene flow rate can be much lower than the "stray" rate. In a well-run segregated program, the level of gene flow should be quite low for four reasons: 1) Nooksack natural winter run population size is comparatively strong, averaging 1,760 annually for the five years with estimates since 2004; 2) the numbers of hatchery-origin fish that have escaped harvest should be low compared to the number of natural-origin fish present; 3) the reproductive success of the

hatchery-origin fish can be expected to be low (Leider et al. 1990; Kostow et al. 2003; McLean et al. 2003; McLean et al. 2004); and 4) spawning overlap may be low (Scott and Gill 2008, Co-manager unpublished spawn survey data).

Operational changes were implemented in 2009 to remove hatchery fish including adults trapped in excess of broodstock needs. This includes not re-cycling fish for additional sport opportunities and that trapping facilities would continue removing hatchery fish until March 15 or later as conditions allow.

Disease Transmission: Interactions between hatchery reared and naturally produced populations could be a source of pathogen and disease transmission although there is little evidence showing that diseases are transmitted from hatchery fish to natural-origin fish (Steward and Bjornn 1990). WDFW conducts fish disease examinations to ensure minimal disease transmission and to prevent the introduction and/or spread of any fish diseases. Fish health-monitoring efforts include fish health examinations and virus sampling, abnormal fish loss investigations, and pre-transfer and pre-release inspections. All activities are done in accordance with guidelines developed under *the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).

Competition/Niche-Displacement: Freshwater carrying capacity may be compromised if hatchery steelhead smolts released or those produced naturally from hatchery spawners competitively displace or compete with natural origin fish in their natural rearing habitats. Although studies specific to competition or niche displacement in the Nooksack River system are not conducted, telemetry studies indicate that steelhead migrate out of the Puget Sound quickly, with an average travel time of 9 days to the Strait of Juan de Fuca (Moore et al. 2013, Moore et al. 2010, Goetz et al. 2008). Migration rates of approximately 20 river miles per day have been observed with steelhead smolts released in the Cowlitz River (Harza 1999). With hatchery steelhead released as smolts, and a short outmigration timeframe, the opportunity for competition is reduced. Interactions with listed salmonids in the estuarine and nearshore environment are likely to be limited.

Predation: Steelhead released from hatchery programs may prey upon listed species of salmonids, but the magnitude of predation will depend upon the characteristic of the listed population of salmonids, the habitat in which the population occurs, and the characteristics of the hatchery program (e.g., release time, release location, number released, and size of fish released). Based on stomach fullness, most steelhead smolts do not begin to feed extensively until about a week after release (Cannamela 1993). Recent WDFW research (Sharpe et al. 2008) has shown that the predation risks from hatchery steelhead smolt releases are minimal on smaller prey fish. Based on a study in the Skagit basin, Pflug et al. 2013 showed that hatchery steelhead smolts did not prey on natural origin steelhead juveniles and there was evidence of limited predation on Chinook, pink and chum.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.

Listed Chinook have not been collected during winter steelhead trapping. Bull trout or natural origin steelhead may be inadvertently handled and released from trapping facilities but operational protocols are in place to return these adults back to the river as quickly as possible when and where they occur. Inadvertent mortality on all listed fish encountered at these trapping sites and returned back to stream is estimated to be 0-1 fish yearly. In most years staff have reported none.

- Provide projected annual take levels for listed fish by life stage (juvenile and adult) quantified (to the extent feasible) by the type of take resulting from the hatchery program (e.g. capture, handling, tagging, injury, or lethal take).

We do not expect take level to exceed what has occurred in the past.

- Indicate contingency plans for addressing situations where take levels within a given year have exceeded, or are projected to exceed, take levels described in this plan for the program.

Any additionally mortality from these activities, above what is anticipated and described above, would be communicated to WDFW Fish Program, local Co-managers and NOAA staff for additional guidance.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g. *Hood Canal Summer Chum Conservation Initiative*) or other regionally accepted policies (e.g. the NPPC *Annual Production Review* Report and Recommendations - NPPC document 99-15). Explain any proposed deviations from the plan or policies.

This HGMP is a component of the Co-managers resource management plan for Puget Sound steelhead.

3.2) List all existing cooperative agreements, memoranda of understanding, memoranda of agreement, or other management plans or court orders under which program operates.

The Lummi Nation and Nooksack Tribe along with WDFW prepare an annual fishery management plan for the harvest of Nooksack River system winter steelhead produced from this program (WDFW et al. 2008 to present). Emergency in-season regulations may restrict fishing when hatchery escapement shortfalls are anticipated. Fishing restrictions will be used to assist in meeting and necessary to meet program goals.

WDFW hatcheries in Puget Sound operate under *U.S. v Washington* that provides the legal framework for coordinating these programs, defining artificial production objectives, and maintaining treaty-fishing rights through the court-ordered *Puget Sound Salmon Management Plan* (PSSMP 1985). This co-management process requires that both the State of Washington and the relevant Puget Sound Tribe(s) develop program goals and objectives and agree on the function, purpose and release strategies of all hatchery programs.

Equilibrium and Future Brood Document (EBD and FBD): The PSSMP defines the EBD as the annual expression of the equilibrium brood document as it pertains to the coming year's run of salmon and describes the standard mode of operation for existing facilities/functions, associated with fish culture activities. The FBD provide descriptions of facilities, species propagated, and fishery management, hatchery production, broodstock management, eggtake, rearing, and release goals for each facility. While it does not include all of the requirements of the EBD, he Future Brood Document (FBD) provides pre-season planning information for EBD fish hatchery production reporting information in Washington State for the upcoming brood stock collection and fish rearing season (July 1 –June 30). The FBD is coordinated between WDFW, Puget Sound and coastal treaty tribes, the Northwest Indian Fisheries Commission (NWIFC), eastern Washington treaty tribes, and Federal fish hatcheries. Hatchery production by volunteers, schools, and Regional Fisheries Enhancement Groups are represented by WDFW.

See also HGMP section 3.1.

3.3) Relationship to harvest objectives.

WDFW general harvest goals are to provide fishing opportunities consistent with the mandate of the agency for restoration and recovery of natural origin indigenous salmonid runs, the Pacific Salmon Treaty, the *Puget Sound Salmon Management Plan*, the *Statewide Steelhead Management Plan*, annual fisheries management plans, *US v. Washington*, and other state, federal, and international legal obligations. The Lummi Nation and Nooksack Tribe along with WDFW prepare an annual fishery management plan for the harvest of Nooksack River system summer and winter steelhead released from hatchery programs (WDFW et al. 2008 to present). In each of these plans they have agreed not to target natural origin steelhead, due to Co-manager agreement on a lack of harvestable surplus.

3.3.1) Describe fisheries benefitting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1988-99), if available.

Harvest on targeted hatchery fish: Returning winter steelhead adults provide for limited tribal commercial and subsistence use and provide a localized recreational sport fishery, mostly from November through January each year, (and February 15 in the terminal area near the hatchery). Tribal fisheries include net fisheries from early December through mid-January (Lummi Nation et al. 2011). The directed sport fishery is open June to mid-February (Nooksack River) within selected stream reaches with two hatchery origin steelhead over 20 inches allowed (WDFW Sport Fishing Rules 2013/2014).

Table 3.3.1.1: Kendall Creek Hatchery Winter (Early) Steelhead Harvest 2001-2012.

Return Year[a]	Total Released	Sport Harvest[b]	Tribal Harvest	Hatchery Escapement	SAR %
2000/2001	33,900	305	37	18	1.06%
2001/2002	35,000	302	34	193	1.51%
2002/2003	30,500	238	1	7	0.81%
2003/2004	34,800	173	8	73	0.73%
2004/2005	160,000	447	9	376	0.52%
2005/2006	175,500	238	10	219	0.27%
2006/2007	63,400	216	3	66	0.45%
2007/2008	165,000	147	66	159	0.23%
2008/2009	160,000	46	15	36	0.06%
2009/2010	164,000	56	28	96	0.11%
2010/2011	146,500	106	47	158	0.21%
2011/2012	106,200	69	116	156	0.32%
Average	**106,233**	**195**	**31**	**130**	**0.52%**

Source: WDFW Catch Record Card (CRC) Database 2013. WDFW Hatcheries Headquarters Database 2013.

[a] Smolt releases made two years earlier in the spring.

[b] 2- or 3-salt returns cannot be broken out, and is the total of the Nooksack River system.

[c] 38,500 released from Kendall after being reared at McKinnon.

