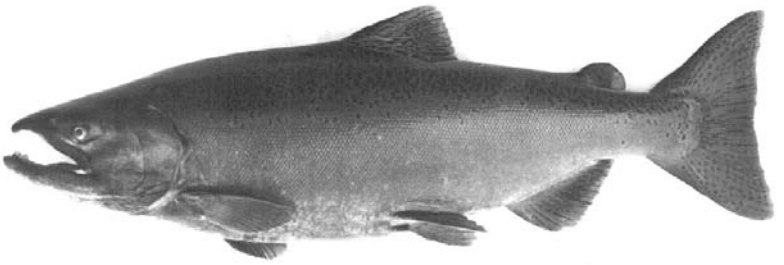
SKYKOMISH RIVER SUMMER CHINOOK



HATCHERY GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	The Tulalip Tribes Bernie Kai-Kai Gobin Salmon Hatchery "Tulalip Hatchery"
Species or Hatchery Stock:	Skykomish Summer Chinook: Wallace River Hatchery
Agency/Operator:	The Tulalip Tribes
Watershed and Region:	Tulalip Creek, WRIA Region 07
Date Submitted:	July 26, 2005
Date Last Updated:	July 26, 2005

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Bernie Kai-Kai Gobin Salmon Hatchery, Tulalip Summer Chinook Program.

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

Chinook salmon (*Oncorhynchus tshawyhtscha)*, Skykomish Chinook, threatened.

1.3) Responsible organization and individuals
Indicate lead contact and on-site operations staff lead.

Name (and title): Steven Young, Hatchery Manager
Agency or Tribe: The Tulalip Tribes
Address: 10610 Waterworks Road, Tulalip WA, 98271
Telephone: (360) 651-4550
Fax: (360) 651-4460
Email: syoung@tulalip.nsn.us

Name (and title): Mike Crewson, Fishery Enhancement Biologist
Agency or Tribe: Tulalip Tribes
Address:
Natural Resources Division
Fisheries/Wildlife Department
7515 Totem Beach Rd.
Tulalip, WA. 98271
Telephone: (360) 651-4804
Fax: (360) 651-4490
Email: mcrewson@tulaliptribes-nsn.gov

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

Egg takes will be conducted in cooperation with the Washington Department of Fish and Wildlife (WDFW) Wallace River Hatchery using native Skykomish River Chinook.

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

Funding sources are the Bureau of Indian Affairs and the Tulalip Tribes. Staffing levels will be four full-time hatchery employees, one eight-month temporary employee, one four-month temporary employee, and from one to twelve temporary workers during spawning, egg shocking and picking, fish transfers, and tagging operations. Operational costs are approximately $300,000 annually.

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

Tulalip Creek- WRIA 07.0001, RMPC Code- 3F10308 070001 R.
Tulalip Salmon Hatchery- WRIA 07.0001, RMPC Code- 3F10308 070001 H.

Tulalip Tribes Bernie Kai-Kai Gobin Salmon Hatchery:
10610 Waterworks Road
Tulalip, WA 98271

The Bernie Kai-Kai Gobin Salmon Hatchery is located at the juncture of the east and west forks of Tulalip Creek just above the point at which Tulalip Creek feeds into Tony's Marsh, at river kilometer 2.0.

Upper Tulalip Creek Pond:

Upper Tulalip Creek pond near is located near:
7615 Totem Beach Rd.
Tulalip, WA. 98271

The upper pond is located in WRIA 7, stream number 0001, river kilometer 0.1, behind a dam just upstream from the lower Tulalip Creek pond, which drains directly into Tulalip Bay via a fish ladder, and/or a valved pond drain line. Anadromous fish passage is prevented above the lower Tulalip Creek pond.

Lower Tulalip Creek pond and spawning station:

The lower Tulalip Creek pond and spawning station are also located near to:
7615 Totem Beach Rd.
Tulalip, WA. 98271

The Lower Tulalip Creek release pond is located in WRIA 7, Stream 0001, stream kilometer 0.0, just downstream from the upper Tulalip Creek pond, which feeds it via a screened outlet structure and a fish release/screened outlet structure from upper to lower Tulalip Creek ponds.

1.6) Type of program.

Integrated Harvest.

1.7) Purpose (Goal) of program.

The purpose of this program is to provide Chinook salmon for harvest by Tulalip Tribal members in a terminal area fishery. Production from this program is also available for harvest by the non-Indian sport fishery and contributes to other directed and incidental Treaty/non-Treaty harvest of Chinook salmon in fisheries in southeast Alaska, British Columbia, Washington coast, and Puget Sound preterminal areas.

