HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Keta Creek Complex
Species or Hatchery Stock:	Fall Chum Salmon
Agency/Operator:	Muckleshoot Indian Tribe
Watershed and Region:	Green- Duwamish, Puget Sound
Date Submitted:	
Date Last Updated:	July 18, 2014

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.
Keta Creek Complex

1.2) Species and population (or stock) under propagation, and ESA status.
Fall Chum salmon – *Oncorhynchus keta*

1.3) Responsible organization and individuals

Name (and title): Dennis Moore – Fish Enhancement Manager
Hugo Hernandez- Green River Enhancement Team Leader
Agency or Tribe: Muckleshoot Indian Tribe
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:
N/A

1.4) Funding source, staffing level, and annual hatchery program operational costs.
Tribal funding sources and Bureau of Indian Affairs
5 permanent full-time staff, and up to 15 seasonal staff
O&M – Approximately $500,000
Note: the above information applies cumulatively for all Keta Creek Complex programs and is not broken out by specific program.

1.5) Location(s) of hatchery and associated facilities.
Keta Creek Complex: RM 1.1 on Crisp Creek (09.0013), a right bank tributary of the Green River (09.0001) entering at RM 40.1

1.6) Type of program.
Integrated Harvest

1.7) Purpose (Goal) of program.

Augmentation. The goal of this program is to provide harvest opportunities for tribal, commercial, and recreational fishers.

Note: The Muckleshoot Indian Tribe reserves the right to discontinue current production; modify the current production level; or to change species reared to meet the needs and policy direction of the Tribe in consultation with their co-manager and with appropriate federal agencies to ensure compliance with the ESA.

1.8) Justification for the program.

The Keta Creek Complex chum salmon program is intended to produce fish for harvest while minimizing adverse effects on listed fish species using measures listed in Section 1.10.2. Salmon harvest is essential to the culture and well-being of the Muckleshoot Indian Tribe. The harvest of fish under this program is an essential part of the Tribe's federally-recognized treaty fishing rights reserved in the Treaties of Medicine Creek and Point Elliott. The role of this and other hatchery programs associated with treaty-reserved fishing rights is to support four basic values recognized by the Federal courts: (1) resource conservation, (2) ceremonial, religious, and spiritual values, (3) subsistence values, and (4) commercial values.

The natural production of chum salmon in the Green-Duwamish watershed has been diminished by the extensive loss and degradation of habitat. The lower two-thirds of the Green-Duwamish basin is dominated by urban, commercial, residential, port, and industrial land uses, while the upper third is managed for timber production. Total impervious surface area in 2006 was estimated at 38% of the basin area below Howard Hanson Dam (HHD) (NWIFC 2012). Flood control and spring reservoir storage operations at the HHD and water diversion operations significantly alter the natural flow regime and aquatic habitat. Ninety-eight percent of the historic estuary has been lost to development, and sediment and water quality in the current estuarine habitat is poor. Intertidal and marine shorelines are lined with artificial structures, while levees and revetments confine the lower 30 river miles and much of the middle river. These and other factors continue to degrade or eliminate habitat and natural processes needed to support the life history of chum salmon, reducing the abundance and productivity of natural populations in the watershed. The prospects for restoring sufficient areas of properly functioning habitat and natural ecosystem processes in this basin are limited.

So long as watersheds are unable to maintain self-sustaining and abundant salmonid populations, hatchery programs will be needed to replace lost natural production and provide meaningful harvest opportunity in fulfillment of promises made in the Treaties and the Muckleshoot Indian Tribe's treaty fishing rights affirmed by the U.S. v. Washington proceedings. The program will be operated to minimize adverse effects on listed fish by releasing fish at a size and time that will reduce spatial and temporal interactions with listed fish, by preventing the spread, introduction or amplification of pathogens that might affect the health of listed fish, and by insuring that hatchery facilities are in compliance with state water rights and water quality (NPDES) permit requirements.

1.9) List of program "Performance Standards". See Section 1.10 below.

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 standards, indicators, and monitoring and evaluation addressing benefits.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Hatchery operations support Puget Sound Salmon Management Plan (US v Washington) and sustain Muckleshoot tribal fisheries guaranteed through the Treaties of Point Elliott and Medicine Creek.	Contributes to tribal sustainable harvests. Abundance and survival is sufficient for harvest plus escapement.	Survival and contribution to fisheries will be estimated for each brood year released.
Program contributes to fulfilling co-management, tribal trust responsibility mandates and treaty rights per applicable agreements.	Coordination with WDFW and other tribal governments.	Participate in meetings between the co-managers to identify and report on issues of interest, coordinate management, and review programs (Future Brood Document process).

1.10.2) "Performance Indicators" addressing risks.

Table 1.10.1.2 Performance standards, indicators, and monitoring and evaluation addressing risks.

Performance Standard	Performance Indicator	Monitoring & Evaluation
Minimize impacts and/or interactions to ESA listed fish.	Hatchery operations comply with all state and federal regulations. Releases are made at size and time that promotes rapid downstream migration.	Monitor and record size, number and date of release. Fish health is documented.
Facilities are operated incompliance with applicable fish health guidelines, facility operation standards and protocols including Co-managers Fish Health Policy and FDA drug use rules.	Prevent the introduction, amplification, or spread of pathogens that might affect the health of both hatchery and naturally reproducing stocks and to produce healthy fry that will contribute to program goals.	Pathologists from NWIFC monitor program monthly. Exams performed at each life stage may include tests for virus, bacteria, parasites, and/or pathological changes, as needed.
Implement measures for broodstock management to maintain genetic integrity and diversity.	Broodstock are collected throughout the spawning run in proportion to timing, age, and sex composition of return.	Annual run timing, age, and sex composition and return timing data are collected to adhere to best management practices.
Hatchery operations comply with state and federal water quality and quantity standards.	NPDES permit compliance. WDOE water rights permit compliance.	Discharge water quality tested for monthly NPDES reports. Water usage is monitored.
Hatchery water withdrawals and diversion structures do not affect spawning behavior of natural populations or impact juveniles.	Hatchery intake structures meet state and federal guidelines.	Intake structure monitored for maintenance and intake structure compliance is assessed, and any needed fixes are prioritized.

1.11) Expected size of program.

Expected program size is up to five million chum fry. As noted above, the Muckleshoot Indian Tribe reserves the right to discontinue current production; modify the current production level; or change species reared to meet the needs and policy direction of the Tribe, in consultation with their comanager, and with appropriate federal agencies to ensure that any modifications comply with the ESA.