Incidental impact on non-targeted natural origin steelhead: Implementation of selective-fishing rules which requires the release of all natural origin, unmarked steelhead in Puget Sound began in the 1990s. This has reduced natural origin steelhead harvest statewide to approximately 1% of the catch (Scott and Gill 2008). Cool water temperatures at this time minimize incidental mortality on listed steelhead. Non-targeted natural origin steelhead may be hooked and released with an unknown impact for most streams and direct studies have not been done in this system. Nelson et al. (2005) showed catch and release mortalities of 1.4% to 5.8% in 1999 and 2000 respectively on

steelhead caught in recreational fisheries on the Chilliwack River in British Columbia. A hook and line mortality study conducted in the Samish River on winter-run steelhead also showed similar results to this, although it indicated that there may be a negative relationship between a fish being caught in a sport fishery and its survival to out migration as kelts (Ashbrook et al. in press). This study also showed no indication of increased mortality on fish that had been caught and released multiple times. Taylor and Barnhart (1999) determined that summer steelhead caught and released in the Mad and Trinity Rivers of California had a 9.5% mortality rate, with 83% of the mortalities occurring at water temperatures of 21°C or greater. As such hooking mortality associated with recreational sport harvest is generally believed to be less than 10% of fish hooked and released. As the Nooksack River sport harvest season ends by January 31, except in close proximity to the hatchery, most of the incidental catch and release may be prior to majority of the natural origin winter run being present.

3.4) Relationship to habitat protection and recovery strategies.

The purpose of this joint state-tribal hatchery program is to provide harvest opportunity while remaining consistent with the Co-manager's primary management strategy and recovery objectives for local natural steelhead populations. Habitat protection and restoration strategies are paramount to the recovery of self-sustaining, natural populations. If land use practices have been optimized to allow sufficient habitat protection and restoration, and harvest goals are being met, the hatchery program will be the remaining focus to meet management criteria for population status, genetic brood stock management, ecological benefits and risks, and environment regulations. With habitat and harvest goals being met, the conservation objective will be the primary requirement. The alternative would be evaluated relative to policy goals for the watershed.

Salmon Recovery Funding Board (SRFB): Created by the Legislature in 1999, the SRFB is composed of five citizens appointed by the Governor and five state agency directors, the Board provides grant funds to protect or restore salmon habitat and assist related activities. It works closely with local watershed groups known as lead entities (see below). The Board supports salmon recovery by funding habitat protection and restoration projects, and related programs and activities that produce sustainable and measurable benefits for fish and their habitat.

Lead Entities: Whatcom County, with the passage of resolutions by the Nooksack Tribe, Lummi Nation, Cities of Ferndale, Everson, Lynden, Sumas, Nooksack, Blaine and Bellingham; and Skagit and Whatcom counties, was selected to be the Lead Entity in the Nooksack River basin. The Lead Entity was changed to the WRIA 1 Salmon Recovery Board in 2004 with the passage of an Interlocal Agreement that established the WRIA 1 Salmon Recovery Board, which is comprised of Nooksack Tribe, Lummi Nation, WDFW, Whatcom County, and Cities of Bellingham, Ferndale, Everson, Lynden, Sumas, Nooksack, and Blaine. Under the Interlocal Agreement, as the Lead Entity the WRIA 1 Salmon Recovery Board is the lead "for salmon recovery efforts and programs in WRIA 1 when cooperative and joint actions described within various federal, state, and local statutes and administrative programs are required." See also http://www.rco.wa.gov/salmon_recovery/lead_entities.shtml

Regional Fisheries Enhancement Groups (*RFEGs*): Several citizen based groups in conjunction with local governments work on habitat actions to benefit both listed and non-listed stock in the system including the Nooksack Salmon Enhancement Association.

Puget Sound Partnership Action Agenda An ESU-wide ecosystem recovery planning effort is being undertaken by the Puget Sound Partnership, a state agency dedicated to restoring Puget Sound , including salmon and steelhead (online at http://www.pugetsoundpartnership.org).

3.5) Ecological interactions.

See HGMP section 11 for new research on impacts.

(1) *Salmonid and non-salmonid fishes or other species that could negatively impact the program.* Negative impacts by fishes and other species on the Kendall Creek Hatchery winter steelhead program could occur directly through predation on program fish, or indirectly through food resource competition, genetic effects, or other ecological interactions. In particular, fishes and other species could negatively impact steelhead survival rates through predation on newly released, emigrating juvenile fish in the freshwater and marine areas. Certain avian and mammalian species may also prey on juvenile steelhead while the fish are rearing at the hatchery site, if these species are not excluded from the rearing areas. Species that could negatively impact juvenile steelhead through predation include the following:

- Avian predators, including mergansers, cormorants, belted kingfishers, great blue herons, and night herons
- Mammalian predators, including mink, river otters, harbor seals, harbor porpoises and sea lions
- Cutthroat trout and bull trout

Rearing and migrating adult steelhead originating from the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Nooksack River and Kendall Creek to the detriment of stock abundance and the program's success in harvest augmentation. Species that may negatively impact program fish through predation may include:

- Orcas
- Sea lions
- Harbor seals and harbor porpoises
- River otters

(2) Salmonid and non-salmonid fishes or other species that could be negatively impacted by the program (focus is on listed and candidate salmonid species).

- Puget Sound Chinook
- Puget Sound steelhead
- Puget Sound bull trout

(3) Salmonid and non-salmonid fishes or other species that could positively impact the program. The hatchery program protocols are designed to minimize the interaction between the program fish and other salmon and non-salmonid fishes. Therefore there are not expected to be significant positive impacts from salmon and non-salmon fishes to the program. The production and release of only smolts through fish culture and volitional release practices fosters rapid seaward migration, limits interactions with other species and reduces residualism.

(4) Salmonid and non-salmonid fishes or other species that could be positively impacted by the program. The program could positively impact freshwater and marine fish species that prey on juvenile fish. While adult carcasses from program fish are thought to be very limited, nutrients provided by the few decaying steelhead carcasses might also benefit fish in freshwater. These species include*:*

- Cutthroat trout
- Bull trout
- Chinook Salmon
- Steelhead
- Coho salmon
- Pacific staghorn sculpin

SECTION 4. WATER SOURCE

4.1) Provide a quantitative and narrative description of the water source (spring, well, surface), water quality profile, and natural limitations to production attributable to the water source.

Table 4.1.1: Water sources available at Kendall Creek Hatchery.

Facility	Water Source	Available Water Flow (gpm)	Water Temp (ºF)	Usage	Limitations
Kendall Creek Hatchery	Wells (5)	Up to 12,200	47	All	No limitations
	Kendall Cr (surface)	Up to 10,700	30-50	Broodstook holding, rearing, acclimation.	Limited summer usage.
McKinnon Acclimation Pond	Unnamed stream (surface)	800-900	38-45	Temporary rearing	No limitations

Table 4.1.2: Record of NPDES permit compliance at Kendall Creek Hatchery.

Facility/ Permit #	Reports Submitted Y/N			Last Inspection Date	Violations Last 5 yrs (see Table 4.2.2)	Corrective Actions Y/N	Meets Compliance Y/N
	Monthly	Qtrly	Annual				
Kendall Cr WAG13-3007	Y	Y	Y	5/23/2005	1	N	Y

Source: Ann West, WDFW Hatcheries Headquarters Database 2013

Table 4.1.3: List of NPDES violations at Kendall Creek Hatchery over the last five years (2008-2012).

Monitoring Month	Parameter	Sample Type	Result/ Violation	Permit Limit	Comment	Action
September 2011	N/A	N/A	DMR due to Ecology by July 30, 2011	N/A	Late DMR to Ecology	Explanation to personnel to correct procedures

Source: Ann West, WDFW Hatcheries Headquarters Database 2013

Kendall Creek Hatchery: Well and surface (when available) water can be used in steelhead production. Well water is of excellent quality, pathogen-free, at constant temperature of 47°F, and is available year round. Well water is passed through a de-nitro tower to improve the dissolved oxygen content.

The surface water supply at the hatchery is limited by water flows. Kendall Creek is a seasonal stream that can run dry during summer; while it maintains flows throughout the spring months, it is not always able to provide water for hatchery use. When available, creek water can be mixed with well water and used for adult attraction and holding, rearing and acclimation. However, incubation and initial rearing of steelhead at Kendall Creek is done strictly on well water.

Surface water rights are formalized through trust water right permits # G1-10562c, G1-2361c, and S1-00317.

McKinnon Pond: The facility consists of a single pond, gravity-fed by surface water from a stream known locally as "Peat Bog Creek" (WRIA 01.0352). The water supply is influenced by stream flows; while reduced in summer, the supply is relatively consistent, and especially for December through March rearing. Water temperatures range from 38°-45°F.