This HGMP reflects a major change in the primary source of Chinook broodstock for the Tulalip enhancement program from exogenous fall Chinook to native Skykomish River Chinook returning to the Wallace River Hatchery, located on the Skykomish River. The hatchery fall Chinook stock is originally not native to the Skykomish River (they are of Green River origin). Summer Chinook are native Skykomish River stock. It also reflects new policies for natural-origin broodstock integration and upstream passage, new production numbers, and provisions for mass-adipose fin-marking.

Effective with the 2003 return, the primary source of Chinook broodstock for the Tulalip enhancement program changed from fall Chinook to earlier-timed Skykomish summer Chinook. A new 2005 State-Tulalip MOU agreement is expected to be signed shortly by the comanagers, which reflects all of the recent changes in the Tulalip and Wallace River Hatchery cooperative Chinook enhancement programs. Changes in broodstock source and numbers, as described in this HGMP and in the draft 2005 hatchery MOU Agreement, have also been incorporated into the 2005 Future Brood Document.

We will continue to coded-wire tag approximately 100,000 Skykomish Chinook per year, given that funds are available, with a target release goal of 1.7 million subyearling Chinook annually. This tagging provides for necessary assessments of directed and incidental fishery impacts on hatchery- and natural-origin Chinook and for differentiation of incidental impacts on other listed Chinook stocks, survival rates, straying rates, and hatchery- and natural-origin contribution rates to natural and hatchery escapements in the Snohomish region.

1.8) Justification for the program.

Shifting primary enhancement efforts to this locally-adapted, native stock will provide an alternative to the fall Chinook stock, originally of Green River origin, or other out-of-basin Chinook stocks, that have been used in the past as the primary source of fall Chinook broodstock for this program. This is the stock now being reared at the Washington State Department of Fish and Wildlife Wallace River Hatchery. Fall Chinook releases were discontinued at the Wallace River Hatchery after broodyear 1997.

The Tulalip summer Chinook stock is a secondary harvest management unit in all areas, except 8D, where the fishery is managed to target Tulalip Chinook while minimizing interceptions of other Chinook stocks (see the annual Stillaguamish/Snohomish status reports). All Chinook salmon production from Bernie Kai-Kai Gobin Hatchery will receive unique thermal otolith marks by their stock of origin, and 100,000 of each stock will be adipose fin-clipped and coded-wire tagged annually, provided adequate funding for this remains available, so that hatchery returns originating from each stock can be identified in terminal fisheries and in natural and hatchery spawning groups.

Until listed wild stocks are fully recovered, Tulalip Tribal fisheries will continue to depend on harvestable surplus of hatchery Chinook. This program is limited to a maximum release of 1,700,000 subyearling smolts each year.

Shifting primary enhancement efforts to locally-adapted, native summer Chinook will provide an alternative to the fall Chinook stock, originally of Green River origin, or other out-of-basin Chinook stocks, that have been used in the past as the primary source of Chinook broodstock for the Tulalip Enhancement Program. This is the stock now being reared at the Washington State Department of Fish and Wildlife Wallace River Hatchery. Fall Chinook releases were discontinued at the Wallace River Hatchery after broodyear 1996.

1.9) List of program "Performance Standards".

1) Assure a continuing ceremonial, subsistence, and commercial harvest of Chinook salmon for the fishers of the Tulalip Tribes in a terminal area fishery is the primary performance standard for this program. Production from this program is also available for harvest by the non-Indian sport fishery and contributes to other directed and incidental harvest of Chinook salmon in fisheries in southeast Alaska, British Columbia, and Puget Sound preterminal areas as a secondary performance standard.

2) The tagged portion of this production release will allow for ongoing assessments of post-release survival, contribution to fisheries, straying, and incidental impacts to other listed salmon populations while directing harvest at the summer Chinook stock.

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

Please see the performance standards in Section 1.9 above. Note, annual accomplishment of research, monitoring, and evaluation projects listed throughout this HGMP and in performance standards and indicators is contingent on availability of funding. As of 2005, most hatchery monitoring and reform projects in this HGMP have been partially funded through competitive funding via Hatchery Reform and Bureau of Indian Affairs Hatchery Cyclical Maintenance funding, which has increasingly been supplemented by Tulalip Tribal funding in order to pay for increased operational and monitoring costs while

available funds have been consistently reduced each fiscal year from the previously mentioned sources.