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

Annual broodstock level collected is between 2500 and 5000 adults.

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

Life Stage	Release Location	Annual Release Level
Fry	Keta Creek Hatchery	Up to 5 million

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

The program fry to adult survival rate has not yet been assessed. Performance to date has been assessed based on adult survival to terminal fisheries and sufficient brood returns to the hatchery**.**

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

The program started in 1975.

1.14) Expected duration of program.

Indefinite at this time.

1.15) Watersheds targeted by program.

Green Duwamish River (09.0001)

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

Potential alternative actions to produce comparable chum salmon abundance for harvest might include large-scale floodplain and estuarine habitat restoration in the lower watershed. Existing urban development, high land costs, and conflicting land and shoreline use prevent such an opportunity for large-scale properly functioning habitat and natural processes restoration, and for these reasons this approach is not being proposed.

SECTION 2. PROGRAM EFFECTS ON ESA-LISTED SALMONID POPULATIONS.

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

This HGMP is being submitted to NOAA Fisheries for ESA consultation, and determination regarding compliance of the plan with ESA section 4(d) rule criteria for joint state/tribal hatchery resource management plans affecting listed Chinook salmon and steelhead

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

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

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

None

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

Puget Sound Chinook ESU, Duwamish/Green River Chinook *(O. 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, as well as twenty-six artificial propagation programs (Ford 2011). In the Duwamish/ Green River basin, the Technical Recovery Team (TRT) has identified one demographically independent population (DIP) (Duwamish/Green River Chinook) (Ruckelshaus et al. 2006).

Puget Sound Steelhead DPS, Green River *(O. mykiss):* 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, in streams in the river basins of the Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington, bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive), as well as the Green River natural and Hamma Hamma winter-run steelhead hatchery stocks. In the Duwamish/Green River basin, the TRT has preliminarily delineated one demographically independent population (DIP) of winter steelhead; (Green River), no summer run populations were identified in the basin (PSSTRT 2011).

2.2.2) Status of 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

Green/Duwamish River Fall Chinook salmon in the Puget Sound ESU *(O. tshawytscha):* NMFS (1999) considered this stock to be in the ESU, but not essential for recovery. The stock was designated Category 2a, as the hatchery population is derived from a native, local population (SSHAG 2003). The NMFS subsequently listed hatchery production in the Green because these hatchery stocks are not significantly divergent from naturally-spawning fish in the watershed (70 FR 37160. June 28, 2005; NMFS SHIEER 2004, NMFS 2005). Recent escapement levels (2003-2011) have averaged 1,860 for natural spawners in the Green/Duwamish DIP. During this same time period, the population has shown declining trend (SaSI, WDFW 2012). The Puget Sound Chinook Harvest Plan (PSIT and WDFW 2010a) set natural-origin-recruit spawner low abundance threshold of 1,800 and an upper management threshold of 5,800 for the Green River fall Chinook. The NMFS refers to a critical threshold of 835 and a viable threshold of 5,523 for this population in their evaluation of the Harvest Plan (NMFS 2011). Between 2000 and 2011, Green River fall Chinook naturally spawning escapements have remained above critical threshold levels except in 2009 and 2011. The levels have been at or above viable thresholds in 7 of these last twelve years.

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 actions identified in the Puget Sound Chinook recovery plan are expected to take years or decades to be implemented and to potentially 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.

Green River steelhead in the Puget Sound DPS *(O. mykiss***)**: The Green River winter-run population has declined in abundance since the 1980s with the sharpest decline since 2005. The PSSTRT population viability analyses indicate the majority of steelhead populations in the Puget Sound DPS are at moderate to high levels of extinction risk (PSSTRT 2012). The extinction risk appears to be especially high for the Central and Southern Sound MPG. Most populations within the DPS are showing continued downward trends in estimated abundance, a few sharply so (Ford et al. 2010). The estimated probability that the Green River steelhead population would decline to 10% of its current estimated abundance (i.e., to 45 fish) is about 90% within 80 years. With an estimated mean population growth rate of -0.042 ($\lambda = 0.959$) and process variance of 0.001, we can be highly confident ($P < 0.05$) that a 90% decline in this population will not occur within the next 20 years, and that a 99% decline will not occur within the next 45 years. However, beyond the next 50 years we are highly uncertain about the precise level of risk (Ford et al. 2011). The Comanagers developed critical and viable threshold values for annual spawning escapement in each management unit (MU) as part of the 'Puget Sound Steelhead Management Plan' (PSIT and WDFW 2010b). The PSSTRT may develop thresholds for each DIP in the future. The

Comanagers' critical and viable thresholds for the Green River population were set at 250 and 1000 (PSIT and WDFW 2010b).

- Provide the most recent 12 year (e.g. 2000-present) progeny-to-parent ratios, survival data by life-stage, or other measures of productivity for the listed population. Indicate the source of these data.

Green/Duwamish River fall Chinook salmon (*O. tshawytscha):* WDFW smolt monitoring activities occur on this system and sampling is conducted with five-foot screw trap located at river mile 34.5 (upstream of Soos Creek). The Muckleshoot Indian Tribe currently operates a smolt trap on Soos Creek just upstream of the hatchery at RM 1.0.

Table 2.2.2.1. Puget Sound Chinook population average productivity for five-year intervals measured as recruits per spawner (R/S) and spawners per spawner (S/S). Trend over the intervals is also given.

Brood Years	**1982-1986**		**1987-1991**		**1992-1996**		**1997-2001**		**2002-2006**		**Trend**	
Populations	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S	R/S	S/S
Green/Duwamish	*4.69*	*1.18*	*1.34*	*0.23*	*3.1*	*0.53*	*3.58*	*0.73*	*3.12*	*0.29*	*-0.09*	*-0.13*
ESU	*9.57*	*2.19*	*5.05*	*0.96*	*3.01*	*1.24*	*2.70*	*1.19*	*1.67*	*0.67*	*-1.81*	*-0.28*

Source Data: Ford et al. 2011

Table 2.2.2.2. Short and long term population trend and growth rate estimates for the Puget Sound Chinook ESU populations.

