4(d) Rule Limit 6

Proposed Evaluation and Pending Determination

Title of RMP:	Ten Joint Hatchery and Genetic Management Plans for the Duwamish/Green River Basin
RMP Submitted by:	Washington Department of Fish and Wildlife Muckleshoot Indian Tribe Suquamish Tribe
ESU/DPS:	Puget Sound Chinook Salmon ESU Puget Sound Steelhead DPS
4(d) Rule Limit:	Limit 6
NMFS Tracking Number:	WCR-2016-4659
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1 EVALUATION

NOAA's National Marine Fisheries Service (NMFS) issued a final Endangered Species Act (ESA) 4(d) Rule adopting regulations necessary and advisable to conserve Puget Sound Chinook salmon (50 CFR 223.203(b); 70 FR 37160, June 28, 2005). These regulations were subsequently applied to the Puget Sound Steelhead Distinct Population Segment (DPS) in a separate final rule (73 FR 55451, June 25, 2008). Under limit 6 of the Rule, ESA section 9 take prohibitions for these listed salmonid species do not apply to hatchery activities that are undertaken in compliance with a resource management plan (RMP) developed jointly by the Tribes and the State of Washington that is consistent with the 4(d) Rule criteria.

Section 9 of the ESA prohibits the take of endangered species, and pursuant to §4 NMFS has extended that prohibition to threatened salmon and steelhead. Under the joint state-tribal 4(d) rule (50 CFR 223.203(b)(6)), those prohibitions are rescinded for hatchery activities described in an RMP, provided that:

- The Secretary of Commerce has determined pursuant to 50 CFR 223.204(b) [the Tribal 4(d) rule] and the government-to-government processes therein that implementing and enforcing the RMP will not appreciably reduce the likelihood of survival and recovery of listed salmon and trout;
- The joint plans applying for 4(d) Limit 6 review will be implemented and enforced within the parameters set forth in *U.S. v. Oregon* or *U.S. v. Washington*; and
- The Secretary of Commerce has taken comment on how any HGMP addresses the 4(d) rule limit 5 criteria (§223.203(b)(5)).

The Muckleshoot Indian Tribe, Washington Department of Fish and Wildlife (WDFW), and the Suquamish Tribe, as co-managers of the fisheries resource under *United States v. Washington* (1974), have provided NMFS with ten hatchery and genetic management plans (HGMP) proposed for implementation in the Duwamish/Green River watershed and adjacent marine areas (Table 1; Fig. 1). The applicants have provided the HGMPs and supplementary information for review and determination by NMFS pursuant to limit 6 of the ESA 4(d) Rule. Each HGMP serves as an RMP for the purpose of limit 6 consideration; for this evaluation, descriptions of the proposed activities will focus on the descriptions given in the individual HGMPs.

The proposed plans are similar through: shared salmon population recovery and harvest augmentation objectives and effects; broodstock collection locations and actions; fish rearing and release sites; monitoring and evaluation actions; and funding sources (Muckleshoot Indian Tribe 2014; Muckleshoot Indian Tribe and Suquamish Indian Tribe 2014; Muckleshoot Indian Tribe et al. 2019; Schaffler 2019; Scott 2018; WDFW 2013; WDFW 2014a; WDFW 2014b; WDFW 2014c; WDFW 2015). All ten HGMPs were assembled consistent with the Puget Sound Salmon Management Plan (1985), the Federal court orders under *U.S.* v. *Washington* (1974) that control fisheries harvest management and hatchery salmon production.

The programs have been designed to operate adaptively in response to infrastructure changes, habitat improvements or degradation, and natural-origin population responses in the Green River watershed. Program modifications are divided amongst four phases: 1) Current infrastructure, 2) Operation of the

Fish Restoration Facility, 3) Downstream fish passage provided at Howard Hanson Dam, 4) Evaluation of the potential for self-sustaining, natural-origin populations of one or more listed species above and below Howard Hanson Dam. The co-managers have included phases three and four to document the long-term intent of the programs, but recognize that information pertinent to the analysis of effects is likely to arise before transition to phases three and four occurs. Thus, the co-managers will contact NMFS prior to moving from phase two to phase three to enable an accurate analysis of the two latter phases on listed species in the Green River watershed.

Table 1. Proposed salmon and steelhead hatchery programs for the Duwamish/Green River basin; ESA = Endangered Species Act.