Surface water rights are formalized through trust water right permits # S1-27351.

4.2) Indicate risk aversion measures that will be applied to minimize the likelihood for the take of listed natural fish as a result of hatchery water withdrawal, screening, or effluent discharge.

Kendall Creek Hatchery: The intake screens at Kendall Creek Hatchery are in compliance with State and Federal guidelines (NMFS 1995, 1996), but do not meet the current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011a). Screens are identified for replacement, but are at lower priority than at other hatcheries, as listed fish do not occur above the rack on Kendall Creek.

This facility operates under the "Upland Fin-Fish Hatching and Rearing" National Pollution Discharge Elimination System (NPDES) general permit, which conducts effluent monitoring and reporting and operates within the limitations established in its permit administered by the Washington DOE, WAG 13-3007. Monthly and annual reports on water quality sampling, use of chemicals at this facility, compliance records are available from DOE.

Discharges from the cleaning treatment system are monitored as follows:

- *Total Suspended Solids (TSS)* 1 to 2 times per month on composite effluent, maximum effluent and influent samples.
- *Settleable Solids (SS)* 1 to 2 times per week on effluent and influent samples.
- *In-hatchery Water Temperature* - daily maximum and minimum readings.

McKinnon Pond: Gravity water intake screens at McKinnon Pond meets the current *Anadromous Salmonid Passage Facility Design* criteria (NMFS 2011a). Fish production at McKinnon Pond is relatively small, well under the 20,000 pounds limit set by WDOE for concern regarding hatchery effluent discharge effects and NPDES permit requirements. The outflow from the pond consists of a settling box and about 100-yards of heavily vegetated stream channel that returns directly into Peat Bog Creek, not far above the confluence with the Middle Fork.

Initially, eggs are incubated on well water. Post hatch, the juvenile steelhead are reared on a combination of surface and well water at Kendall Creek hatchery (surface water as a primary source and well water as backup depending on the availability of surface water). Historically, Kendall Creek has minimal flows during drought conditions. In these situations, well water may be used exclusively. After rearing at McKinnon ponds, steelhead are brought back to Kendall Creek Hatchery for a more lengthy final rearing/acclimation that occurs on surface water to minimize possibility of straying.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

The early winter steelhead broodstock is recruited from adults returning to the hatchery trap, reconditioned kelts, or captive brood at Kendall Creek Hatchery until up to 200,000 eggs are collected.

A permanent weir across Kendall Creek, directs fish into a ladder and the "V"-trap, which leads into the adult holding pond.

Broodstocking efforts may include hook and line during open seasons and in open waters.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).

This facility has 1000-, 850- and 400-gallon tanker trucks, equipped with aerators and oxygen tanks available for fish transportation.

5.3) Broodstock holding and spawning facilities.

At Kendall Creek Hatchery broodstock is held in the adult pond, which is supplied with well or well/creek water mix if creek water is available. Ripe adults not selected for kelt reconditioning killed and transported in totes to the hatchery building to be spawned. The adults selected for kelt reconditioning will be live spawned, then rehabilitated and reared.

5.4) Incubation facilities.

A portion of the progeny from 2014 brood year or years with significantly low eggtake, may be reared to begin a captive brood program, which along with kelt reconditioning may be a backup source for eggs in the future if sufficient volitionally returning adults are not available.

Table 5.4.1: Incubation vessels available at Kendall Creek Hatchery.

Type	Number	Size
Vertical stack incubators	336 trays	24" x 25' x 3"
Troughs	24	24" x 31" x 17"

5.5) Rearing facilities.

Table 5.5.1: Rearing ponds available at Kendall Creek Hatchery.

Type	Number	Size
Asphalt-lined rearing ponds	3	½ acre
Standard raceways	12	10' x 100' x 4'
Super-raceways	3	21’ x 130’ x 6’
Fiberglass circular ponds	2	20' diameter x 4'deep
Fiberglass circular ponds	8	16' diameter x 4'deep
Fiberglass circular ponds	6	6' diameter x 4'deep
Aluminum Capilano troughs	8	20' x 3' x 2'
Fiberglass intermediate troughs	6	11' x 3' x 36'
Fiberglass shallow troughs	34	14' x 12" x 7.5"
Fiberglass “ugly trough”	1	15' x 5' x 42'

Table 5.5.2: Rearing ponds available at McKinnon Pond.

Type	Number	Size
Asphalt-lined rearing ponds	1	292' x 42' x 6'

McKinnon pond is used to rear up to 50,000 steelhead from December through March 1.

5.6) Acclimation/release facilities.

Kendall Creek Hatchery raises salmon, steelhead, and trout at various life-stages for programs at other WDFW or tribal facilities; the use of rearing ponds can change depending on demand and availability. Final rearing of winter steelhead for this program may take place in super raceways or in the asphalt lined rearing ponds. If released from the super raceways, the fish are reared and acclimated on a well/creek water mix if creek water is available. If released from the asphalt-lined ponds, fish are reared and acclimated on well water.

In the past, some steelhead were released from McKinnon Pond. This facility is operated and maintained by volunteers from Mt. Baker High School Agriculture Education program and the Association of Northwest Steelheaders, coordinated by Trout Unlimited. Since there are no means to trap and remove returning fish, up to 50,000 juveniles are still reared at McKinnon Pond from December through March 1, and then transferred back to Kendall Creek Hatchery for final rearing and April 15th through May release.

Initially, eggs are incubated on well water. Post hatch, the juvenile steelhead are reared on a combination of surface and well water at Kendall Creek hatchery (surface water as a primary source and well water as backup depending on the availability of surface water). Historically, Kendall Creek has minimal flows during drought conditions. In these situations, well water may be used exclusively. After rearing at McKinnon ponds, steelhead are brought back to Kendall Creek Hatchery for a more lengthy final rearing/acclimation that occurs on surface water to minimize possibility of straying.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.

No operational difficulties have led to significant fish loss.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.

Listed fish are not reared in this program.

Kendall Creek Hatchery: An employee is on standby at all times to monitor hatchery operations and respond to any unexpected events. The facility is equipped with low water alarms and a back-up generator in case of power loss.

McKinnon pond is gravity fed, with no power available. The facility is operated and maintained by volunteers from the Mt. Baker High School Agriculture Education program (Advanced Natural Resources class) and the Association of Northwest Steelheaders, coordinated by Northwest Steelheaders. This educational facility will be monitored for risk aversion measures and performance.

Fish rearing is conducted in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006) to minimize the likelihood for the take of listed natural fish that may result from disease transmission. Adherence to artificial propagation, sanitation and disease prevention, diagnosis, treatment and control practices defined in the policy prevent or reduce the incidence and intensity of disease during hatchery spawning, incubation and rearing. As well as control the transmission of infectious pathogens between hatchery fish and the potential to infect natural-origin salmonids from hatchery effluent or directly by preventing or reducing releases of infected hatchery fish.

The 2012 Legislature passed the "Jobs Now" bill, which provided WDFW with funding for hatchery capital improvements in addition to our capital budget request. At Kendall Creek Hatchery, this allowed the following improvements:

Table 5.8.1: Hatcheries capital improvement projects funded under the "Jobs Now Act" (2012).

Projects
Renovate pollution abatement ponds.
Construct new 2-bay adult holding pond.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

Describe the origin and identity of broodstock used in the program, its ESA-listing status, annual collection goals, and relationship to natural origin fish of the same species/population.

6.1) Source.

Adult hatchery (distinguished by an adipose fin-clip) winter steelhead returning to the Kendall Creek Hatchery trap through January 31. The early winter stock is used for this hatchery program and is not ESA listed.

6.2) Supporting information.

6.2.1) History.

The Kendall Creek Hatchery winter steelhead program utilizes fish derived from the early winter hatchery stock, which was established in 1945 from a winter run steelhead population collected at South Tacoma Hatchery (now Lakewood Hatchery -WRIA 12) (Scott and Gill 2008). Warmer water available at the location was used to accelerate spawning time and encourage growing of smolts as a one-year age product rather than two-years, thereby significantly reducing cost of rearing in freshwater and increasing survival (Crawford 1979). The early winter stock, as a part of the Regional Egg Source, was utilized by several hatcheries in Puget Sound, and transferred to and between several river systems including the Skykomish, Snoqualmie, Skagit, Stillaguamish and Bogachiel rivers.