Regions and Populations	**Years**	**Trend Natural Spawners w/Cl**	**Hatchery Fish Success = 0 Lambda w/Cl**	**p>1**	**Hatchery Fish Success = 1 Lambda w/Cl**	**p>1**
Green River Fall Run Chinook	1995-2009	0.952 (0.851 - 1.065)	1.003 (0.274 - 3.67)	0.51	0.835 (0.3 - 2.324)	0.13
	1968-2009	1.01 (0.981 - 1.039)	0.994 (0.892 - 1.108)	0.45	0.799 (0.716 - 0.89)	0.00

Source Data: Ford et al. 2011

Table 2.2.2.3. Abundance of juvenile migrant Chinook (sub-yearling) in the Green River above and below the WDFW juvenile trap site (Rkm 55), and in Soos Creek above Soos Creek Hatchery rack.

	Above Trap			**Below Trap**			**Soos Creek**			**Total Abundance**
Trap Year	Redds	Deposition	Abundance	Redds	Deposition	Abundance	Females	Deposition	Abundance	
2000	1,625	7,312,500	475,207	826	3,717,000	241,551	1,616	7,272,000	275,125	991,883
2001	3,064	1,378,800	809,616	936	4,212,000	247,324	1,580	7,110,000	275,000	1,331,940
2002	2,711	12,199,500	584,151	480	2,160,000	103,428	995	4,477,500	275,000	962,579
2003	3,772	16,974,000	449,956	2,314	10,413,000	276,034	1,239	5,575,500	275,000	1,000,990
2004	3,124	14,058,000	236,650	1,038	4,671,000	78,631	720	3,240,000	54,542	369,823
2005	4,769	21,460,500	470,334	827	3,721,500	80,561	623	2,803,500	61,442	612,337
2006	1,553	6,988,500	99,796	82	369,000	5,269	598	2,691,000	38,428	143,493
2007	3,170	14,265,000	127,491	883	3,973,500	35,512	313	1,408,500	12,588	175,591
2008	2,435	10,957,500	400,763	438	1,971,000	72,088	676	304,200	111,259	584,110
2009	2,107	94,810,500	196,118	282	1,269,000	26,248	504	2,268,000	46,911	269,277
2010	218	981,000	55,547	57	256,500	14,524	759	3,415,500	193,395	263,466

Source: Topping et al. 2011

Green-Duwamish River Steelhead (*O.mykiss*)

Table 2.2.2.4. Abundance estimates for natural-origin steelhead smolts rearing above the Green River juvenile trap (RKm 55) for migration years 2000-2010.

Trap Year	Abundance	95% C.I.		CV
		Lower	Upper	
2000	14,529	-----	-----	-----
2001	53,077	-----	-----	-----
2002	12,612	-----	-----	-----
2003	n/a	-----	-----	-----
2004	n/a	-----	-----	-----
2005	n/a	-----	-----	-----
2006	16,748	-----	-----	-----
2007	2,285	-----	-----	-----
2008	n/a	-----	-----	-----
2009	26,174	10,151	42,198	19.4%
2010	71,710	49,317	94,103	15.9%

Source: Topping and Zimmerman 2011.

Table 2.2.2.5. Exp. Steelhead Population Trend ln (natural spawners) (95% CI)

Population	1985-2009	1995-2009
Green River winter-run	0.992 (0.969 - 1.016)	0.953 (0.892 - 1.019)

Source Data: Ford et al. 2011.

- Provide the most recent 12 year (e.g. 2000-2011) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 2.2.2.6. Mainstem Green River and Soos Creek summer/fall Chinook total natural spawners, 2000-2012.

Year	Natural-Origin Spawners	Hatchery-Origin Spawners	Total Spawners*	Passed Above Soos Creek Weir***
2000	NA	NA	4,473**	2,419
2001	NA	NA	6,473**	3,623
2002	NA	NA	7,564**	3,401
2003	2,613	3,251	5,864	1,516
2004	2,922	5,025	7,947	1,134
2005	1,109	1,414	2,523	1,160
2006	2,516	3,274	5,790	1,564
2007	1,832	2,469	4,301	1,556
2008	3,825	2,146	5,971	1,053
2009	164	524	688	1,669
2010	839	1,253	2,092	1,504
2011	459	534	993	478
2012	1,629	1,462	3,091	1,217

Source: Aaron Bosworth, WDFW 2013 and SaSI 2013.

Notes:

** Escapement estimates listed here include all HOR and NOR fish spawning naturally in the*

mainstem Green River and Newaukum Creek.

*** Standardization of the redd -based spawner survey methodology has resulted in revised estimates for years prior to 2003.*

**** Not included in mainstem Green River spawner count.*

Table 2.2.2.7. Green (Duwamish) River wild winter steelhead spawning escapement 2000-2011.

Return Year	Escapement
1999/2000	1,705
2000/2001	1,402
2001/2002	1,068
2002/2003	1,612
2003/2004	2,359
2004/2005	1,298
2005/2006	1,955
2006/2007	1,452
2007/2008	833
2008/2009	304
2009/2010	423
2010/2011	855
Average	**1,321**

Source: Aaron Bosworth, WDFW District Biologist, 2012. Data are total escapement estimates based on cumulative redd counts in all mainstem spawning areas and in index reaches in Soos and Newaukum creeks totaling 12 miles. Does not include wild brood collected for hatchery program.

- Provide the most recent 12 year (e.g. 2000-2011) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Table 2.2.2.8. Puget Sound Chinook average natural (natural-origin and hatchery) and natural-origin only spawners and percent hatchery contributions for five year intervals. Spawning abundance averages are geometric means and hatchery contribution averages are arithmetic.

Return Years	1990-1994			1995-1999			2000-2004			2005-2009		
Populations	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**	**Nat**	**%**	**NOR**
Green-Duwamish	5,239	56%	2,214	6,792	68%	2,007	6,335	37%	3,921	3,077	56%	1,288
ESU	23,938	75%	17,905	27,392	63%	17,245	43,192	72%	31,294	34,486	69%	23,938

Data Source: Ford et al. 2011

Green River (Duwamish) steelhead (*Oncorhynchus mykiss*): The level of hatchery winter run steelhead spawners in the Green River is unknown. Due to timing differences between early Chambers winter stock and Skamania summer stock steelhead and a majority of the existing wild winter stocks (being later February – June), interaction on the spawning grounds is unclear.

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

- 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 Collection, Handling, and Holding: Adults returning to Keta Creek Complex volitionally enter a trap situated in Crisp Creek. No listed fish spawn naturally in Crisp Creek and none will be captured, handled, and released as a result of implementation of the program.