Hatchery Program	ESA-listed?	Operator[2]	Program Purpose
Soos Creek Hatchery Fall Chinook Salmon	Yes	WDFW	Integrated/Segregated Harvest[3]
Fish Restoration Facility-Fall Chinook	Yes[1]	MIT	Segregated Harvest[3]
Fish Restoration Facility Green River Coho Salmon	No	MIT	Integrated Harvest
Keta Creek Complex Yearling Coho Salmon	No	MIT; SIT	Integrated Harvest
Soos Creek Hatchery Coho Salmon	No	WDFW	Integrated Harvest
Marine Technology Center Coho Salmon	No	WDFW	Segregated Harvest
Keta Creek Complex Fall Chum Salmon	No	MIT	Integrated Harvest
Fish Restoration Facility Winter Steelhead	Yes[1]	MIT	Integrated Conservation
Green River Native Winter (Late) Steelhead	Yes	WDFW	Integrated Conservation
Soos Creek Hatchery Summer Steelhead	No	WDFW	Segregated Harvest

[1] These programs are not yet in operation, but will be added to the listing in anticipation of their operation.

[2] MIT = Muckleshoot Indian Tribe; WDFW = Washington Department of Fish and Wildlife; SIT = Suquamish Indian Tribe.

3 These programs are genetically linked: returns from an integrated component at Soos Creek Hatchery are then used as broodstock for a segregated component at Soos Creek Hatchery, and will be used as broodstock for a segregated program at the Fish Restoration facility when it becomes operational.

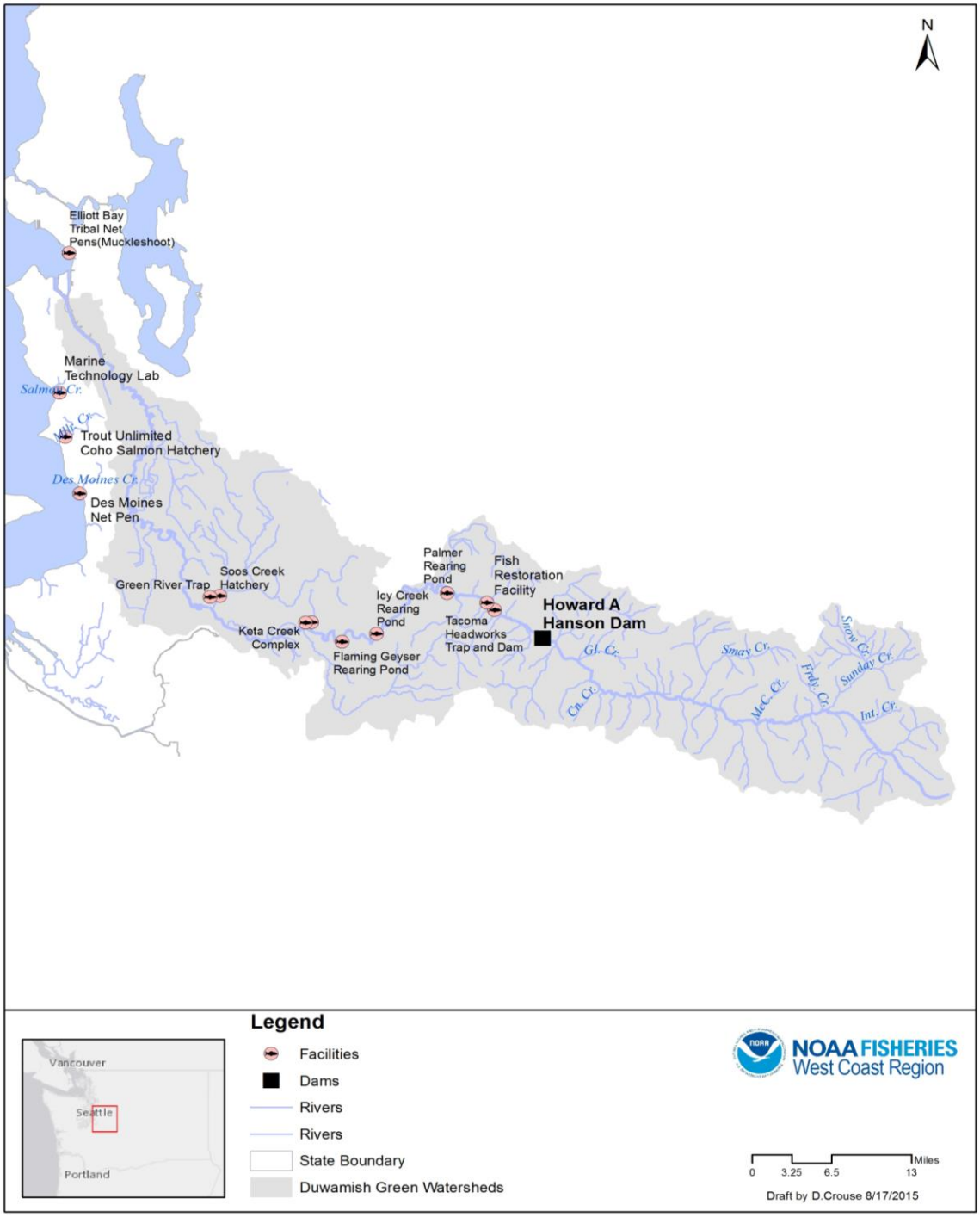

Figure 1. Duwamish/Green River watershed, adjacent marine areas, and the facilities associated with the Duwamish/Green salmon and steelhead hatcheries.