Goal (Section 1.7-1.8)	**Performance Standard** (Section 1.9)	**Performance Indicator** (Section 1.10)
Provide ceremonial, subsistence, and commercial, harvest opportunities for the Tulalip Tribal terminal area fishery. Provide commercial and recreational harvest opportunities for Treaty and non-Treaty fishers in pre-terminal areas.	Hatchery return provides opportunity for weekly three-day Tulalip Tribal opening for Chinook salmon in Area 8D as well as for a directed non-Treaty sport fishery in the same area.	On average, the estimate of survival rate for the hatchery production remains above 0.005 to provide: • for the recruitment of 10,000 December Age-3 Chinook, and • an average terminal harvest rate of > 0.95.
Compare in-hatchery and post-release survival of native summer Chinook salmon with rates previously observed for fall Chinook salmon.	Survival rates of summer Chinook compare favorably with those previously observed for fall Chinook salmon released from Tulalip Hatchery.	The overall survival rate of summer Chinook will not be less than survival rates previously observed for Tulalip fall Chinook salmon ($p < 0.10$; chi square).
Compare incidental impacts to other listed salmon populations while targeting harvest on program fish in the terminal fishery.	Harvest directed at Tulalip Chinook will not unduly impact listed natural Chinook populations when considered in conjunction with all other harvest-related impacts on these populations.	▪ Annual fishery plans will project exploitation rates below the Comanagers' guidelines for all Puget Sound Chinook management units. ▪ Post-season assessments of exploitation rates on Stillaguamish and Snohomish Chinook will continue to be below Comanagers' guidelines.
Provide natural- and hatchery-origin Chinook needed to provide broodstock for Tulalip and Wallace River Hatchery Chinook programs and to maintain the Tulalip Tribal Chinook fishery.	See the Wallace River Hatchery fingerling and yearling summer Chinook HGMP's.	See the Wallace River Hatchery fingerling and yearling summer Chinook HGMP's.
Limit genetic and ecological impacts of program fish to local natural Chinook populations to acceptable levels. Annually assess adult straying, return timing, and juvenile ecological	Hatchery Chinook production will not contribute significantly to naturally-spawning populations. Program Chinook released into Tulalip Bay will not contribute to local, natural listed Chinook escapements at a rate greater than previously measured for exogenous fall Chinook.	The proportion of Tulalip-origin spawners in the natural spawning areas will remain below comanagers' guidelines.

Goal (Section 1.7-1.8)	**Performance Standard** (Section 1.9)	**Performance Indicator** (Section 1.10)
interactions among program and natural fish.	Broodstock collection will be carried out with minimum impacts on natural populations.	See the Wallace River Hatchery HGMP and Sections 6.2 and 6.3.
	Release practices will be carried out with minimum impacts on natural production.	Evaluate the level of interaction of hatchery-origin summer Chinook smolts released into Tulalip Bay with natural-origin, juvenile Chinook in estuarine and nearshore marine habitats. Test the hypothesis that the time of peak abundance of Tulalip summer Chinook salmon and naturally-produced Chinook salmon in Tulalip Bay do not differ significantly.

1.11) Expected size of program.

The expected size of this program is 1,700,000 subyearling smolts released at a size of 80 fish per pound.

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

No Chinook broodstock will be collected at the Tulalip Hatchery. Chinook salmon returning to the Skykomish River will be selected for broodstock as described in Sections 6.2 and 6.3. The annual adult collection goal at the Wallace River Hatchery is 2,350 summer Chinook adults (55%: 45% male: female) to result in 3.5 million green eggs, which includes the 1.8 million eyed eggs (or 2.0 million green eggs) for the Tulalip Tribe's Chinook program.

The 1.8 million eyed, Skykomish Chinook eggs will be transferred annually from the WDFW Wallace River Hatchery to Tulalip Hatchery. A draft State-Tulalip Tribal hatchery MOU Agreement is expected to be signed in 2005, which describes understandings and agreements concerning Chinook hatchery programs at the Bernie Kai-Kai Gobin Salmon Hatchery, operated by the Tulalip Tribes, and the Wallace River Hatchery, operated by WDFW. See Section 6; Broodstock Origin and Identity, for further details.

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

Life Stage	**Release Location**	**Annual Release Level**
Subyearling (smolt)	Tulalip Bay	1,700,000

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

a) Smolt-to-adult survival: While no adult returns have been completely reconstructed by broodyear for summer Chinook releases, we expect the smolt-to-adult survival rate to exceed 0.5% annually.

b) Adult production levels: Please see the Wallace River WDFW HGMP. At a 0.5% survival rate, of a production release of 1,700,000 smolts, a return of approximately 8,500 adult Chinook to Tulalip Bay might be expected.

c) Escapement levels: All program fish returning to Tulalip Bay will be targeted for harvest, and the only program fish that might return to the Snohomish basin will be a very small proportion of the Tulalip Bay release comprised of native stock (averages contribution rates of Tulalip Chinook to the Skykomish River and Snohomish basin from 1997 through 2001 were 2.2% and 5.2%, respectively (see table on following page).