Broodstock Spawning/Pathology Sampling: The fall chum salmon propagated through the program are a non-listed species, and no listed salmonids in the Duwamish-Green River system will be affected by chum salmon spawning and pathology sampling activities that are part of this program. No listed fish spawn naturally in Crisp Creek and none will be affected through broodstock spawning as a result of implementation of the program. Consistent with the Co-managers' Washington Fish Health Policy (NWIFC and WDFW 2006), ovarian fluid and kidney- spleen samples collected from up to 60 chum salmon adults will be evaluated each year for fish pathogen and disease incidence. Fish disease control measures consistent with the policy will be applied to reduce the risk of adverse effects on listed fish populations.

Rearing Program: NWIFC pathologists screen fish on a monthly basis. Releases of chum subyearlings into the Duwamish-Green River system are consistent with Co-Managers Washington Fish Health Policy (NWIFC and WDFW 2006) protocols and standards to minimize the risks any disease, pathogen transfer, and amplification risk to listed fish populations in the watershed. No impacts to listed fish are anticipated as a result of the rearing program.

Operation of Hatchery Facilities: Operation of the hatchery physical plant will have none to very minor effects on listed fish in the watershed. Withdrawal of surface water and ground water to supply the hatchery is screened to avoid entrainment of juvenile salmon, in accordance with NMFS guidelines (NMFS 1995, 1996). Hatchery effluent may alter various properties of the receiving water used by listed and other stocks. These properties include suspended solids, settled solids, temperature, dissolved oxygen, biological oxygen demand, and nutrient. This program is operated under discharge limitations set by the U.S. Environmental Protection agency limiting the changes and effects of these properties on the receiving water. Hatchery effluent is rapidly diluted at the point of discharge, and effluent quality is maintained within federal and/or state effluent discharge permit guidelines to ensure that downstream aquatic life (including fish) is adequately protected.

Monitoring Activities: The Keta Creek Complex hatchery chum program has no monitoring activities that would adversely affect ESA listed species.

Predation: Keta Creek Complex hatchery chum salmon are released on-station in Crisp Creek beginning in April at a size less than75 mm. Salmonid predation is generally thought to be greatest when the prey is 1/3 or less the length of predator species (USFWS 1994). Assuming the "1/3 size rule" in this instance, the chum hatchery releases are well below the 155 mm plus size considered to promote predation on natural origin Chinook or steelhead juveniles present in freshwater during the time of release. Moreover, chum juveniles are not piscivorous and feed primarily on insects in freshwater, and on copepods and other zooplankton in estuarine areas. Steelhead utilize chum hatchery releases as a food source.

Competition/Niche Displacement: The Keta Hatchery chum releases may compete with listed Chinook and steelhead for food and space in the freshwater, estuarine, and marine environment. Chum juveniles can overlap in time and space with juvenile Chinook and steelhead during their Puget Sound residency. However, the risk of competition in freshwater and estuarine habitat between chum releases under this HGMP and listed species has been minimized by rearing and release strategies (e.g., larger size and migration readiness) that promote rapid seaward migration. Chum salmon migrate out of freshwater rapidly and likely rear in the marine nearshore in a different microhabitat niche than Chinook or steelhead. Kemp et. Al. (2013) found that while the diet composition of juvenile salmon and herring in Puget Sound in July and in September/October showed similarity among species, Chinook and coho salmon diets were most similar, followed by herring, and least similar was chum salmon. Migration rates of chum salmon in nearshore areas depend upon such factors as fish size, foraging success and currents, while habitat use appears to be strongly size dependent (Fresh, K. 2006). Steelhead enter Puget Sound at a much larger size than chum. A NMFS (2013) review of studies conducted in freshwater found that intraspecific rather than interspecific competition is of a greater magnitude due to greater niche overlap within species than between species (e.g., Fraser 1969, Allee 1974, Bisson et al.1988, Flagg et al 2000, Hasegawa and Maekawa 2008). Similarly, other studies suggest that competition among co-occurring salmonid species is minimized by species-specific differences in habitat preference (Hearn 1987, Bisson et al 1988, Dolloff and Reeves 1990). No impacts on listed steelhead or Chinook are expected from any stray hatchery chum spawning in the Green River in terms of competition with spawning habitat or redd disturbance due to the difference in spawn timing and spawning habitat selection among these species.

Disease Transmission: Hatchery effluent has the potential to transport pathogens from the hatchery water supply to receiving water containing listed and other stocks. Pathogens may also be transmitted by direct contact of infected hatchery fish with other stocks. Although these methods of disease transmission are possible, there is little information showing that pathogens are transferred to naturally produced stocks. This program is operated under the disease prevention and detection guidelines established in the Salmonid Disease Control Policy of the Fisheries Co-Managers of Washington State (NWIFC and WDFW 2008). These practices should minimize this risk for both listed and other stocks.

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

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**).

  See take tables at the end of this document.

- **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 projected take that would exceed estimates given in this HGMP would be communicated to 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.

The program is consistent with hatchery program guidelines in the co-managers' Puget Sound hatchery resource management plan (WDFW and PSTT 2004), and is consistent with the Washington state co-managers Salmonid Disease Policy that identifies Fish Health Management Zones, eggs and fish transfer policies, and guidelines designed to limit the spread of fish pathogens between and in watersheds (NWIFC and WDFW 1998, 2006).

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

This program operates under and is consistent with several court orders and agreements. These include U.S. v. Washington Boldt decision, and subsequent orders including the Puget Sound Salmon Management Plan (PSSMP), and Comprehensive Management Plan for Puget Sound Chinook: Hatchery Management and Harvest Management components. The Tribe's chum salmon program is consistent with the Puget Sound Management Plan and Comanager Future Brood Document. The Future Brood Document is a detailed listing of agreed annual juvenile fish production goals. This document is reviewed and updated each spring, and finalized in July. The Current Brood Document presents actual juvenile fish production levels relative to annual production goals. This second document is developed in the spring after eggs spawned that year have been enumerated and actual resultant juvenile fish production levels can be estimated. Through this process, the co-managers document their agreement on the function, purpose and release strategies for all Puget Sound region hatchery programs.

3.3) Relationship to harvest objectives.

Chum salmon return as adults for harvest between mid-October to late December, with minimal if any conflicts with earlier returning Chinook salmon or later returning steelhead. Recently, the co-managers prepared an updated Harvest Management Plan for Puget Sound Chinook salmon. The Plan states specific objectives for harvest of the 15 Puget Sound management units, the technical bases for the objectives, and procedures for their implementation. The Plan assures that the survival and recovery of the Puget Sound ESU for Chinook will not be impeded by fisheries-related mortality. The Plan was submitted and NMFS (NOAA Fisheries) reached a finding, based on the conditions stated in the 4(d) rule, that fisheries-related take in Washington waters is exempt from prohibition under Section 9 of the ESA.