1.1 5(i)(A) The HGMP has clearly stated goals, performance objectives, and performance indicators that indicate the purpose of the program, its intended results, and measurements of its performance in meeting those results.

Each of the HGMPs has clearly stated its goal, performance objectives, and methods for measuring the progress toward achieving those objectives. The general program goals described in section 1.7 of each HGMP for propagating hatchery fish are to contribute to:

- Mitigating for lost natural-origin fish production
- Recovering ESA-listed Puget Sound Chinook salmon and steelhead
- Fulfilling federal tribal trust responsibility and treaty rights guaranteed through treaties and affirmed in *U.S. v. Washington* (1974)
- Providing for ceremonial and subsistence fishery values
- Meeting Pacific Salmon Treaty obligations

Performance objectives and performance indicators that would be used to gauge compliance with each objective, are described in section 1.10 of each HGMP. Evaluation and monitoring to ensure standards and indicators are met are further described in section 1.8 of this document and are summarized in Table 2.

Monitoring of HGMP implementation would generally be designed to determine:

1. Program consistency with proposed hatchery actions and intended results (e.g., juvenile fish release and adult return levels);
2. Measurement of the program's success or failure in attaining results; and
3. Effects of the program on listed natural-origin fish populations in Puget Sound freshwater and marine waters where these fish may migrate or return.

Table 2. Summary of HGMP program performance standards and indicators.

Standard	Indicator
Produce fish for harvest while minimizing excess hatchery returns	• Measure adult harvest and escapement • Mass marking to allow selective fisheries
Supplement natural population (integrated programs only)	• Increasing proportion of natural-origin fish • Increasing natural smolt levels
Proper broodstock collection and management	• Collected randomly throughout the run • Weir/trap checked regularly • Proportion of natural-origin fish • Designated mating scheme, sex ratio • Adheres to spawning guidelines (Seidel 1983) • Stray rates
Meet hatchery juvenile production goal	• Egg to fry or smolt survival is as expected • Release target
Minimize interactions of releases with natural-origin fish	• Juveniles released at sea-water ready life stages • Size and time of release accounts for listed stocks
Life history characteristics of the natural population do not change due to artificial propogation	• Stable life history patterns of natural fish • Age and size data for natural population
Natural population genetic variation does not change due to artificial propagation	• Proportion of naturally spawning hatchery fish • Genetic assessment
Limit pathogen amplification and transmission	• Follows co-manager fish health policy (NWIFC and WDFW 2006) • Follows USFWS fish health policy (2004)

1.2 5(i)(B) The HGMP utilizes the concepts of viable and critical salmonid population thresholds, consistent with the concepts contained in the technical document entitled "Viable Salmonid Populations."

HGMPs proposed for consideration under the 4(d) rule must use the concepts of viable and critical thresholds as defined in the NMFS Viable Salmonid Population (VSP) document (McElhany et al. 2000). Application of these VSP concepts is needed to adequately assess and limit the take of listed salmonids for the protection of the species. Section 2.2.2 of each HGMP describes the status of the listed Chinook salmon and steelhead populations relative to "critical" and "viable" population thresholds within the Green/Duwamish watershed and references NMFS reviews' of species status.

The current abundance and productivity of Green River natural-origin Chinook salmon are substantially reduced from historical levels that are estimated to have been approximately 37,700 adult fish with a return per spawner ratio of 3.2 at MSY (Ford et al. 2011; Watershed Resource Inventory Area 9 Steering Committee 2005). Between 1999 and 2014, the geometric mean total annual naturally spawning Chinook salmon escapement was 1,179 natural-origin spawners compared with the recovery goal of 27,000 fish at low productivity (NMFS 2006). This recovery goal would require a sizeable increase in both habitat capacity and productivity in the Green River basin. The escapement goal under this 'properly functioning conditions' scenario would be approximately 6,400 Chinook.

Hatchery-origin Chinook salmon associated with Soos Creek Chinook salmon hatchery program make up a sizable fraction of the annual naturally spawning adult abundance; averaging 63% for the basin (WDFW Score Database 2016)[1]. It is believed that the Green River watershed historically supported an early returning life history type of Chinook salmon but it is unclear if that was a distinct population or a diversity component of a larger population Based on the status of the fall Chinook population, the program is integrated to reduce the risks associated with genetic effects of hatchery fish spawning naturally.