Wallace River summer Chinook fingerlings were coded-wire tagged in broodyears 1971, 1972, and 1985. The 1985 broodyear survived at 0.10% (RMIS database). At this survival, the current annual release of 1,000,000 fingerling summer Chinook will produce 1000 returning adults.

Escapement levels back to the hatchery rack for broodyears 1995 through 2003 were 1,911, 2,254, 1,456, 1,514, 2,353, 4,928, 4,082, 3,558 and 5,687, respectively.

Using average fecundity (4,250 eggs per female), average female holding survival rate (80.3%), and average female sex ratio (45.6%) for Wallace River summer Chinook broodstock from 1995 through 2002, a return of 2,250 total Chinook to the hatchery would be required, on average, to produce 1,026 females, resulting in 824 viable female spawners to yield 3.5 million green eggs for both the Wallace and Tulalip Chinook programs.

For the 2.0 million green eggs (1.8 million eyed eggs) required for the Tulalip Hatchery Chinook program, a return of 1,285 Chinook to Wallace River Hatchery would, on average, produce 586 females, of which 471 would survive to be viable female spawners to produce 2.0 million green eggs for the Tulalip Chinook program.

1997 to 2001 Skykomish River total Chinook salmon natural spawning escapements by hatchery and natural origins.
Please do not use without permission: Kit Rawson, 6/14/04; krawson@tulaliptribes-nsn.gov.

				Otolith Expansion							
Year	**Population**	**Estimated Spawning Escapement**	**No. Tulalip Hatchery**	**Percent Tulalip Hatchery (Otolith Expansion)**	**No. Wallace Hatchery**	**Percent Wallace Hatchery (Otolith Expansion)**	**No. Other Hatchery (CWT)**	**Percent Other Hatchery (CWT)**	**No. Total Hatchery**	**Percent Total Hatchery**	**No. Natural (Unmarked)**
1997	Skykomish	2,171	104	4.8%	491	22.6%	26	1.2%	621	28.6%	1,540
1998	Skykomish	4,414	88	2.0%	2,832	64.2%	0	0.0%	2,920	66.2%	1,495
1999	Skykomish	3,446	5	0.1%	2,040	59.2%	0	0.0%	2,045	59.3%	1,401
2000	Skykomish	4,668	69	1.5%	2,088	44.7%	736	15.8%	2,893	62.0%	1,775
2001	Skykomish	4,575	110	2.4%	1,077	23.5%	336	7.3%	1,523	33.3%	3,054
Arithmetic Means:		**3,855**	**75**	**2.2%**	**1,706**	**42.8%**	**220**	**4.9%**	**2,000**	**49.9%**	**1,853**

1997 to 2001 Snoqualmie River total Chinook salmon natural spawning escapements by hatchery and natural origins.
Please do not use without permission: Kit Rawson, 6/14/04; krawson@tulaliptribes-nsn.gov.

				Otolith Expansion							
Year	**Population**	**Estimated Spawning Escapement**	**No. Tulalip Hatchery**	**Percent Tulalip Hatchery (Otolith Expansion)**	**No. Wallace Hatchery**	**Percent Wallace Hatchery (Otolith Expansion)**	**No. Other Hatchery (CWT)**	**Percent Other Hatchery (CWT)**	**No. Total Hatchery**	**Percent Total Hatchery**	**No. Natural (Unmarked)**
1997	Snoqualmie	1,917	117	6.1%	0	0.0%	4	0.2%	121	6.3%	1,796
1998	Snoqualmie	1,892	349	18.4%	119	6.3%	62	3.3%	530	28.0%	1,361
1999	Snoqualmie	1,344	244	18.2%	52	3.9%	9	0.7%	305	22.7%	1,040
2000	Snoqualmie	1,427	139	9.7%	26	1.8%	14	1.0%	179	12.5%	1,248
2001	Snoqualmie	3,589	305	8.5%	0	0.0%	0	0.0%	305	8.5%	3,284
Arithmetic Means:		**2,034**	**231**	**12.2%**	**39**	**2.4%**	**18**	**1.0%**	**288**	**15.6%**	**1,746**

1997 to 2001 Snohomish basin total Chinook salmon natural spawning escapements by hatchery and natural origins.
Please do not use without permission: Kit Rawson, 6/14/04; krawson@tulaliptribes-nsn.gov.