3.3.1 Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (2000-2011), if available.

Although this chum salmon program provides fisheries benefits for non-Treaty as well as Treaty fisheries, levels of harvest are not available at this time.

3.4) Relationship to habitat protection and recovery strategies.

The hatchery chum salmon program provides treaty and non-treaty harvest opportunity in light of habitat loss and degradation limiting natural production in the Green-Duwamish River basin (WRIA 9) streams and Puget Sound. Howard Hanson Dam near river mile 64 is an impassable barrier to fish migration and prevents natural production of salmonids into over 100 miles of stream habitat in the upper Green River watershed. The majority of the lower half of the accessible basin is highly developed, channelized, and/or industrialized. Ninety eight percent of the historic estuary has been lost to development. Riprap and other structures line the intertidal and marine shorelines, along with levees and revetments in the middle and lower river. Agriculture and urban development have degraded the hydrology, water quality, floodplain, channel diversity, and riparian areas of most lowland streams in WRIA 9. Water temperatures exceed lethal levels for salmonids at times due to inadequate shade. These factors have degraded or eliminated habitat areas and natural processes important for chum and other salmon, reducing the abundance and productivity of the natural population in the watershed.

Efforts are ongoing by tribal, state, local and federal governments in WRIA 9 to try to protect and improve instream flows, water quality, fish passage, near-shore and riparian and floodplain habitats, and where possible, the natural ecosystem processes that create and maintain salmon habitat.

King County is the lead entity for the WRIA 9 salmon recovery planning group, a coalition of local governments and stakeholders. The WRIA 9 Salmon Habitat Plan (August 2005) outlined projects and programs focusing on habitat limitations identified in the basin: transition habitat in the Duwamish estuary; rearing habitat in the estuary, middle and lower river, and nearshore marine areas, and spawning habitat in the middle and lower river. The Salmon Recovery Funding Board (SRFB) is composed of citizens appointed by the Governor and five state agency directors that provides grant funds to protect or restore salmon habitat and assist related activities in the basin. The US Army Corps of Engineers' Ecosystem Restoration Program has also funded projects intended to improve habitat conditions for salmon in the basin. The non-governmental Mid Puget Sound Regional Enhancement Group works to implement habitat restoration projects in cooperation with other entities to benefit salmonids in the system. A number of habitat restoration activities were initiated under the 2001 Tacoma Water Green River Habitat Conservation Plan in the upper river, and a Superfund cleanup plan is being developed to address toxic contamination of Duwamish River sediments. The net cumulative effect of these activities is uncertain, and salmon habitat was reported to be in continued decline since the adoption of the Puget Sound Chinook Recovery Plan (Judge, M. 2011).

Member Tribes have worked with the NWIFC and SSHIAP to create the State of Our Watersheds report (NWIFC 2012). This document examines key indicators of habitat quality and quantity across more than 20 watersheds in western Washington that lie within tribal Usual and Accustomed fishing areas as defined by *U.S. vs. Washington* (Boldt decision). The Green River habitat section can be found under the Muckleshoot chapter at http://maps.nwifc.org:8080/sow2012/.

3.5) Ecological interactions.

(1) *Salmonid and non-salmonid fishes or other species that could negatively impact the program*. Negative impacts by fishes and other species on the hatchery chum 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 chum survival rates through predation on newly released, emigrating juveniles in the freshwater and marine areas. Steelhead, coho, cutthroat trout and other fish species utilize chum hatchery releases as a food source. Certain avian and mammalian species may also prey on juvenile chum at the hatchery site, if these species are not excluded from rearing areas. Species that could negatively impact juvenile chum through predation include mergansers, cormorants, belted kingfishers, great blue herons, and green herons. Migrating adult chum produced by the program may also serve as prey for mammals in marine areas, nearshore marine areas and in the Green River to the detriment of population abundance and harvest augmentation. Species that may negatively impact adult program fish through predation may include orcas, sea lions, harbor seals and 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).* Listed species potentially negatively impacted include Puget Sound Chinook and Puget Sound steelhead. Hatchery fish can interact with the listed species through competition and predation (Fresh 1997). Important considerations include the type of species reared, fish size at time of release, number of fish released and location(s) of program releases. Keta Creek Complex hatchery chum salmon are released on-station beginning in April at size less than 75 mm. Salmonid predation is generally thought to be greatest when the prey is 1/3 or less the length of predator species (USFWS 1994). Assuming the "1/3 size rule" in this instance, the hatchery release is well below the 155 mm plus size considered to promote predation on the natural Chinook population during time of release. Natural steelhead outmigrants are similar in size to the hatchery coho releases in the basin at 150 mm. Over half of the Chinook outmigration has occurred by this time (Seiler et al, 2002). In addition, Chinook migrants are larger in size by May.

(3) *Salmonid and non-salmonid fishes or other species that could positively impact the program.* Fish species that could positively impact the program may include rainbow and cutthroat trout and other salmonid species present in the Green River watershed through natural production. Salmonid adults that return to watershed streams and any seeding efforts using adult salmon carcasses may provide a source of nutrients and stimulate stream productivity. Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed, providing food resources for the emigrating chum. Carcasses from returning adult salmon may elevate stream productivity through several

pathways, including: 1) the releases of nutrients from decaying carcasses has been observed to stimulate primary productivity (Wipfli et al. 1998); 2) the decaying carcasses have been found to enrich the food base of aquatic invertebrates (Mathisen et al. 1988); and 3) juvenile salmonids have been observed to feed directly on the carcasses (Bilby et al. 1996).

(4) *Salmonid and non-salmonid fishes or other species that could be positively impacted by the program.* The chum program will positively impact freshwater and marine fish species that prey on adult and juvenile fish. These species include: Southern Resident Killer Whale/Orca, Northern pikeminnow, cutthroat trout, bull trout, steelhead, Pacific staghorn sculpin, and numerous marine pelagic fish species. Southern Resident Killer Whale/Orca feed on chum and other salmon species in Puget Sound, with a preference for Chinook. Notably, chum salmon are observed to make up a large proportion of the ESA- listed Southern Resident Killer Whale/Orca diet in the fall (Ford and Ellis, 2005). This program is expected to benefit Southern Resident Killer Whale/Orca by contributing to the availability of a seasonally critical source of prey. Prey availability (salmon) has been given as one of the main factors for the decline of the Southern Resident Killer Whale/Orca population in Puget Sound.