Winter run steelhead releases into Nooksack River basin started in 1900s. From 1909-1939 Kendall Hatchery spawned small numbers of local steelhead broodstock, with a low of 6 females and a high of 76 females (Ernst, WDG, 1950, as described in WRIA 1 SRB 2005). Norgore and Anderson (1921) mention that a North Fork tributary near the hatchery named Racehorse Creek was a location of steelhead collection. There were few hatchery releases from Kendall Hatchery in the 1940's. The Washington Department of Game (WDG) began releasing Chambers Creek origin steelhead annually into the Nooksack watershed in 1972, primarily with smolts from Bellingham Hatchery (WDG, 1984. Nooksack River Winter Steelhead Inventory). The report also mentions WDG cooperation with sports clubs to begin rearing natural origin Nooksack steelhead in 1981. From the 1970s through 2010, eggs originating from several facilities, including Bellingham Hatchery, were transferred to Kendall Creek Hatchery for incubation and distribution to off-station acclimation and release sites. Fish were released from Kendall Creek Hatchery for the first time in 1998. In 2001, broodstock collection was initiated at Kendall Creek Hatchery, but not enough fish were returning for program needs; backfill from Tokul Creek and/or Marblemount hatcheries were used to fill egg shortages. In order to develop a locally-adapted broodstock source for the Nooksack River system and eliminate reliance on other facilities, a four-year transition plan was developed and initiated in 2008. The last egg transfer to Kendall Creek Hatchery from an out-of-basin facility took place in 2010. Starting in 2008 Whatcom Creek Hatchery was used as an additional rearing and release site and as a back-up broodstock collection site for the Kendall Creek program. The Whatcom Creek program was discontinued in 2014. Releases from McKinnon Ponds ended in 2004.

6.2.2) Annual size.

Up to 50 pairs of adult fish are collected for broodstock. No natural origin fish are included.

6.2.3) Past and proposed level of natural fish in broodstock.

Prior to the implementation of mass marking of steelhead by the Washington State Department of Game (WDG) in 1981, any level of mixing natural fish in the broodstock in the past could not be identified (B. Crawford pers. comm. 2006).

This winter steelhead production is currently managed as a segregated program, which means that the hatchery broodstock is reproductively segregated from the naturally-spawning populations, and is composed entirely of returning hatchery-origin adults identified by a missing adipose fin.

6.2.4) Genetic or ecological differences.

Early winter stock hatchery fish typically return from late-November through early-February, while their natural origin counterparts return from November through June. Peak hatchery spawning occurs in January, while peak natural origin winter spawning occurs in late-April/May, with peak natural origin summer steelhead spawning thought to be approximately one month earlier. South Fork summer run steelhead occupy habitats upstream of waterfalls, the lower of which is at river mile 25. Nooksack winter run steelhead are not considered to occupy this habitat, with their use ending at river mile 25 (WDG 1984). Hatchery steelhead are released as

age 1+ smolts, whereas natural origin steelhead are predominately age 2+ smolts. Out-migration timing for both life history types is similar but is slightly earlier for the hatchery component (Fuss et al. 1998).

Recent genetic analysis has been performed and detailed results can be found in HGMP section 2.2.2, Warheit, 2014 unpublished report and addendum to this HGMP.

DNA collections and analysis will be conducted to update genetic makeup of endemic and non-local steelhead stocks in Puget Sound (See HGMP Section 2.2.2 for current results).

See also "*Genetic Introgression*" in HGMP section 2.2.3.

6.2.5) Reasons for choosing.

The early winter steelhead stock was selected for its early arrival and spawn timing (as compared to natural origin steelhead), availability and the ability to release one-year smolts (Crawford 1979). This stock has been used statewide to provide fish for recreational and/or tribal harvest with minimal overlap in time and space with natural-origin steelhead.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Fish collected for this hatchery program are from the early winter hatchery stock and priority is given to keeping hatchery returns to Snoqualmie facilities (Tokul Creek) and the Skykomish facilities (Wallace and Reiter) within each respective river basin in an effort to promote local adaptation and reduce straying. No natural-origin fish are included in the broodstock. No eggs are collected after January 31 (change implemented with the 2008 broodstock collection). Target of 100% mass marking allows exclusion of natural-origin fish from the hatchery broodstock and selection for earlier-maturing fish deepens temporal separation, keeping the hatchery and naturally-spawning fish genetically different and increasing divergence of the populations.

This production is managed as a segregated program with the intent to separate hatchery and natural origin stocks and excludes utilization of natural-origin (adipose present) steelhead. The separation was achieved by producing fish that spawn earlier than natural origin fish. Early winter stock hatchery fish typically return from late-November through early-February, while their wild counterparts return from November through June. Peak hatchery spawning takes place in January, while the peak spawn timing for natural origin winter steelhead is from late-April through early May (Hoffmann 2014). To further accentuate and minimize spawning overlap with known natural origin winter steelhead present in the system, adipose clipped hatchery broodstock collection period was further limited to fish maturing before January 31st, from the previously accepted date of February 28.

The proposed rules for listing Puget Sound steelhead (71 FR15666; March 29, 2006) stated "Several BRT members noted that anecdotal historical accounts discuss significant early runs of wild steelhead, but expressed concern that these early wild spawners have apparently disappeared from several river systems." While we acknowledge that significant uncertainty exists in our understanding of the historical run and spawn timing of steelhead, we believed that it was important to evaluate the risk that the proposed early winter hatchery programs could suppress re-expression of this potential component of the population. This could occur, for example, if the early spawning natural origin steelhead spawned with hatchery-origin steelhead, and if the resulting hybrids had a lower chance of survival than natural origin by natural origin crosses.

One important piece of information to evaluate this risk is the historical spawn timing of steelhead in Puget Sound rivers. The PSSTRT (2013) compiled historical records from a wide variety of sources to help define the historical populations of steelhead in the Puget Sound DPS.

We have summarized this information in Table 6.3.1. The limited information available from these sources is consistent with our current observations for the spawn timing of Puget Sound natural origin winter steelhead (Hoffmann 2014).

Table 6.3.1. Summary of historical information regarding the spawn timing of steelhead in the Puget Sound DPS.

River Basin	Timing	Comments
Baker	March 8 – May 9	Collection of adults in 1900 for Baker Lake Hatchery. May include summer-run. Ravenal (1900) cited in PSSTRT (2013).
Sauk	Early February through June 15	Collection of steelhead spawn in 1906. Riseland (1907) as cited in PSSTRT (2013).
Sultan	April 8 – June 4	Spawning at the Sultan River Hatchery in 1920s. Leach (1923) as cited in PSSTRT (2013).
Quilcene	February 27 – June 7	Spawning at the Quilcene National Fishery Hatchery in 1922. USBF (1923) as cited in PSSTRT (2013)
Hood Canal West Side Tributaries	March 24 – May 1	Spawning of ripe fish in 1926. Leach (1927) as cited in PSSTRT (2013).

The PSSTRT (2013) also reviewed records of steelhead spawning at Washington Department of Game hatcheries in the 1930s. The PSSTRT cautioned that the timing of egg collection "may not be fully representative of natural spawn timing"; however, little if any spawning occurred at the Nooksack, Samish, Skykomish, or Dungeness hatcheries prior to March 1. In some years, spawning did occur earlier at the Puyallup Hatchery (as early as early February in two of six years analyzed) and the Green Hatchery (as early as early-February), but there is no evidence that these early spawning fish comprised a significant component of the return,

A third source of information is Snow Creek, a small lowland tributary to the Strait of Juan de Fuca. The Department has conducted extensive research on Snow Creek for more than 30 years. Fishing has been prohibited since 1977, and no releases of hatchery-origin steelhead have occurred that would affect the timing of spawners. The initial redds in this stream can be constructed as early as February or March. For example, the date of first redd construction was the week of March 1 in 1979 and February 4 in 1980. The average date of spawning in these years was March 28th , and 95% of the spawning occurs after the end of February (Hoffmann 2014).

The PSSTRT (2013) concluded that "steelhead spawn earlier in small lowland streams where water temperatures are generally warmer than in larger rivers with higher elevation headwaters." Our analysis of historical information and current data support this conclusion and suggest that natural origin steelhead spawn from early March through mid-June in rivers originating in the Cascades or Olympics. As evident from Snow Creek, initial spawning in small lowland streams can be earlier, early February to early March.