				Otolith Expansion							
Year	**Population**	**Estimated Spawning Escapement**	**No. Tulalip Hatchery**	**Percent Tulalip Hatchery (Otolith Expansion)**	**No. Wallace Hatchery**	**Percent Wallace Hatchery (Otolith Expansion)**	**No. Other Hatchery (CWT)**	**Percent Other Hatchery (CWT)**	**No. Total Hatchery**	**Percent Total Hatchery**	**No. Natural (Unmarked)**
1997	Snohomish Basin	4,088	221	5.4%	491	12.0%	30	0.7%	742	18.2%	3,336
1998	Snohomish Basin	6,306	436	6.9%	2,951	46.8%	62	1.0%	3,450	54.7%	2,856
1999	Snohomish Basin	4,790	249	5.2%	2,092	43.7%	9	0.2%	2,350	49.1%	2,441
2000	Snohomish Basin	6,095	208	3.4%	2,114	34.7%	750	12.3%	3,072	50.4%	3,023
2001	Snohomish Basin	8,164	415	5.1%	1,077	13.2%	336	4.1%	1,828	22.4%	6,338
Arithmetic Means:		**5,889**	**306**	**5.2%**	**1,745**	**30.1%**	**237**	**3.7%**	**2,288**	**38.9%**	**3,599**

Comment [k1]: Mike – Remove the "please do no use without permission" line. This will be a public document.

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

This summer Chinook program was initiated in broodyear 1998.

1.14) Expected duration of program.

Presuming that this program proves to be a success in terms of fish health and survival, post-release survival, timing for harvest management, straying rates and incidental impacts to other listed Chinook stocks or other salmon stocks of concern, availability of eggs, and other considerations, marked and/or tagged hatchery Chinook returns of Skykomish River-origin will continue to be a permanent replacement production stock for the Tulalip enhancement program.

1.15) Watersheds targeted by program.

Tulalip Hatchery is on Tulalip Creek, WRIA 7, stream number 0001.

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

This shift toward eliminating the fall Chinook program and replacing it with native Skykomish summer Chinook as the primary source of broodstock for production releases by the Tulalip Tribes is an alternative action to attain the Tribe's program goals, and no other alternative actions are being contemplated at this time. However, this HGMP is an evolving plan that will continue to incorporate adaptive management and decision-making based upon monitoring, evaluation, and research before and after program fish are released to optimize viability of natural and hatchery populations. Summer Chinook yearling releases from Wallace River Hatchery were already reduced by 52.8% from 530,000 to 250,000. This reduction occurred just before the egg take was essentially doubled due to Tulalip converting their Chinook program from fall to summer Chinook.

Since Chinook have not yet returned from these recent, sweeping changes, it remains to be seen whether or not there will even be enough adequate returns for hatchery escapement to sustain the Wallace and Tulalip programs, much less provide for Chinook fisheries in Tulalip Bay that target on the hatchery production. This concern is due to not knowing how the reduced release at Wallace and the increased egg take demand will be further impacted by the requirement to mass-mark the Tulalip Hatchery Chinook production and the anticipated resultant increases in mark-selective fishery impacts that may all interact to reduce Chinook returns to the terminal area fishery and hatchery escapement.

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 developed to provide the basis for an incidental take permit under a 4(d) rule. Harvest management of Chinook populations within Puget Sound is implemented through the draft Puget Sound Comprehensive Chinook Management Plan (PSCCMP) - Harvest Management Component (Puget Sound Indian Tribes and WDFW, 2004). The PSCCMP lists harvest management guidelines for populations within the Puget Sound ESU, including the Skykomish and Snoqualmie. This plan was approved by NOAA Fisheries as an RMP under the 4(d) rule. All operations of the Bernie Kai-Kai Gobin Hatchery are consistent with this plan.

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.

Threatened populations of Chinook salmon within the Puget Sound ESU, including north and south fork Stillaguamish, Snoqualmie, and Skykomish Chinook may potentially be affected by this program. The delineation of these groups as populations was documented by Ruckelshaus et al. (2004). Broodstocking take issues are addressed in Sections 6.2 and 6.3 of this HGMP and in the Wallace River Hatchery summer Chinook fingerling and yearling HGMP's. Other effects on listed populations might include competition between listed juvenile natural Chinook and hatchery-origin juvenile Chinook in estuarine and nearshore marine areas after release.

Juvenile estuarine and nearshore residency of listed Puget Sound Chinook salmon may temporally and spatially overlap with habitats utilized by Skykomish Chinook juveniles released by this program. Potential competitive effects are unknown at this time. Out-migration studies, which are currently underway in the Snohomish and Stillaguamish systems, will provide better information on the timing of hatchery-origin Chinook and local, listed, juvenile Chinook inhabiting estuarine and nearshore habitats, so that we can assess the extent to which any overlap may occur with program fish.