Nutrients provided by decaying carcasses might also benefit fish and aquatic invertebrates in freshwater, as well as fish, bird, invertebrate, and mammal species that feed on carcasses directly. The hatchery releases will also provide forage for avian predators, including gulls, mergansers, cormorants, belted kingfishers, great blue herons and night herons. Mammals that benefit from migrating fingerlings and adults besides orcas include river otters, harbor seals, and sea lions.

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.

The Keta Creek complex operates on surface water from Crisp Creek and on groundwater spring sources. Crisp Creek itself is fed by groundwater recharge and springs that discharge to the creek. Water yield is naturally limited and varies by season. Water quality in Crisp Creek source meets most of Washington State's Class A standards, which are the current standards that apply to the creek. Available water quality data collected indicate that Crisp Creek meets State water quality standards for temperature, turbidity, dissolved oxygen, and pH.

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.

The Keta Creek Complex operates under NPDES Permit No. WAG-130020 with surface water usage regulated under permits S1-23839C, S1-24508C, S1- 22503C, and S1-22989C. The hatchery water intake structure is in compliance with NOAA Fisheries screening criteria (NMFS 1995, 1996). Water intake screening and structures are inspected several times each week to insure they are operating correctly. Anadromous fish are not present upstream of the adult trap on Crisp Creek.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

At the Keta Creek Complex, broodstock are collected in an in-stream trap situated in Crisp Creek. The trap pond is the natural stream channel and measures about 25'x 60' with a "v" entry way. It has two holding pens above an upper removal weir. Pending facility renovation plans call for a new off-channel adult collection and handling facility.

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

Transport is not necessary for this program.

5.3) Broodstock holding and spawning facilities.

Chum adults are generally spawned within a few days after arriving in the trap pond. Adults are seined, sorted, killed and spawned at a spawning shed.

5.4) Incubation facilities.

The incubation facilities consists of Heath trays (vertical incubators).

5.5) Rearing facilities.

Rearing facilities consist of four 10'by 100' raceways, two earthen ponds, five intermediate rearing tanks and six 4'by 40' rearing tanks. Facility renovation plans call for replacing all existing rearing vessels.

5.6) Acclimation/release facilities.

Program juveniles are released on-station from rearing tanks into Crisp Creek.

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

N/A

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.

The hatchery is equipped with a backup generator and adequate fuel supply in the event of a power outage. A caretaker lives on site to enable quick responses that occur outside of normal working hours. The final back-up for all facilities is direct release in case of complete loss of water supply.

Fish rearing is conducted in compliance with the co-managers Fish Health Policy (WDFW and WWTIT 1998, updated 2006). Adherence to artificial propagation, sanitation and disease control practices defined in the policy should reduce the risk of fish disease pathogen transfers.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

6.1) Source.

1975 – Quilcene hatchery stock
1976 – 1980 – Finch Creek (Hoodsport /WDFW)
1980-1988 – Keta Creek returns
1990 – 1995 – East Kitsap (Suquamish Tribe)
1996 –present – Keta Creek returns

6.2) Supporting information.

6.2.1) History

For the first year of operations (1975), chum eggs were made available by U.S. Fish and Wildlife Service from Quilcene National Hatchery on Hood Canal. For the second year and several years following, chum eggs were received from the WDFW Hoodsport Hatchery, also located on Hood Canal. In 1989, stock management issues mandated that the Keta Creek hatchery program on the Green River use a Mid-Sound chum stock. To accomplish that, the Tribe discontinued spawning the returning fish that originated from the Hood Canal stocks. Starting in 1990, program eggs were transferred in from East Kitsap and continued until sufficient returns allowed the program to be self-sufficient again.

6.2.2) Annual size.

Up to 5,000 adults

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

N/A

6.2.4) Genetic or ecological differences.

None known.

6.2.5) Reasons for choosing.

The mid-Sound fall chum stock from East Kitsap County was the most local stock available. Since 1996, the program has relied upon chum returning to Crisp Creek for broodstock.

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.

N/A

Section 7. BROODSTOCK COLLECTION

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

Adults

7.2) Collection or sampling design.

Broodstock taken at the Keta Creek Complex are collected from adults returning to Crisp Creek trap throughout the entire run. Adults enter the trap between early November and late December. Fish are seined and checked for ripeness. Mature fish are spawned 5 to 6 days per week during the peak of the run.

7.3) Identity

Broodstock is from hatchery returns. There is a proposal to otolith-mark program chum releases in the future.

7.4) Proposed number to be collected:

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

A total of 3500 to 5000 adults are needed to meet production goals.

7.4.2) Broodstock collection levels for the last twelve years (e.g. 2000-2011), or for most recent years available.

Table 7.4.2. Keta Creek Complex chum salmon broodstock levels for years 2000-2011.

Brood Year	Females	Males	Eggs	Juveniles
2000	48	49	116,000	95,540
2001	1065	1756	2,032,768	1,159,300
2002	844	844	1,600,000	1,206,100
2003	925	936	2,049,226	1,341,048
2004	926	927	2,265,600	1,923,800
2005	834	827	1,980,600	1,769,950
2006	1139	1153	3,148,200	2,659,000
2007	1292	1337	3,102,100	2,874,700
2008	1597	1700	4,349,800	3,778,300
2009	1136	1209	2,558,200	2,271,000
2010	1538	1516	3,870,500	3,476,200
2011	1585	1720	3,487,000	2,877,000

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

Un-spawned adults are distributed to tribal members (a small quantity) and the rest are sold to a fish carcass buyer for processing.

7.6) Fish transportation and holding methods.

N/A

7.7) Describe fish health maintenance and sanitation procedures applied.

Standard fish health protocol is utilized as defined in the current Co-manager Fish Health Policy.

7.8) Disposition of carcasses.

Carcasses, both spawned and unspawned, may be sold to a contracted buyer, given to tribal members, or may be used as part of an approved nutrient enhancement program on a limited basis.

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.

N/A

SECTION 8. MATING

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

8.1) Selection method.

Adults are chosen randomly from ripe fish on spawn day. To represent the total run of fish, adults are taken for spawning throughout the run timing.

8.2) Males.

Chum males are selected randomly for spawning from ripe broodstock collected in the fish trap.

8.3) Fertilization.