This information, and the substantial modification of early winter steelhead programs that have occurred since 2008, suggest that interbreeding of early winter hatchery-origin and natural origin steelhead is unlikely to suppress re-expression of a potential early spawning component of a natural origin steelhead population. In the larger rivers with higher elevation headwaters, the

hatchery-origin early winter steelhead spawn well before the natural origin steelhead. In small lowland streams, like Snow Creek, the potential for genetic interaction between hatchery-origin early winter steelhead and natural origin steelhead is greater, but remains small. Even in this case, Hoffmann (2014) estimated that only 7.4% of Snow Creek natural origin steelhead would spawn during the same time period as early winter steelhead from the Tokul Creek Hatchery. Even more importantly, the elimination of all off-station releases and the cessation of releasing steelhead in small streams (e.g., Samish River, Pilchuck Creek, Pilchuck River, Raging River, Tolt River, Sultan River, east side Hood Canal rivers) provided additional risk control measures.

SECTION 7. BROODSTOCK COLLECTION

7.1) Life-history stage to be collected (adults, eggs, or juveniles).

Adults.

7.2) Collection or sampling design.

Early winter steelhead broodstock is recruited from adults returning to the hatchery trap, reconditioned kelts, or captive brood at Kendall Creek Hatchery until the egg take goal of up to 200,000 is reached.

The trap at Kendall Creek Hatchery is operated from late May through at least March15 to collect spring Chinook, chum, and winter steelhead broodstock and for the removal of hatchery-origin steelhead from the system. Winter steelhead returns peak from the end of December through January, and broodstock is collected until January 31. Any fish returning after that date are removed from the system.

Broodstock collection by "hook and line" for hatchery steelhead within the basin may be considered if an additional source of broodstock is needed.

In the past, when the egg-take goal was not achieved, eggs were transferred from Tokul Creek (WRIA7), and Marblemount (WRIA 4) hatcheries. The last out-of-basin egg transfer took place in 2010. From then on the program has been dependent on local production.

7.3) Identity.

All fish released through this hatchery program have been consistently 100% mass-marked (adipose fin-clipped) since the 1999 releases (brood year 1998).

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):

Up to 50 pairs of adult fish collected annually.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

The following data represents broodstock spawned at Kendall Creek hatchery for steelhead programs at Kendall and Whatcom Creek hatcheries. Until 2010, egg shortages were supplemented from Marblemount or Tokul Creek hatcheries. Broodstock for this program will be collected at Kendall Creek Hatchery with the discontinuation of the Whatcom Creek program in 2014.

Table 7.4.2: Sex composition of winter steelhead broodstock spawned at Kendall Creek

Brood Year	Kendall	
	Females	Males[a]
2001	6	2+6
2002	61	65 + 1
2003	2	+2
2004	34	35
2005	94	97
2006	47	51
2007	33	33 + 2
2008	81	77
2009	13	19
2010	33	40
2011	65	82
2012	52	59
2013	26	29
Average	**45**	**49**

Source: Bellingham Technical College, 2012, WDFW Hatcheries Headquarters Database 2013, (2011-12 data preliminary).

[a] "+ number" indicates live spawned males

7.5) Disposition of hatchery-origin fish collected in surplus of broodstock needs.

In most years, no surplus fish are available. In years when fish are collected in surplus of broodstock needs they are removed from the system; no recycling occurs. Removed fish may be donated to Nooksack Tribe and Lummi Nation, approved charitable organizations or used for nutrient enhancement.

7.6) Fish transportation and holding methods.

Adults are not transported.

7.7) Describe fish health maintenance and sanitation procedures applied.

The program adheres to standard fish health protocols, as defined in the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (WDFW and WWTIT 1998, updated 2006).

7.8) Disposition of carcasses.

Food-grade quality carcasses may be distributed to approved charitable organizations and local tribes for ceremonial and subsistence purposes. Nonfood-grade carcasses are used in local streams for nutrient enhancement if approved by the Fish Health Specialist.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

This production is managed as a segregated program, with the intent to separate hatchery and natural origin stocks. As such, listed steelhead are not targeted for hatchery broodstock and are not typically encountered.

In the past eggs for this program were collected through February. A policy introduced in 2008 eliminated broodstock collection takes after January 31. Early winter stock hatchery fish typically return from late-November through early-February, while their natural origin counterparts return from November through June. Peak hatchery spawning takes place in January, while the peak natural origin winter spawning occurs in late-April/May. The new collection period takes place earlier than much of the natural origin winter steelhead spawning observed in this system (SaSI, WDFW 2012, Co-manager spawn survey data), and may further accentuate and minimize overlap with natural origin winter steelhead present in this system. This collection timeframe avoids trapping listed Chinook during the steelhead broodstocking season, and unmarked steelhead have not been trapped at the hatchery during the last 12 years.

SECTION 8. MATING

Describe fish mating procedures that will be used, including those applied to meet performance indicators identified previously.

8.1) Selection method.

All fish are selected randomly based on ripeness prior to January 31. In years when limited numbers of fish are collected, all available fish are utilized for broodstock.

8.2) Males.

All males collected are considered for spawning and are selected randomly on spawn days. The practice of "live spawning" males is not commonly used at this facility. Males have only been live-spawned twice during the last 12 years. Steelhead jacks are not seen at this facility.

8.3) Fertilization.

Eggs from each female are collected in a separate container, mixed with milt from one male and allowed 30-60 seconds for fertilization. Then milt from a second, back up male is added in case of poor quality milt from the primary male. The second/back-up male would be the primary male used to fertilize the eggs of the previous female.

8.4) Cryopreserved gametes.

Cryopreserved gametes are not used.

8.5) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the mating scheme.

Listed steelhead are not included in the broodstock as part of the mating scheme. Regardless, proper spawning protocols are implemented in an effort to minimize directed, artificial selection of traits and maximize the representation of each individual adult.

SECTION 9. INCUBATION AND REARING -

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

9.1) Incubation:

The current egg-take goal for the winter steelhead program at Kendall Creek Hatchery is 200,000.

9.1.1) Number of eggs taken and survival rates to eye-up and/or ponding.

Table 9.1.1.1: Egg-to–ponding survival of eggs collected for winter steelhead program at Kendall Creek Hatchery.

Brood Year	Eggs Collected		Survival Rates (%)	
	Kendall	Total Used	Green-to-Eyed Up	Eyed-Up-to-Ponding
2001	15,000	171,300	94.1	93.5
2002	225,000	225,000	97.8	96.0
2003	6,000	310,000	94.2	95.9
2004	110,000	288,753	86.6	82.0
2005	250,000	275,716	98.0	98.6
2006	149,000	280,000	94.6	94.4
2007	87,000	187,000	98.5	98.3
2008	253,000	253,000	94.1	96.0
2009	47,000	147,200	99.9	99.8
2010	132,000	232,000	97.8	99.1
2011	236,000	260,000*	99.2	98.5
2012	208,000	208,000	98.3	98.9
Average	**145,167**	**236,497**	**96.1**	**95.9**

Source: WDFW Hatchery Records 2012.
*24,000 eggs were collected at Whatcom Creek Hatchery

9.1.2) Cause for, and disposition of surplus egg takes.

Extra eggs may be collected for this program, to allow for a larger effective gene pool and to offset losses to predation and disease. When additional eggs are taken, the surplus is typically culled at picking or after initial swim up. If losses are too high, then the program goals may not be met.

9.1.3) Loading densities applied during incubation.

Fertilized eggs are placed in vertical incubators at approximately10,000 per tray.

9.1.4) Incubation conditions.

All eggs are incubated in vertical trays supplied with well water at a rate of 3gpm. The temperature of the inflowing water is a constant 47ºF. Dissolved oxygen is checked when needed and Vexar® layers are placed in the trays to provide substrate.

9.1.5) Ponding.

When fish are completely buttoned up -- condition factor (KD) ranges from 1.80 to 1.85 and corresponds with approximately 1,200 TU -- and ready for initial feeding (April), they are ponded into either indoor shallow troughs or outdoor Capilano troughs supplied with well water.

9.1.6) Fish health maintenance and monitoring.

All eggs are fertilized and water-hardened in an iodophor solution. Fungus in the incubators is controlled by a formalin drip (15-minute injection per day at a target dose of 1,667-ppm formalin) throughout incubation until just prior to hatching. Once eyed (~400 TU), the eggs are shocked and dead eggs are removed. Fry loss is picked at upon ponding and then daily.

9.1.7) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish during incubation.

Listed fish are not incubated for this program.

9.2) Rearing:

9.2.1) Provide survival rate data (average program performance) by hatchery life stage (fry to sub-yearling; sub-yearling to smolt) for the most recent twelve years (1988-99), or for years dependable data are available.

Table 9.2.1.1: Survival rates of winter steelhead juveniles reared at Kendall Creek Hatchery.