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

None by this program. However, Skykomish Chinook may be affected by collection of natural-origin broodstock, which, in combination with hatchery-origin fish returning to Wallace River Hatchery, supplies eggs for this program. Takes of listed fish were constrained by limiting sources of natural-origin fish to two specific subwatersheds and limiting the allowable takes from those watersheds based on analysis of natural capacity

and productivity under current conditions using EDT, as described further in Sections 6.2 and 6.3.

The comanagers also used a very simple simulation model to project the abundance of natural-origin spawners, assuming that the population dynamics operates according to Beverton-Holt spawner-recruit parameters estimated in the EDT analysis. This analysis suggested that natural-origin spawners would equilibrate well above current conditions MSY escapement level and in the top quarter of the past 20 years of observations.

It is also important to note that if, in any year, either pre-season or in-season run size information indicates that the critical escapement level for the Skykomish population will not be reached, the broodstocking protocol will be modified to assure that the collection of natural-origin broodstock from Wallace River and Sunset Falls will not cause the natural-origin spawning escapement to fall below the critical level.

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

Snohomish and Stillaguamish basin naturally-spawning Chinook stocks may be incidentally affected by this program.

2.2.2) <u>Status of ESA-listed salmonid population(s) affected by the program.</u>

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

Currently, numbers of listed, adult Chinook salmon in the North Fork Stillaguamish, Skykomish, and Snoqualmie, have been consistently above the critical thresholds defined in the comanagers' harvest management plan (Puget Sound Indian Tribes and WDFW 2004). South Fork Stillaguamish estimated escapements were below the critical threshold in 2003 and 2004. The reasons for this are currently under discussion by the comanagers and NOAA Fisheries.

All four populations are at levels substantially below viability thresholds, as defined by the comanagers' recovery goals in the Stillaguamish and Snohomish watershed recovery chapters (Stillaguamish Implementation Review Committee 2005; Snohomish Basin Salmon Recovery Forum 2005). These chapters, part of the draft Puget Sound Salmon Recovery Plan submitted to NOAA on June 30, 2005, include actions in the areas of harvest, hatchery, and habitat management.

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

The following two tables show the most recent available estimates of natural-origin recruits per natural spawner for the North Fork Stillaguamish Chinook population, representing the Stillaguamish system, and the Skykomish Chinook population, representing the Snohomish system. Data are from abundance and productivity tables produced by the Puget Sound Technical Recovery Team in August of 2004. Tables for the South Fork Stillaguamish and Snoqualmie populations are not included because difficulties in estimating spawning escapement in some years render computations of recruits per spawner somewhat unreliable.

North Fork Stillaguamish Recruits per Spawner

Year	Natural Spawners(S)	Progeny NOR Recruits(R)	R/S
1988	516	2715	5.26
1989	537	2042	3.80
1990	575	4106	7.14
1991	1331	1252	0.94
1992	486	1431	2.94
1993	583	2661	4.56
1994	667	1865	2.80
1995	599	534	0.89
1996	993	1534	1.55
1997	930	1304	1.40
1998	1292	810	0.63
1999	845	1215	1.44

SOURCE: Puget Sound Technical Recovery Team (Abundance and Productivity Tables)

Skykomish Recruits per Spawner

Year	Natural Spawners(S)	Progeny NOR Recruits(R)	R/S
1988	4004	8533	2.13
1989	2221	1454	0.65
1990	2932	6489	2.21
1991	2192	1339	0.61
1992	2002	4447	2.22
1993	1653	4760	2.88
1994	2898	4934	1.70
1995	2791	3225	1.16
1996	3819	6153	1.61
1997	2355	5607	2.38
1998	4412	5285	1.20
1999	3455	2533	0.73

SOURCE: Puget Sound Technical Recovery Team (Abundance and Productivity Tables)

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

Natural Chinook escapement in the Stillaguamish basin 1993-2004.

Year	North Fork	South Fork	Total
1993	583	345	928
1994	667	287	954
1995	599	223	822
1996	993	251	1,244
1997	930	226	1,156
1998	1,292	248	1,540
1999	845	253	1,098
2000	1,403	243	1,646
2001	1,066	283	1,349
2002	1,196	393	1,589
2003	856	132	988
2004	1,358	148	1,506

SOURCE: WDFW Region 4.

Natural Chinook escapement in the Snohomish basin 1993-2004.