Females are paired one on one with males. In a single bucket, the eggs of a randomly chosen female are fertilized using the milt of a randomly chosen male. After 2 minutes the fertilized eggs of three females are consolidated into one bucket in order to maximize the success of fertilization that otherwise might be compromised by the weak milt of a male. The pooled eggs are mixed and within 3 minutes are rinsed and then disinfected with iodine at 100 parts per million (ppm) for 1 hour during water hardening as required by Co-managers Fish Health Policy (1998). Fertilized eggs are taken to the hatchery and set into vertical incubators or "jars".

8.4) Cryopreserved gametes.

N/A

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.

N/A

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:

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

Typically, survival of eggs from green to eyed-up stage ranges from 85 to 95 percent depending on water quality on a given year. Total survival from green eggs to released fry has ranged from 70 to 95 percent.

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

Egg takes are managed to limit the likelihood of eggs surplus to incubation capacity, however, in the event that surplus eggs are taken, additional bulk hatching containers are set up.

9.1.3) Loading densities applied during incubation.

Standard loading per Heath tray at 8,000 eggs per tray.

9.1.4) Incubation conditions.

Incubation water ranges from 49 to 50 degrees F. Silt and sediment are gently flushed out of green eggs when the eggs reach at least 200 TU (Temperature Units). This task is performed throughout the incubation period as needed to prevent suffocation of the eggs due to any excessive silt or sediment in the incubation trays.

9.1.5) Ponding.

Fish are ponded when yolk sac condition is a small slit (about 1 mm) to buttoned up (index stage).

9.1.6) Fish health maintenance and monitoring.

In order to control any fungus outbreak in the incubators, a 15 minute formalin drip at 100 parts per million (ppm) is conducted every other day, until the eggs are ready to hatch. When eggs reach eyed stage, they are visually inspected for abnormalities and dead eggs are removed.

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.

N/A

9.2) Rearing:

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

Generally, swim-up fry to released fry survival rates range from 91% to 96%.

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

Density goal is not to exceed 0.5 pounds per cubic foot, actual levels are below that limit.

9.2.3) Fish rearing conditions

Presently we are using the Standard 100 foot raceways which we supplement with oxygen during rearing to keep an oxygen saturation of about 95%. In the near future, the raceways will be replaced with circular rearing tanks.

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.

Fish are sampled (100 fish samples) for size (millimeters and grams) and health on a weekly basis throughout rearing

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

Growth rates will depend on fish health status. Feed adjustments are conducted as dictated by work-up data. Growth rates are somewhat conditioned by release strategies.

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).

Ewos and Bio-Oregon diets are fed at a rate of up to 2.5 body weight per day depending on environmental conditions and fish health. Feed conversion efficiency is about 0.8: 1.0 (0.8 lbs of feed produces 1.0 lbs of fish).

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

Fish are monitored on a daily basis for health and disease concerns and inspected monthly by the Olympia Fish Health Center (NWIFC).

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

N/A

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

N/A

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.

N/A

SECTION 10. RELEASE

Describe fish release levels, and release practices applied through the hatchery program. *Specify any management goals (e.g. number, size or age at release, population uniformity, residualization controls) that the hatchery is operating under for the hatchery stock in the appropriate sections below.*

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Fry	5 million	450-150	April to June	Crisp Creek @ RM 1.1

10.2) Specific location(s) of proposed release (hatchery): Keta Creek Complex

Stream, river, or watercourse: Crisp Creek 09.0113
Release point: RM 1.1 on Crisp Creek, tributary to the Green River at RM 40.1
Major watershed: Green Duwamish River (WRIA 9)
Basin or Region: Puget Sound

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

Table 10.3.1. Keta Creek Complex chum salmon fry releases by age class, 1998-2012.

Release Year	Fry	Average Size (or Range) (fpp)	Release Date
1998	1,215,000	354 - 212	4/3 to 5/11
1999	1,687,000	375	3/15 to 4/31
2000	1,160,000	389- 301	3/13 to 4/17
2001	96,540	188	4/26
2002	1,159,300	631- 422	3/19 to 4/12
2003	1,206,100	579- 354	3/17 to 4/7
2004	1,341,000	1370- 319	3/6 to 4/23
2005	2,265,600 470,200 (Grover's)	890- 313 1100- 1050	3/21 to 4/28 3/28 to 4/15
2006	1,769,950	775 - 107	3/22 to 5/31
2007	2,659,000 232,000 (Grover's)	900 – 100 194	3/10 to 6/1 5/14
2008	2,874,700 291,000 (Grover's)	1066 -140 1200 - 140	3/4 to 5/22 3/21 to 5/22
2009	3,778,300	1300 - 160	3/10 to 5/14
2010	2,271,000	1400 - 204	3/22 to 5/19
2011	3,476,000	1400 - 193	3/3 to 6/9
2012	2,877,000	1275 - 132	2/29 to 6/8

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

See Table 10.3.1. above. All releases are forced from raceways and rearing tanks into the outlet structure then are allowed to volitionally leave the Crisp Creek system on their own.

10.5) Fish transportation procedures, if applicable.
N/A

10.6) Acclimation procedures
N/A

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

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

10.9) Fish health certification procedures applied pre-release.

Fish are inspected and certified according to the Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State (NWIFC and WDFW 1998, 2006)

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

Fish will be released directly into Crisp Creek.

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.
N/A

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

This section describes how "Performance Indicators" listed in Section 1.10 will be monitored. Results of "Performance Indicator" monitoring will be evaluated annually and used to adaptively manage the hatchery program, as needed, to meet "Performance Standards".

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.

See Tables 1.10.1.1 and 10.10.1.2 above.

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

The ability to estimate such indicators will be determined by implementation plans, budgets, and assessment priorities. Program funding is subject to annual evaluation and support from WDFW, Northwest Indian Fisheries Commission, Bureau of Indian Affairs, and other sources. However, at present we anticipate that funding, staffing and support logistics will be available to implement all or most of the monitoring and evaluation activities shown in the tables in Section 1.10.

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.

N/A

SECTION 12. RESEARCH

Provide the following information for any research programs conducted in ***direct association with the hatchery program described in this HGMP. Provide sufficient detail to allow for the independent assessment of the effects of the research program on listed fish****. If applicable, correlate with research indicated as needed in any ESU hatchery plan approved by the co-managers and NMFS. Attach a copy of any formal research proposal addressing activities covered in this section. Include estimated take levels for the research program with take levels provided for the associated hatchery program in* ***Table 1****.*

Research related to the chum program is not being conducted at this time.

12.1) Objective or purpose.
12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

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

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

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

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

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

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).