Brood Year	Survival Rates (%)	
	Fry-to-Sub-yearling	Sub-yearling-to-Smolt
2001	95.2	99.1
2002	97.4	99.4
2003	97.3	97.4
2004	87.6	91.8
2005	98.8	98.8
2006	93.0	95.8
2007	99.2	99.7
2008	97.8	98.7
2009	99.7	99.9
2010	98.4	98.5
2011	99.2	99.9
2012	98.5	99.7
Average	**96.8**	**98.2**

Source: WDFW Hatcheries Headquarters Database 2013

9.2.2) Density and loading criteria (goals and actual levels).

Loading and density levels at WDFW hatcheries conform to standards and guidelines set forth in *Fish Hatchery Management* (Piper et al. 1982) and the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). Fish rearing densities are maintained at a maximum of less than 3lbs of fish /gpm at release and under 0.35lbs/ft^3.

9.2.3) Fish rearing conditions.

When juveniles reach ~500 fish per pound (fpp) (June), all fish are moved outside into standard raceways and reared on well water. Mass-marking takes place in September, when fish are ~100 fpp. After marking, fish destined for rearing exclusively at Kendall Creek Hatchery can be placed back into the super raceways or asphalt-lined rearing ponds. Depending on the rearing destination, fish are reared on well/creek water mix (super raceways) or well water (asphalt rearing ponds). Fish destined to be transferred to McKinnon Ponds for temporary rearing are reared strictly on well water. In December, up to 50,000 fish at ~35 fpp are moved to McKinnon Pond, where they are reared until March 1, before being transferred back to Kendall Creek Hatchery for final rearing and mid-April or May release with the other on station steelhead.

Table 9.2.3.1: Monthly average surface water temperature (°F) at M.F. Nooksack River near Deming and Peat Bog Creek.

Month	MF Nooksack River near Deming USGS station	McKinnon Pond Average Water Temperature (ºF)
January	NA	42
February	NA	42
March	NA	45
April	40	48
May	43	NA
June	46	NA
July	49	NA
August	50	NA
September	48	NA
October	NA	NA
November	NA	NA
December	NA	42

Source: MF Nooksack, USGS data; McKinnon Pond, Todd Rightmire - personal communication

9.2.4) Indicate biweekly or monthly fish growth information (average program performance), including length, weight, and condition factor data collected during rearing, if available.

Table 9.2.4.1: Average size (fpp), by month, of juvenile winter steelhead reared at Kendall Creek Hatchery.

Month	Average Size (fpp)
April	2,000
May	800
June	500
July	350
August	250
September	100
October	40
November	30
December	20
January	15
February	10
March	8
April	7
May	5

Source: WDFW Hatchery Records 2012.

9.2.5) Indicate monthly fish growth rate and energy reserve data (average program performance), if available.

See **Table 9.2.4.1** for growth information. No energy reserve data is available.

9.2.6) Indicate food type used, daily application schedule, feeding rate range (e.g. % B.W./day and lbs/gpm inflow), and estimates of total food conversion efficiency during rearing (average program performance).

Steelhead are fed a variety of diet formulations including starter, crumbles and pellets; the food brand used may vary, depending on cost and vendor contacts. Feeding frequencies vary depending on the fish size and water temperature and usually begin at three feedings/seven days a week and end at two feedings/seven days a week. Feed rates vary from 1% to 3% B.W./day. An overall seasonal food conversion rate is approximately 0.6-1:1. The food brand used depends upon cost and contacts with vendors and may differ in the future.

Fish reared at McKinnon Pond are hand fed at first and then by on-demand feeders, which are resupplied 2-3 times a week.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.

Fish health is monitored on a daily basis by the hatchery staff and at least monthly by a state Fish Health Specialist (FHS). Hatchery personnel carry out treatments prescribed by the FHS. Procedures are consistent with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006). See also HGMP section 10.9 for WDFW Standard Fish Health Procedures.

The same protocols have been adopted at McKinnon Ponds.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.

The migratory state of the released stock is determined by fish behavior. Aggressive screen and intake crowding, leaner condition factors, a more silvery physical appearance and loose scales during feeding events are signs of smolt development. ATPase activity is not measured.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.

No "NATURES" type rearing methods are applied through the program.

9.2.10) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish under propagation.

This program is managed as segregated and listed steelhead are not included in the hatchery broodstock and are not under the propagation in this program.

Hatchery fish are reared to meet *Statewide Steelhead Rearing and Release Guidelines* (Tipping 2001) to achieve a size and condition factor at a time of releases that represents the best chance for survival in order to meet adult goals. Rearing fish to a yearling smolt stage is mandatory in order to foster out migration and subsequent survival when the fish vacate the system. Fry or sub-yearlings stage fish will not be released from this program in order to minimize interactions with natural origin and ESA listed fish rearing in the system.

All reasonable and prudent measures are employed to minimize rearing and incubation losses. These include the use of high quality spring or well water for incubation, high quality feeds for rearing, rearing densities and loadings that conform to best management practices, frequent fish health inspections and presence of professionally trained personnel to operate facilities and predator protection. Hatcheries are designed to provide a safe and secure rearing environment through the use of alarm systems, backup generators, and water re-use pumping systems to prevent catastrophic fish losses.

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program.

10.1) Proposed fish release levels.

Table 10.1.1. Proposed fish release levels.

Age Class	Maximum Number[a]	Size (fpp)	Release Date	Location
Yearling	150,000	5.0	April 15/May	Nooksack River

Source: WDFW Future Brood Document 2013
Note: 5.0 fpp = 210mm fork length (fl).

10.2) Specific location(s) of proposed release(s).

Stream, river, or watercourse: Kendall Creek (01.0406)

Release point: RM 0.25 (Kendall Creek Hatchery)

Major watershed: Nooksack River

Basin or Region: Puget Sound

10.3) Actual numbers and sizes of fish released by age class through the program.

Surplus fish above the release goal were released into various Whatcom County lakes for use in non-anadromous programs (**Table 10.3.2**). Non-migratory fish will be planted into lakes that are functionally isolated from anadromous accessible freshwater and in compliance with the *Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State* (WDFW and WWTIT 1998, updated 2006).

Table 10.3.1. Numbers of hatchery winter steelhead released, by year, age and size at Kendall Creek Hatchery.

Release Year	Yearling	Avg. size (fpp)	CV	Date(s)
2002	34,800	5.0	6.3	5/1
2003	160,000	5.0	6.3	5/1, 5/4
2004	175,500[a]	5.5	7.0	5/3
2005	63,400	5.1	7.3	5/2
2006	165,000	6.0	7.5	5/2
2007	160,000	5.3	7.0	5/16
2008	164,000	5.5	5.6	5/19
2009	146,500	6.0	5.4	5/18
2010	106,200	5.0	4.2	5/12
2011	99,999	6.0	7.9	5/4
2012	116,360	6.0	7.0	5/7
2013	118,806	6.0	6.0	5/8-10
Average	**132,405**	**5.5**	**6.6**	

Source: WDFW Hatcheries Headquarters Database 2013.
Note: 5.0 fpp = 210mm; 5.5 fpp = 205 mm; 6.0 fpp = 198 mm
[a] 38,500 fish released from McKinnon Pond.

Table 10.3.2: Lake releases (fry), by location, numbers, size and date of release, Kendall Creek Hatchery winter steelhead.

Release Year	Site	Number	Avg. size (fpp)	CV	Date(s)
2003	Lake Fazon	5,000	250	NA	June 5
2003	Lake Terrell	15,000	250	NA	June 5
2006	Lake Fazon	6,000	10	NA	March 14
2006	Wiser Lake	2,000	10	NA	March 14
2010	Lake Fazon	80,000	150	NA	October 18

Source: WDFW Hatcheries Headquarters Database 2013.

10.4) Actual dates of release and description of release protocols.

Volitional releases would occur no earlier than April 15th (under same criteria as stated in HGMP Section 2.2.3 - Residualism. Screens will be open for up to one and ½ months, or less if all the fish out-migrate. Fish that do not volitionally out-migrate will be placed into landlocked lakes. 10.5) Fish transportation procedures, if applicable.

Fish through this program are released on-station, so there is no fish transportation to release sites. Fish reared at McKinnon Pond are transported in a 1,000-gallon tanker truck, equipped with aerators and oxygen tanks. The transport time to McKinnon Pond is around 30 minutes.

10.6) Acclimation procedures.

All winter steelhead are reared and acclimated on well water if final rearing takes place in an asphalt lined pond or well/creek water mix if final rearing takes place in super raceways and creek water is available.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.

Table 10.7.1. Marks applied to Kendall Creek winter steelhead releases.