Historical catch data included in Myers et al. (2015) estimated Green River steelhead run-sizes of 45,000 to 55,000 in the early 1900s. Recent abundance is less than two percent of historical abundances (2010-2014 geometric mean of 621; NWFSC 2015). Intrinsic potential (IP) production estimates[2] based on basin geological, hydrologic, and ecological characteristics indicate the Green River basin could historically have supported a total winter-run steelhead abundance of approximately 19,768 to 39,537 adults (Myers et al. 2015). The historical population structure is unknown for the Green River, but the Green River may have supported a native summer population (Puget Sound Steelhead Technical Recovery Team 2011). Based on the status of the steelhead population, the winter steelhead program is integrated with the primary immediate goal of aiding in population recovery. The summer steelhead hatchery program is designed to limit gene flow to the winter population.

1.3 5(i)(C) Taking into account health, abundances, and trends in the donor population, broodstock collection programs reflect appropriate priorities.

A prioritized purpose of a broodstock collection program using listed fish is to re-establish an indigenous salmonid population for conservation purposes, including restoration of similar at-risk populations within the same ESU, and reintroduction of at-risk populations to under-seeded habitat. Under this 4(d) rule criterion, as described in the 4(d) rule, listed salmonids may be intentionally taken for broodstock only if:

[1] https://fortress.wa.gov/dfw/score/score/maps/map_details.jsp?geocode=wria&geoarea=WRIA09_Duwamish_Green

[2] The intrinsic potential estimates include all habitat upstream of the estuary, including the mainstem and tributaries, as well as all habitat upstream of TPU diversion structure.

1. The donor population is currently at or above the viable threshold and the collection will not impair its function, or
2. The donor population is not currently viable but the sole objective is to enhance the propagation or survival of the listed ESU, or
3. The donor population is shown with a high degree of confidence to be above the critical threshold although not yet functioning at viable levels, and the collection will not appreciably slow attainment of viable status for that population.

Four programs take listed fish for broodstock: the Fish Restoration Facility (FRF) Fall Chinook Salmon, the Soos Creek Hatchery Fall Chinook Salmon, the FRF Winter Steelhead, and the Green River Native Winter Steelhead. The Soos Creek Hatchery Fall Chinook Salmon program is comprised of two genetically linked components; an integrated component of 1 million subyearlings, and a segregated component of 5.5 million (yearlings and subyearlings). For this type of program, adult returns from the integrated component are used as broodstock for the segregated component to minimize the risk of adverse genetic effects. Once the FRF Fall Chinook Salmon comes online in phase 2, this program will function as an expansion of the segregated component of the Soos Creek Fall Chinook Salmon program with an additional 600,000 subyearling fish produced. These programs rely on collection of Green River natural-origin adult fish for which the average annual return is above the critical threshold. This is consistent with number 3 above for the prioritized use of listed fish for broodstock. The co-managers also propose to limit natural-origin fish used for integrated broodstock to 40 percent of the projected post fishery return.

Broodstock used for non-listed programs are discussed in the following section (1.4).

A critical abundance threshold has not yet been established for the Green River winter-run steelhead population, but data indicate adult returns are below the viability threshold established for the population (Hard et al. 2015). To respond to the current low abundance of the population, the winter steelhead programs would rear fish initially for conservation purposes, transitioning in future years to harvest augmentation as the abundance of returning adults increases, which is consistent with number 2 above. Natural-origin winter-run steelhead would be incorporated as broodstock to limit divergence from the natural-origin component of the population while fish are under propagation. The program will limit the impact on native steelhead by taking no more than 20 percent of the annual natural run.

1.4 5(i)(D) The HGMP includes protocols to address fish health, broodstock collection and spawning, rearing and release of juveniles, disposition of hatchery adults, and catastrophic risk management.

The proposed HGMPs include protocols for fish health, broodstock collection, broodstock spawning, rearing and release of juveniles, deposition of hatchery adults, and catastrophic risk management.

Fish Health (HGMP sections 7, 9, and 10)

All of the hatchery programs would be operated in compliance with the co-manager and USFWS fish health policies (NWIFC and WDFW 2006; USFWS 2004). The policies are designed to limit the spread of fish pathogens between and within watersheds by regulating the transfers of eggs and fish. The policies also outline standard fish health diagnosis, maintenance, and hatchery sanitation protocols to

reduce the risk of pathogen amplification and transmission within the hatchery and to fish in the natural environment during broodstock collection and mating as well as fish incubation, rearing, and release. Fish health specialists and pathologists from WDFW, NWIFC, or the USFWS would provide fish health management support and diagnostic fish health services.