12.10) Alternative methods to achieve project objectives.

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

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.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

"I hereby certify that the foregoing information 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."
By submitting this material the Muckleshoot Indian Tribe is not conceding the application of the ESA to its hatchery operations. This information is primarily submitted to facilitate the ability of the NMFS to carry out it's duties under ESA consistent with the government to government relationship between the Muckleshoot Indian Tribe and the United States.

Name, Title, and Signature of Applicant:

Dennis Moore, Fish Enhancement Manager

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.

This HGMP is being submitted for ESA consultation and take prohibition exemption under ESA section 4(d).

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

Green (Duwamish) 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). The Green River is considered critical habitat for bull trout and is thought to serve rearing, migration and overwintering purposes (USFWS 2004). Bull trout have been documented in the Green River as far upstream as RM 41 in recent years and are consistently reported in the lower Duwamish River. It is unclear whether these fish represent a local spawning population or transients from other systems as there is no information on timing or distribution of spawning in the basin if any occurs (SaSI 2004). No bull trout have been documented in Crisp Creek nor have any been encountered at the Keta/Crisp Creek trap or any other hatchery program facilities since the hatchery began operations in 1975.

Habitat--The Green River watershed has been heavily impacted by human activities, which include logging, road construction, flood control and municipal water supply diversion dams, agricultural development, river channelization, intensive industrial and residential development, and estuarine dredging and filling. Historically the contribution of the White and Black Rivers which accounted for two-thirds of the flow of the Duwamish would have greatly increased the amount of favorable bull trout habitat in the system. While water temperatures in the lower basin are often unsuitable for this species, however it is possible that some suitable habitat may still be available the upper watershed above Howard Hanson Dam. It is not known if bull trout occupied the upper watershed in the past; they do not appear to be present now (Watson and Toth 1994). More recently, no bull trout were found during extensive gill net sampling in Howard Hanson reservoir conducted in winter and spring of 2008 by the US Army Corps (Fred Goetz, USACE, *pers. comm.).*

Several listed and candidate species are found in King 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]
Canada Lynx (*Lynx canadensis*) –Threatened [critical habitat designated]

Gray Wolf (*Canis lupus*) –Threatened
Grizzly bear (*Ursus arctos horribilis*) –Threatened
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
Oregon spotted frog *(Rana pretiosa)* [historic]
Yellow-billed cuckoo *(Coccyzus americanus)*
Whitebark pine *(Pinus albicaulis*)

15.3) Analyze effects.

Hatchery activities, including broodstock collection, hatchery weir/trap, water discharges, and water intake structures at the Keta Creek Complex may pose a risk to any bull trout that might be in proximity to these facilities. However, risk to bull trout populations is expected to be low as bull trout are not documented in Crisp Creek nor have any been encountered at the Keta/Crisp Creek adult collection weir or at any other hatchery facilities since the hatchery operations began in 1975.

Water discharges from the hatchery may affect water quality in Crisp Creek, however, the risk of water quality degradation affecting the health of bull trout would be low given that hatchery operations comply with NPDES permit and monitoring requirements to avoid or limit adverse effects on water quality.

Hatchery operations may introduce or spread fish pathogens that might pose a risk to the health of any bull trout that may occur in the creek. However, this risk would be low as hatchery facilities and fish culture practices are operated in compliance with all applicable fish health guidelines, facility operation standards, and protocols, including routine monitoring and testing for pathogens.

The Keta Creek complex operates on surface water from Crisp Creek and on groundwater spring sources. Water withdrawals from Crisp Creek and from tributary springs to Crisp Creek are non-consumptive, and do not exceed the rates authorized by existing state water rights certificates. The risk to bull trout from water withdrawals is low as the water supplied to the hatchery is non consumptive and returns to the Creek a very short distance from where it is withdrawn, and continuous streamflow is maintained in the Crisp Creek channel between the intakes.

Juvenile fish releases from the hatchery could provide prey for any bull trout occurring in the Green River downstream of the hatchery.

15.4) Actions taken to minimize potential effects.

The Keta Creek Complex broodstock collection facilities are checked at least daily when operating. In the event that any bull trout are encountered at the Keta Creek complex hatchery weir/trap or water intake facilities would immediately be returned to Crisp Creek. Any bull trout encountered at the hatchery facilities or related activities will be recorded and reported to USFWS.

Hatchery operations comply with NPDES permit and monitoring requirements to avoid or limit adverse effects on water quality.

Water withdrawals from Crisp Creek are non-consumptive and limited to the rates authorized by existing state water rights certificates. Surface flow will be retained in the Crisp Creek channel in the reach between intake structures to maintain the health of the creek.

The two intake structures that supply water from Crisp Creek to the rearing ponds and tanks are screened in compliance with current state and federal agency fish protection criteria. Water intake screening and structures are inspected several times each week to insure they are operating correctly. Any bull trout encountered at the water intake facilities would be returned immediately to the Crisp Creek, and reported to USFWS.

Program facilities are operated in compliance with all applicable fish health guidelines, facility operation standards and protocols including the Co-managers Fish Health Policy (NWIFC and WDFW, 2006) to prevent the introduction or spreading of fish pathogens including routine monitoring and testing for pathogens.

15.5) References

Northwest Indian Fisheries Commission (NWIFC) and Washington State Department of Fish and Wildlife (WDFW). 2006. Salmonid Disease Control Policy of the Fisheries Co-managers of Washington State. Washington Department of Fish and Wildlife and Western Washington Treaty Indian Tribes, Olympia Washington.

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

Listed species affected: Chinook *(Oncorhynchus tshawytscha)*	**ESU/Population:** Puget Sound / Green River Fall Chinook		**Activity:** Keta Creek Complex Chum Program	
Location of hatchery activity: RM 1.1 on Crisp Creek (09.0013)	**Dates of activity:** November-April		**Hatchery program operator:** Muckleshoot Indian Tribe	
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)	-	-	-	-
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)	Unknown	Unknown	Unknown	Unknown

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 1 (b) Estimated listed salmonid take levels of by hatchery activity.

Listed species affected: Steelhead *(Oncorhynchus mykiss)*	**ESU/Population:** Puget Sound / Green River winter steelhead		**Activity:** Keta Creek Complex Chum Program
Location of hatchery activity: RM 1.1 on Crisp Creek (09.0013)	**Dates of activity:** November-April		**Hatchery program operator:** Muckleshoot Indian Tribe
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)	-	-	-	-
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)	Unknown	Unknown	Unknown	Unknown

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.