Brood Year	Yearlings	Marks Applied
2013	150,000	AD-only

Source: WDFW Future Brood Document 2013.

Hatchery steelhead are intended to be 100% adipose fin-clipped. Due to regeneration of a partially-clipped or missed fin-clips, some hatchery adults may return with an intact adipose fin. WDFW monitors the clip success rate during the marking process, and partial- or missed-clips are recorded as a "bad clip."

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.

The egg-take is carefully managed to minimize the likelihood of collecting surplus eggs or raising surplus fry. Annual fluctuations in survival may result in production levels above the release goal, and actual releases of up to 10% above the release goal is acceptable. If fish are available for release in excess of 10% of the acceptable level, regional staff and NOAA Fisheries will be informed and consulted for proper action to be taken. In the past, fish available over the 10% limit were released, according to the direction of WDFW Fish Management, into lakes for use in non-anadromous programs (see **Table 10.3.2**).

10.9) Fish health certification procedures applied pre-release.

Standard Fish Health Procedures performed at the facility:

- *All fish health monitoring is conducted by a qualified WDFW Fish Health Specialist.*

- *Juvenile fish examinations are conducted at least monthly and more often if necessary*. A representative sample (at the discretion of the fish health specialist) of healthy and moribund fish from each lot is examined.
- *Abnormal levels of fish loss are investigated if they occur.*
- *Fish health status is determined prior to release or transfer to another facility*. The exam may occur during the regular monthly monitoring visit, i.e. within one month of release or transfer.
- *Appropriate actions, including drug or chemical treatments are recommended as necessary*. If a bacterial pathogen requires treatment with antibiotics a drug sensitivity profile is be generated when possible.
- *Findings and results of fish health monitoring are recorded on a standard fish health reporting form and maintained in a fish health database.*
- *Fish culture practices are reviewed as necessary with facility personnel*. Where pertinent; nutrition, water flow and chemistry, loading and density indices, handling, disinfecting procedures and treatments are discussed.

10.10) Emergency release procedures in response to flooding or water system failure.

Flooding is not a problem at Kendall Creek Hatchery. Generators and creek water as a back up water supply are available in case of a system failure. If severe drought conditions arise, the fish may be released early to prevent loss. Flooding is also not a problem at McKinnon Ponds.

Hatcheries Standby Procedures (revised March 2012), a guideline developed by WDFW, includes information regarding proper actions to follow by hatchery employees in case of an emergency.

10.11) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from fish releases.

WDFW has taken following actions to minimize adverse genetic and ecological effects to listed species resulting from hatchery releases:

- Eliminated transfers of eggs and juveniles between watersheds.
- Eliminated egg-takes after January 31, to keep hatchery and natural populations temporally segregated.
- Eliminated off-station releases where no trapping facilities are available.
- Eliminated recycling of hatchery origin adults back to anadromous waters for sport fishing opportunities.
- Eliminated fry and sub-yearling releases, and mandatory rearing; release only yearling smolts, which are in migratory condition. This promotes rapid out-migration and thus minimizes the time spent in the river, in order to minimize or eliminate interactions with natural-origin salmonids rearing in the system (*Statewide Steelhead Rearing and Release Guidelines*; Tipping 2001).
- Leave trapping facilities open during the entire return time for adults of the segregated stock.
- Use volitional releases to foster rapid seaward migration and limit residualism and freshwater interactions with listed Chinook and steelhead juveniles, bull trout and other naturally-produced salmonids.
- Mass-mark all releases for harvest selection and removal from the system.
- Release fish no earlier than April 15, to allow listed stocks (Chinook and steelhead) and pink salmon, to emigrate out of the system, and/or provide time for additional growth to minimize potential predation.

- Continue monitoring, research and reporting of hatchery smolt migration performance behavior, and interactions with natural origin fish to assess and adjust, if necessary, hatchery production and release strategies to minimize effects on natural origin fish.

Hatchery steelhead releases have been 100% mass-marked since 1980s to enable identification during selective harvest, broodstock selection and, most recently, removal from the system.

WDFW continues monitoring, research and reporting of hatchery smolt migration performance behavior, and interactions with natural-origin fish to assess and adjust, if necessary, hatchery production and release strategies to minimize effects on natural-origin fish. WDFW is conducting research on the effects of volitional releases in Upper Columbia basin. This study is not yet fully completed, but preliminary results suggest faster fish migration, and lower rates of residualism when released volitionally (Snow et al. 2013).

With changes already being implemented, WDFW continues monitoring its hatchery programs and the affected watersheds to observe the effects on the populations at the hatcheries and natural spawning grounds.

See also Section 2.2.3.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

11.1) Monitoring and evaluation of "Performance Indicators" presented in Section 1.10.

11.1.1) Describe plans and methods proposed to collect data necessary to respond to each "Performance Indicator" identified for the program.

The purpose of monitoring is to identify and evaluate the benefits and risks from this hatchery program, elements of which are identified in HGMP section 1.10. The Co-managers conduct numerous ongoing monitoring programs, including, catch, escapement, marking, tagging, smolt trapping and fish health testing. The focus of enhanced monitoring and evaluation programs will be on the risks posed by ecological interactions with listed species.

Additional research, monitoring and evaluation in the Nooksack watershed: Table 11.1.1.1 should be considered preliminary as this framework is still under development and subject to change.

Table 11.1.1.1: WDFW Nooksack Basin steelhead monitoring.

Project	Description
Hatchery Monitoring	Co-manager activities include oversight and implementation of regional hatcheries, spawning ground surveys, weir operations, and in-season management of broodstock collection activities. Deliverables include: development of hatchery management plans that will contribute to HGMP updates; estimation of performance metrics for WDFW hatchery programs includes adult run timing, spawn timing, broodstock mortality (including handling and pathology), fecundity, egg mortality rate, sex ratios, and stage-specific juvenile survival and marking protocols).
Monitoring of Populations of Winter Steelhead	Co-managers will continue to conduct spawning ground (redd) surveys in the Nooksack River and selected index tributaries that support populations of winter steelhead. *Nooksack River DIP*: Streams surveyed include: sections of the mainstem Nooksack River (WRIA 01.0120) (from Lynden to forks including sections of Silver, Deer, Bertrand, Fishtrap, Double Ditch, Anderson, Smith, McCauley and Mitchel Creeks). The North Fork Nooksack River (WRIA 01.0120) and 23 tributaries, the Middle Fork

	Nooksack River (WRIA 01.0339) (mouth to gorge below barrier dam and six tributaries) and the South Fork Nooksack River (WRIA 01.0246) (mouth to RM 30 and 14 tributaries). Surveys will provide data regarding abundance and distribution which are a key VSP parameters.
Monitoring of Populations of Summer Steelhead	*South Fork Nooksack River DIP*: Not currently monitored. These spawn in remote areas that are hard to access in late winter and early spring. There is thought to be spatial separation from areas accessible to winter run steelhead.
Monitoring of Introgression from Hatchery Steelhead Populations to Natural origin Steelhead Populations	The Co-managers are implementing a genetic monitoring program to measure introgression between segregated hatchery steelhead programs and natural origin populations in the Puget Sound DPS (Warheit, 2014). See Appendix for additional details.

11.1.2) Indicate whether funding, staffing, and other support logistics are available or committed to allow implementation of the monitoring and evaluation program.

See HGMP section 11.1.1

11.2) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed fish resulting from monitoring and evaluation activities.

Risk aversion measures will be developed in conjunction with the monitoring and evaluation plans.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Research specific to Kendall Creek steelhead (Early winter stock) is not currently conducted.

12.2) Cooperating and funding agencies.

Not applicable.

12.3) Principle investigator or project supervisor and staff.

Not applicable.

12.4) Status of stock, particularly the group affected by project, if different than the stock(s) described in Section 2.

Not applicable.

12.5) Techniques: include capture methods, drugs, samples collected, tags applied.

Not applicable.

12.6) Dates or time period in which research activity occurs.

Not applicable.

12.7) Care and maintenance of live fish or eggs, holding duration, transport methods.

Not applicable.

12.8) Expected type and effects of take and potential for injury or mortality.

Not applicable.

12.9) Level of take of listed fish: number or range of fish handled, injured, or killed by sex, age, or size, if not already indicated in Section 2 and the attached "take table" (Table 1).

Not applicable.

12.10) Alternative methods to achieve project objectives.

Not applicable.

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.

Not applicable.

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.