Broodstock Collection and Spawning (HGMP sections 6, 7, and 8)

Both natural and hatchery-origin fish are used for 8 of the 10 programs, consistent with the purpose of the integrated programs. As mentioned above the FRF fall Chinook salmon program does not use natural-origin fall Chinook salmon, but is genetically linked to the integrated component of the Soos Creek fall Chinook salmon program through the use of integrated adult returns for broodstock. The Soos Creek Hatchery Summer Steelhead uses only hatchery adult returns to Soos Creek Hatchery as broodstock. Due to the non-native ancestry of this summer steelhead stock (Skamania), the co-managers are actively considering options to transition to a local stock, but none exists in the Green River.

The protocols for broodstock implement spawning actions consistent with published guidelines (HSRG 2004; Seidel 1983). Pairwise spawning is logistically easier, especially for larger programs, but factorial spawning (e.g., eggs from a single female are fertilized by multiple males and a single male fertilizes multiple females) conserves genetic diversity by limiting the risk of use of a sterile adult during spawning (Busack and Knudsen 2007). For 9 of the 10 programs, pairwise spawning with a back-up male is used to ensure fertilization. The Green River native winter steelhead program uses factorial spawning. Broodstock collection and spawning details are summarized in Table 3.

Table 3. Annual number of broodstock collected, collection method, and spawning approach.

Program	Local source	Collection Location(s)	Collection Method	Collection/ Holding Target	Collection Duration	pNOB
Soos Creek Fall[1] Chinook: integrated component	Hatchery and natural	SCH, IC, PP, TPU, FRF, Green River	Ladder, weir and trap, seine, net	700[2]	August-October	up to 1
Soos Creek Fall[1] Chinook: segregated component	Hatchery			4,100	August-October	0
FRF Fall Chinook[1]						
FRF Coho	Hatchery and natural	TPU, FRF	Ladder, weir and trap	4,580	October-December	up to 1
KCC Yearling Coho		KCC, SCH, TPU, MTC, MCH				up to 1
Soos Creek Coho						up to 1
MTC Coho						up to 1
KCC Fall Chum	Hatchery and	KCC	Ladder and	5,000	October-	up to 1

	natural		trap		December	
FRF Steelhead[2]	Hatchery and natural	TPU, FRF, SCH, IC, PP Green River	Ladder, weir and trap; Angling, seine, net	110	December-April	up to 1
Green River Native Winter Steelhead[2]	Hatchery and natural			50	December-April	up to 1
Green River Summer Steelhead[3]	Hatchery: Skamania stock	IC, SCH	Weir and trap	100	July-January	0

[1] Excess natural-origin fall Chinook salmon collected for broodstock will be released back into the mainstem Green River. The fall Chinook salmon programs will use no more than 40% of the natural-origin return for broodstock. Only natural-origin fall Chinook salmon are passed above the Soos Creek weir.
[2] Excess natural-origin steelhead broodstock will be released back into the mainstem Green River. The winter steelhead programs will use no more than 20% of the natural-origin return for broodstock, and target a minimum pNOB of 50%.
[3] The co-managers are discussing development of a plan to transition to a more local summer steelhead stock.

Rearing and Release of Juveniles (HGMP sections 9 and 10)

Fish from a majority of the programs would be released as seawater-ready smolts (or, for chum salmon, fed fry) to ensure rapid emigration downstream through watershed areas where interactions with rearing listed fish may occur. The exceptions are the Soos Creek Hatchery coho salmon cooperative program, and the Keta Creek Complex yearling coho program, which places some coho in marine net pens for acclimation.. Release numbers, life stage, location, percentage marked, and dates for all hatchery programs are detailed in Table 4. Survival rates from the green-egg life stage to release for the programs rearing listed Chinook salmon and steelhead for which data are available are reflective of well-operated hatchery programs.

Table 4. Fish release details in the Duwamish/Green watershed; SCH = Soos Creek Hatchery, IC = Icy Creek Rearing Ponds, FGP = Flaming Geyser Ponds, KCC = Keta Creek Complex, MCH = Miller Creek Hatchery, MTC = Marine Technology Center; FRF = Fish Restoration Facility, TBD = to be decided.