Year	Skykomish	Snoqualmie	Total
1993	1,653	2,366	4,019
1994	2,898	728	3,626
1995	2,791	385	3,176
1996	3,819	1,032	4,851
1997	2,355	1,937	4,292
1998	4,412	1,892	6,304
1999	3,455	1,344	4,799
2000	4,665	1,427	6,092
2001	4,575	3,589	8,164
2002	4,224	2,996	7,220
2003	1,972	3,474	5,446
2004	2,990	7,616	10,606

SOURCE: WDFW Region 4.

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

These data are not yet available. To date, only partial coded-wire tagged and otolith-marked adult returns are available from this program. A sufficient number (approximately 100,000 pre-smolts) of the summer Chinook hatchery production will continue to be adipose fin-clipped and coded-wire tagged, and all eggs will be differentially, otolith mass-marked, to allow for abundance estimation of the summer run stock component post-release. Assessment of adult stray rates to natural spawning areas will be based upon sampling of carcasses and reading of otoliths according to the methods described in Rawson et al. (2001) and also by coded-wire tag recoveries.

Initial results depicting the contribution rates of Tulalip fall Chinook, Wallace River Hatchery fall Chinook, other hatchery-origin Chinook, and natural-origin Chinook to Snohomish basin natural Chinook escapements, were previously shown in the table in Section 1.12 Part C. The assessment of those contribution rates, by hatchery, utilized identical methodology that will be employed to assess stray rates for Tulalip summer Chinook, once the return data becomes available.

2.2.3) 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.

-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.

Broodstocking may lead to the take of listed Chinook salmon; however, that activity is not a direct activity involving this hatchery program. However, this program depends on the eggs collected by that activity, therefore, potential incidental effects of broodstocking on listed Snohomish basin Chinook was discussed previously in Section 2.2.1 and is described in Sections 6.2, 6.3 and in the WDFW HGMP for the Wallace River Hatchery.

Juvenile estuarine and nearshore residency of listed Puget Sound Chinook salmon may overlap with juveniles released by this program. Potential competitive effects are unknown at this time. Chinook smolt out-migration studies are currently underway in the Snohomish and Stillaguamish systems. These studies will provide better information on the timing of local listed populations so that we can assess the extent to which any overlap might occur with program fish.

Adult, ESA-listed fish may be incidentally-impacted by harvest directed at program Chinook in the Tulalip Bay terminal fishery and/or by broodstocking activities at a relatively low extent, which is the purpose of the marking, tagging, and post-release catch and survival study.

- 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).

The comanagers have refined a plan to rate, on average, between 40% to 93.3% natural-origin Chinook into the Wallace River Hatchery broodstock, corresponding to a range of 0.5 to 0.7 percent natural influence (PNI), in order to maintain genetic integration with the natural Snohomish River summer Chinook population. The most recent proposal calls for an integration rate of 40% - 93.3% or 300 - 700 natural-origin fish into the Wallace River Hatchery broodstock. These adults will come from the Wallace River Hatchery and the Sunset Falls traps (see Sections 6.2.3 and 6.3 for more details).

The projected collection of 300 to 700 natural-origin adult Chinook salmon from the Wallace River and Sunset Falls traps includes all direct and indirect takes. Any mortalities that occur as a result of capture or of captured fish will be counted as part of the 300 to 700.

Previously, all Chinook entering the Wallace River were diverted into adult holding ponds. The comanagers have developed a new protocol for passage of natural-origin Chinook above the Wallace River weir into approximately 3.8 miles of spawning habitat in the upper Wallace River. The new policy also controls the number of hatchery-origin Chinook allowed into this area to increase the degree to which natural Chinook spawners produced from this sub basin are adapted to the natural environment.

The comanagers have established a minimum seeding number of 400 spawners (in the form of 200 natural-origin Chinook pairs) to be passed above the Wallace River weir for natural spawning. These fish will be of natural-origin if available; otherwise, hatchery-origin Chinook will be passed upstream to make the difference to attain the 200 pair minimum seeding goal.

Potential impact to the Skykomish population will be limited because naturally-spawning Chinook above Sunset Falls and the Wallace River weir together comprise only approximately 15% of the potential Skykomish Chinook spawning population under current conditions, thus leaving the great majority of the current natural spawning capacity invulnerable to this broodstock collection. Also, natural-origin Chinook returning to Wallace River Hatchery (as distinguished from those that spawned in natural spawning areas) have not been included in natural escapement estimates in the past and therefore will not impact natural escapement.

The extent of possible adverse competitive effects of hatchery juveniles on listed populations of Puget Sound Chinook is not quantified at this time, but is thought to be low.

- 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.

If, in any year, either pre-season or in-season run size information indicates that the critical escapement level for the Skykomish population will not be reached, the broodstocking protocol will be modified to assure that the collection of natural-origin broodstock from Wallace River and Sunset Falls will not cause the natural-origin spawning escapement to fall below the critical level.