Not applicable.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the information provided is complete, true and correct to the best of my knowledge and belief. I understand that the information provided in this HGMP is submitted for the purpose of receiving limits from take prohibitions specified under the Endangered Species Act of 1973 (16 U.S.C.1531-1543) and regulations promulgated thereafter for the proposed hatchery program, and that any false statement may subject me to the criminal penalties of 18 U.S.C. 1001, or penalties provided under the Endangered Species Act of 1973."

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

ADDENDUM A. PROGRAM EFFECTS ON OTHER (AQUATIC OR TERRESTRIAL) ESA-LISTED POPULATIONS. (Anadromous salmonid effects are addressed in Section 2)

15.1) List all ESA permits or authorizations for USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species associated with the hatchery program.

The WDFW and the USFWS have a Cooperative Agreement pursuant to section 6(c) of the Endangered Species Act that covers the majority of the WDFW actions, including hatchery operations.

> *"The department is authorized by the USFWS for certain activities that may result in the take of bull trout, including salmon/steelhead hatchery broodstocking, hatchery monitoring and evaluation activities and conservation activities such as adult traps, juvenile monitoring, spawning ground surveys..."*

15.2) Describe USFWS ESA-listed, proposed, and candidate salmonid and non-salmonid species and habitat that may be affected by hatchery program.

Nooksack Bull Trout *(Salvelinus confluentus):* Bull trout were listed as a threatened species in the Coastal-Puget Sound Distinct Population Segment on November 1, 1999 (64 FR 58910). Ten local populations have been identified in the Nooksack Core Area, based the distribution of suitable spawning and rearing habitat: Lower, Middle and Upper North Fork, Lower and Upper Middle Fork, Lower and Upper South Fork, Glacier Creek, Lower Canyon Creek and Wanlick Creek. The anadromous form is known to be present and it is possible that the fluvial and resident life history forms are also present in the core area. Anadromous outmigrants have caught in the lower mainstem from early April through mid-July (USFWS 2004). Bull trout spawning is known to occur throughout much of the upper watershed and is mainly confined to non-glacier tributary streams. Little, if any, comprehensive information exists concerning escapement levels, population size, or past harvest levels and as such the current status of the Nooksack bull trout is unknown (WDFW Bull Trout SaSI 2004). The recovered abundance level for bull trout in the Nooksack Core Area has been set at 2000 adult spawners, based on current habitat capacity (USFWS 2004).

Table 15.2.1: Summary table of core area rankings for population abundance, distribution, trend, threat, and final rank.

Core Area Population	Abundance Category (individuals)	Distribution Range Rank (stream length miles)	Short-term Trend Rank	Threat Rank	Final Rank
Nooksack R.	Unknown	620-3000	Unknown	Moderate, imminent	Potential Risk

Source Data: USFWS 2008

Habitat— Past forest practices and related road networks and mass wasting have had some of the most significant impacts to bull trout habitat within this core area. These have resulted in the loss or degradation of a number of spawning and rearing areas within local populations, as well as foraging, migration, and overwintering habitats. Bellingham Diversion has significantly reduced if not precluded connectivity of the Upper Middle Fork Nooksack local population with the rest of the core area. Bellingham Diversion currently prevents most anadromous and fluvial bull trout returning to the Middle Fork Nooksack River from reaching spawning and rearing habitats in the upper watershed. Agriculture practices, residential development, the transportation network and related stream channel and bank modifications have resulted in the loss and degradation of foraging, migration, and overwintering habitats in mainstem reaches of the major forks, as well as in a number of tributaries. Marine foraging habitats for this core area have and continue to be greatly impacted by urbanization along nearshore habitats in Bellingham Bay and Strait of Georgia. The presence of brook trout in many parts of the Nooksack core area and their potential

to further increase in distribution is of significant concern given the level of habitat degradation that has occurred within the core area. The detection of brook trout/Dolly Varden hybrids further emphasizes this threat to bull trout. The absence of established spawner index areas or other repeatable means of monitoring bull trout population abundance and distribution within the core area, continues to hinder the identification, conservation, and restoration of remaining spawning and rearing reaches within the core area (USFWS 2004).

Several other listed and candidate species are found in Whatcom County; however the hatchery operations and facilities for this program do not fall within the critical habitat for any of these species. As such there are no effects anticipated for these species.

Listed or candidate species:
"No effect" for the following species:

Marbled murrelet (*Brachyramphus marmoratus*) –Threatened [critical habitat designated]
Gray Wolf (*Canis lupus*) –Threatened
Grizzly bear (*Ursus arctos horribilis*) –Threatened
Canada Lynx (*Lynx canadensis*) –Threatened [critical habitat designated]
Northern Spotted owl (*Strix occidentalis caurina*) –Threatened [critical habitat designated]

Candidate Species
Fisher *(Martes pennanti)* – West Coast DPS
North American wolverine *(Gulo gulo luteus)* – contiguous U.S. DPS
Yellow-billed cuckoo (*Coccyzus americanus*)
Whitebark pine *(Pinus albicaulis*)

15.3) Analyze effects.

Hatchery activities, including in-river broodstock collection, hatchery trap, and water intake structures may pose a risk to system bull trout populations. Annual estimates of bull trout encounters through the hatchery activities are recorded and reported.

15.4) Actions taken to minimize potential effects.

Trap is checked at least daily. Any bull trout encountered at the trap are immediately returned to the stream. Bull trout may be encountered in other hatchery programs during broodstock collection activities (steelhead or coho) that would directly impact or create potential effects on bull trout in this system based on the current understanding of the status of these fish.

15.5) References

USFWS (U.S. Fish and Wildlife Service). 2004. Draft recovery plan for the coastal-Puget Sound distinct population segment of bull trout (*Salvelinus confluentus*). Volume I (of II): Puget Sound management unit. Portland, Oregon. 389 + xvii pp.

USFWS (U.S. Fish and Wildlife Service). 2008. Bull trout (*Salvelinus confluentus*) 5-year review: Summary and evaluation. U.S. Fish and Wildlife Service. Portland, Oregon. 55 pp.

WDFW (Washington State Department of Fish and Wildlife). 2004. Washington State salmonid stock inventory bull trout/ Dolly Varden. Washington State Department of Fish and Wildlife. Olympia, Washington.

Table 1. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Steelhead *(Oncorhynchus mykiss)*	**DPS/Population:** Puget Sound/ Nooksack River System	**Activity:** Kendall Creek Winter Steelhead Program
Location of hatchery activity: Kendall Creek Hatchery, Kendall Creek (01.0406)	**Dates of activity:** Late December-May	**Hatchery program operator:** WDFW

Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	5*	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-		-
Unintentional lethal take g)			1*	-
Other Take (specify) h)	-	-	-	-

*Natural origin steelhead have not been seen in the hatchery traps for the last 12 years, but with the existing possibility of the encounter we estimate that up to 5 fish may be encountered in a single year in the future during broodstock collections with up to 1 unintentional mortality.

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category.

Instructions:

1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
3. If an individual fish is to be taken more than once on separate occasions, each take must be entered in the take table.

Table 2. Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Puget Sound / NF and SF Nooksack Chinook	**Activity:** Kendall Creek Winter Steelhead Program
Location of hatchery activity: Kendall Creek Hatchery, Kendall Creek (01.0406)	**Dates of activity:** Late December-May	**Hatchery program operator:** WDFW

Type of Take	**Annual Take of Listed Fish By Life Stage *(Number of Fish)***			
	Egg/Fry	**Juvenile/Smolt**	**Adult**	**Carcass**
Observe or harass a)	-	-	-	-
Collect for transport b)	-	-	-	-
Capture, handle, and release c)	-	-	0	-
Capture, handle, tag/mark/tissue sample, and release d)	-	-	-	-
Removal (e.g. broodstock) e)	-	-	-	-
Intentional lethal take f)	-	-	-	-
Unintentional lethal take g)			-	-
Other Take (specify) h)	-	-	-	-

a. Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
b. Take associated with weir or trapping operations where listed fish are captured and transported for release.
c. Take associated with weir or trapping operations where listed fish are captured, handled and released upstream or downstream.
d. Take occurring due to tagging and/or bio-sampling of fish collected through trapping operations prior to upstream or downstream release, or through carcass recovery programs.
e. Listed fish removed from the wild and collected for use as broodstock.
f. Intentional mortality of listed fish, usually as a result of spawning as broodstock.
g. Unintentional mortality of listed fish, including loss of fish during transport or holding prior to spawning or prior to release into the wild, or, for integrated programs, mortalities during incubation and rearing.
h. Other takes not identified above as a category

Instructions:

1. An entry for a fish to be taken should be in the take category that describes the greatest impact.
2. Each take to be entered in the table should be in one take category only (there should not be more than one entry for the same sampling event).
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