Program	Number[2], life stage, and size (fpp)	Percentage marked	Egg incubation and rearing location	Release location	Volitional release?	Release time
Soos Creek Fall Chinook	3,200,000 subyearling; 80	100	SCH	SCH[3]	No	Early May-June
	1,000,000 subyearling; 80	100	SCH	SCH	No	
	2,000,000 subyearling; 45	100	SCH, FRF[3]	Palmer Ponds, SCH, FRF, IC[4]	Yes	June-July 4
	300,000 yearling; 10	100	SCH	IC	Yes	April
FRF Fall Chinook[1]	600,000 subyearling; 65	100	FRF	FRF, Palmer Ponds	TBD	June
FRF Coho[1]	600,000 yearling; 14	100	FRF	FRF	TBD	April 1-May 15
KCC Coho	1,000,000 yearling; 14	100	KCC	KCC	Yes	April 1-May 10
	1,000,000 yearling; 9	100	KCC	Elliott Bay netpens	No	April 1-May 15
	50,000 yearling; 14	None	KCC	FRF site	Yes	April 1-May 10
Soos Creek Coho	600,000 yearling; 17	100	SCH	SCH	Yes	Mid-April-June 30
	30,000 yearling; 15	100	SCH	Des Moines Ponds	No	June
	120,000 fed fry; 1500	None	MCH	Miller, Walker and Des Moines Creeks	No	January
KCC Fall Chum	5,000,000 fry; 450-150	None	KCC	KCC	No	March 1-May 15
MTC Coho	10,000 yearling; 11	100	MTC	MTC	No	April

FRF steelhead[1]	250,000 yearling; 5-10	100	FRF	FRF	TBD	Mid-April-June 30
Green River Native Winter Steelhead	23,000 yearling; 8	100	SCH	IC	Yes	May
	15,000 yearling; 8	100	SCH	FGP	Yes	
	17,000 yearling; 8	100	SCH	Palmer Ponds	Yes	
Green River Summer Steelhead	50,000 yearling; 5	100	SCH	SCH and/or IC	Yes[5]	Mid-April - May
	50,000 yearling; 5	100	SCH		Yes[5]	

[1] These programs will not be operational until phase 2.

[2] In years of high within-hatchery survival, juvenile levels higher than the proposed release numbers may occur. The co-managers plan to

Table 4

[3] Up to 1 million subyearlings may undergo final rearing and release at Palmer Ponds as needed as agreed to by the co-managers annually.

[4] Palmer Ponds is the targeted release site for these fish, but other sites listed here may be used as needed or available as agreed to by the co-managers annually. Under phase 2, when the FRF becomes operational, a portion of this release may be reared and released at the FRF.

[5] Smolts that do not migrate from rearing ponds after a four-week period are collected and planted into non-anadromous waters

Disposition of Hatchery Adults (HGMP sections 7.5 and 7.8)

Adult fish collected in excess of annual broodstock needs are released to spawn naturally, sold to a contracted fish buyer, or distributed to the treaty tribes for subsistence use. For the listed programs, excess hatchery-origin fish are released to spawn naturally until their escapement goals are met (4,423 for Chinook salmon, and 2,020 for steelhead), then removal could occur at any of the adult collection facilities in the Basin that is necessary to meet adult management goals. The Marine Technology Lab Program kills and freezes any excess coho salmon broodstock for use in class dissections as part of the school curriculum. Spawned carcasses may also be sold to a contracted fish buyer, or distributed to the treaty tribes for subsistence in addition to being placed throughout the watershed for marine-derived nutrient enhancement purposes. Native winter-run steelhead that are live-spawned are released to potentially spawn again (males) and return to the ocean for an additional cycle.

Catastrophic Risk Management (HGMP section 5.8)

All facilities identified in Table 5 adhere to the applicants' fish health policies (NWIFC and WDFW 2006; USFWS 2004).

Table 5. Additional measures taken to reduce the likelihood of catastrophic fish loss at the hatchery facilities. NA = not applicable; net pen programs are within Puget Sound and have a ready supply of water.

Facility	Personnel	Water	Power loss
Fish Restoration Facility	Will have on-station personnel	Alarm	Will have back-up generator
Soos Creek Hatchery	On station at all times	Low water alarm	Back-up generator
Keta Creek Complex	On station at all times	Low water alarm	Back-up generator
Marine Technology Lab		Low water alarm	Back-up generator
Trout Unlimited Miller Creek Coho Salmon Hatchery			Back-up generator
Icy Creek Rearing Ponds	Checked daily	Low water alarm	Non-electric gravity-fed water supply
Flaming Geyser Rearing Ponds			Non-electric gravity-fed water supply
Palmer Rearing Ponds			Non-electric gravity-fed water supply
Elliott Bay Net Pens	Checked daily	NA	NA
Des Moines Net Pen	Checked daily	NA	NA

1.5 5(i)(E) The HGMP evaluates, minimizes, and accounts for the propagation programs' genetic and ecological effects on natural populations, including disease transfer, competition, predation, and genetic introgression caused by straying of hatchery fish.

The Duwamish/Green River basin HGMPs provide evaluations of potential genetic and ecological effects on listed salmon and steelhead in section 2 and risk minimization measures in sections 6-10.

Genetic effects

Artificial fish production may result in a loss of within-population genetic diversity (the reduction in quantity, variety and combinations of alleles in a population), outbreeding depression (loss in fitness caused by changes in allele frequency or the introduction of new alleles) and/or hatchery-influenced selection (Busack and Currens 1995). Genetic effects of fall chum and coho salmon on

ESA-listed Chinook salmon and steelhead in the Duwamish/Green River basin are unlikely because these species do not interbreed. Therefore, our consideration of their discussion of genetic effects focuses on the propagation of Chinook salmon and steelhead.

Because the two Chinook salmon and two winter-run steelhead programs are operated as integrated programs, some interbreeding between hatchery- and natural-origin fish is an objective. The HGMPs account for and minimize genetic risks through implementation of the following measures:

- Broodstock are randomly collected throughout the adult return to ensure full representation of run timing, age class, and sex ratio
- Factorial mating of steelhead ensures that all fish contribute to the production of progeny to retain genetic diversity
- Natural-origin fish are incorporated into the broodstock to limit divergence from the Duwamish/Green native populations
- Only natural-origin fall Chinook salmon are passed above the Soos Creek weir
- All fish are marked to differentiate them from other Chinook salmon and steelhead stocks, assess out-of-basin straying, and measure proportions of hatchery- and natural-origin spawners
- Juveniles are acclimated at their site of release to decrease straying potential. Acclimation of hatchery juveniles before release increases the probability that hatchery adults will home back to the release location, reducing their potential to stray into natural spawning areas (Dittman and Quinn 2008)

Ecological effects

The primary ecological risks to natural-origin salmon and steelhead populations posed by salmon and steelhead hatchery programs are identified in the HGMPs as competition for food resources and space, and predation (NMFS 2012). Pathogen transfer and amplification are also risk factors. As noted in the HGMPs and earlier in this document, all hatchery actions would be implemented in accordance with the co-manager and USFWS fish health policies (NWIFC and WDFW 2006; USFWS 2004) to account for and minimize the risks of pathogen transmission and amplification.

All of the HGMPs have incorporated some of the following measures to minimize competition and predation risks associated with program implementation:

- Fish are released as seawater-ready smolts or fry to foster rapid emigration seaward, maximizing clearance from freshwater and estuarine areas where natural fish would be most concentrated and most vulnerable to ecological interactions.
- Releases of juvenile fish will be made during freshets and elevated turbidity, when possible, to speed outmigration

- Fall chum salmon fed fry are too small at the time of their release to prey on or compete with any co-occurring natural-origin juvenile Chinook salmon and steelhead
- Yearling coho produced by the two net pen facilities are released directly into saltwater, with no freshwater interactions with natural-origin fish
- Releases typically occur from mid-April to May after the majority of natural-origin juveniles have emigrated, and prior to the emergence of steelhead fry

1.6 5(i)(F) The HGMP describes interrelationships and interdependencies with fisheries management.

The HGMPs describe the relationship of the proposed actions with fisheries management in section 3.

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

The goals of the HGMPs include providing hatchery-origin Chinook, coho, and fall chum salmon and steelhead for harvest to support fisheries. State recreational and tribal fisheries for hatchery-origin species may incidentally affect natural-origin Chinook salmon and steelhead. However, these fisheries are not considered interrelated with or interdependent on these programs because these programs are not the sole producers of fish for the fisheries.

1.7 5(i)(G) Adequate artificial propagation facilities exist to properly rear progeny of naturally spawned broodstock, to maintain population health and diversity, and to avoid hatchery-influenced selection and domestication.

The two programs that propagate ESA-listed Chinook salmon and winter-run steelhead utilize multiple facilities. This approach reduces the risk of maintaining listed fish at a single location while under propagation, lessening the potential for catastrophic loss of rearing populations in the event of water or power failure at one facility. As described in sections 4 and 5 of the HGMPs, the hatchery facilities used to implement the programs have adequate surface and groundwater sources, egg incubation and fish rearing vessels, and fish release facilities to ensure proper rearing of listed Chinook salmon and steelhead while under propagation. In 2012-2019, a number of improvements were made to Soos Creek Hatchery to further ensure safety of listed Chinook salmon and winter-run steelhead including construction of a new incubation building and incubation settling pond; six new rearing ponds; a new water distribution tower and water supply

line; and a new two-bay pollution abatement pond.

Facilities that rear over 20,000 pounds of fish operate under applicable National Pollutant Discharge Elimination System (NPDES) general permits, which provide for monitoring of temperature, chlorine, and settleable and suspended solids in facility effluent. As mentioned previously, fish health is maintained throughout rearing by adhering to fish health policies and using pathogen-free water sources when possible (NWIFC and WDFW 2006; USFWS 2004). Minimization of catastrophic loss and genetic risks associated with these programs were addressed in Sections 1.4 and 1.5, respectively, of this document.

1.8 5(i)(H) Adequate monitoring and evaluation exist to detect and evaluate the success of the hatchery program and any risks potentially impairing the recovery of the listed ESU.

The HGMPs include implementation of adequate monitoring and evaluation actions to evaluate the performance of each program in meeting program objectives. These actions are summarized in Section 1.10, and are further described in Section 11 of each HGMP. Some of these activities may be covered using other ESA pathways (e.g., Section 10 research permits), but the information obtained may be relevant to our evaluation of the hatchery program. Monitoring and evaluation actions implemented include:

- Spawning ground/redd surveys to determine percent of naturally spawning hatchery-origin fish
- Trapping of outmigrating juveniles to determine post-release emigration timing, emigration rate, and hatchery fish predation levels on natural fish
- Calculating estimates of smolt-to-adult survival rates, harvest of hatchery fish, and straying of Duwamish/Green hatchery salmon to other Puget Sound watersheds using mark recovery programs and creel surveys
- Collection of abundance, timing, age class, sex ratio, and fish health condition data for broodstock to assess run traits of the target populations
- Monitoring of water withdrawal and effluent to ensure compliance with permitted levels
- Monitoring of broodstock collection, egg take, fish survival rates in hatchery, smolt or fry release levels, and hatchery and natural fish escapement to the hatcheries to ensure compliance with program goals
- Fish health monitoring and reporting in compliance with fish health policies.

1.9 5(i)(I) The HGMP provides for evaluating monitoring data and making any revisions of assumptions, management strategies, or objectives that data show are needed.

Under the HGMPs in Section 1.10, data collected relating to hatchery program performance and effects would be evaluated by the applicants to determine whether performance standards were

are being met. Annual reports for the programs assembled by the applicants would be jointly reviewed by NMFS to document program results, and to determine if adjustments to the programs' assumptions and management strategies are warranted. Any changes would be incorporated into Future Brood Documents, Annual Operating Plan documents, and/or the HGMPs as necessary. These programs are enforced through the *U.S. v. Washington* Management Agreement process, upon review of annual reports and operating plans. The tribes and WDFW employ enforcement officers throughout the area, who are responsible for on the ground enforcement to prevent ESA violations.

1.10 5(i)(J) NMFS provides written concurrence [with] the HGMP, which specifies the implementation and reporting requirements.

After completion of the public review and comment period for this proposed evaluation and pending determination document, and after consulting with itself under section 7 of the ESA, NMFS will make a determination regarding the adequacy of the ten Duwamish/Green River basin HGMPs. If the determination is made that implementing and enforcing the plans will not appreciably reduce the likelihood of survival and recovery of the ESA-listed species, and that the plans address all the criteria specified in limit 6 of the 4(d) rule, NMFS will so notify the applicants in writing, and will specify any necessary implementation and reporting requirements.

1.11 5(i)(K) The HGMP is consistent with plans and conditions set within any Federal court proceeding with continuing jurisdiction over tribal harvest allocations.

The Duwamish/Green River basin salmon and steelhead HGMPs were developed by the applicants pursuant to the *U.S. v. Washington* (1974) fisheries and hatchery management framework. The HGMPs are one component of an effort to preserve and recover to a fishable status listed Chinook salmon, steelhead, and other non-listed salmon and steelhead populations in the Duwamish/Green River watershed. The ESU recovery plan for Chinook salmon (NMFS 2006; SSPS 2007) has hatchery, harvest, and habitat components, and includes monitoring, research, and restoration recommendations to complement artificial production. The hatchery actions described in the HGMPs are included within, and consistent with, this recovery plan. There are no other plans or conditions set within Federal court proceedings, including memorandums of understanding, court orders, or other management plans, that direct operation of the proposed salmon and steelhead hatchery programs.

2 PENDING DETERMINATION

As required by limit 6 of the 4(d) rule, the Secretary is seeking comment from the public on the pending determination as to whether or not the plans evaluated here would appreciably reduce the likelihood of survival and recovery of the listed salmon and steelhead. In addition, comment is sought on whether the plans meet the requirements of limit 6 of the 4(d) rule.

NMFS has reviewed the plans and evaluated them together against the requirements of the 4(d) rule. Based on this review and evaluation, NMFS' pending determination, subject to information provided during public comment, is that activities implemented as described would not appreciably reduce the likelihood of survival and recovery of ESA-listed species. This pending determination does not prejudge the outcome of any additional environmental reviews that may be scheduled to be completed prior to a final determination. As required in (6)(iv) of section 223.203 of the 4(d) rule for salmon and steelhead, the Secretary will publish notice of his determination together with a discussion of the biological analysis underlying that determination.

3 REEVALUATION CRITERIA

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

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