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.

Not applicable. An ESU-wide hatchery plan for Puget Sound Chinook is currently being developed. Work groups in the Stillaguamish and Snohomish watersheds are currently in the process of assessing the major factors affecting natural salmon production and are developing recovery plans that integrate hatchery, habitat and harvest management activities occurring I the region to facilitate Chinook salmon recovery. Initial recommendations for the Snohomish basin are described in the *Initial Snohomish River Basin Chinook Salmon Conservation /Recovery Technical Work Plan (October 6, 1999).*

In addition to salmon recovery efforts in this region, the comanagers have sought to go beyond merely complying with ESA directives through the Hatchery Reform process and via comanager's internal operational plans, such as this HGMP or other self-imposed monitoring and research efforts. This new approach is reforming regional hatchery programs to provide benefits to wild salmon recovery and sustainable fisheries. Hatchery management decisions are being based on system-wide, scientific recommendations, providing an important model in the Snohomish basin that can be replicated in other areas as the salmon recovery and hatchery reform process continues to move forward.

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

The Puget Sound Salmon Management Plan (PSSMP 1985) sets out the legal framework under which comanagement of hatchery programs occurs. Programs at the Bernie Kai-Kai Gobin Salmon Hatchery are included in the Stillaguamish/Snohomish Equilibrium Brood Document, which is currently in draft form only. Annual production levels are agreed to by the comanagers and are described in the Future Brood Planning Document. Hatchery escapement goals and terminal area harvest management plans are described in the annual Stillaguamish/Snohomish regional status report (available approximately July 1 each year).

The basic agreements between WDFW and the Tulalip Tribes concerning the operation of the Bernie Kai-Kai Gobin Salmon Hatchery were set forth in a memorandum of understanding dated May 29, 1981. A memorandum of understanding between the Tulalip Tribes and the WDFW (August 26, 1997) described changes in the Chinook program that were agreed to at that time. The comanagers have agreed to new terms of a successor MOU Agreement (dated April 7, 2005), which is expected to be signed by the parties in

2005. This MOU describes current understandings and agreements concerning summer Chinook programs at Tulalip and Wallace River Hatcheries. This MOU outlines new comprehensive hatchery protocols and changes, such as appropriate stocks to be used, mass-marking to be approved at both hatcheries, conditions and methods for conducting sampling and selective fisheries, new production numbers, NOR integration, upstream passage and broodstocking protocols, etc.

Meanwhile, the comanagers are operating under the terms of the new MOU Agreement (e.g., Tulalip mass-marked broodyear 2004 hatchery Chinook at the agreed upon level in the new MOU) to continue joint hatchery operations incorporating the new, innovative changes that have addressed all or nearly all of the remaining hatchery reform issues involving Snohomish region Chinook salmon hatchery programs.

3.3) Relationship to harvest objectives.

The comanagers' harvest management plan for Puget Sound Chinook salmon (Puget Sound Indian Tribes and WDFW 2004) will be in effect until April 2009. This plan lists harvest management objectives for each Puget Sound Chinook management unit. All operations of the Bernie Kai-Kai Gobin Salmon Hatchery are consistent with the harvest management plan. Directed harvest of Chinook released by the Tulalip enhancement program will be conducted in terminal area 8D where hatchery fish have largely separated from other listed stocks as they return to their point of release in Tulalip Bay.

The Tulalip Tribes utilize time and area management and pulse fisheries to focus harvest on hatchery fish. The success of this management approach has been documented through monitoring, which shows that an average of 95.8% of the catch in recent years has been regularly comprised of Tulalip Hatchery-origin fish (see the table following in this section). Since the Tulalip Summer Chinook program was not initiated until 1998, these data are primarily based on fall Chinook contribution rates to the fishery prior to 2001, and combined summer and fall contributions after that time.

These methods will continue to be evaluated through sampling of the terminal area fishery for otoliths and coded-wire tags. Differential thermal marks have been placed on all Tulalip Chinook since 1993 (Rawson, Kraemer, and Volk 2001). In addition, 100,000 summer Chinook have received CWT's since this program was initiated with the 1998 broodyear. We will continue to place differential, thermal marks on otoliths of 100% of the Tulalip Chinook production assuming funding for this work remains available.

In addition, Tulalip initiated mass-adipose fin-marking of Tulalip Chinook (Skykomish summer Chinook origin), effective with the 2004 broodyear, per the new MOU Agreement. The new Agreement calls for 70% of broodyear 2004 Tulalip Hatchery Chinook and coho to be mass-marked by removal of adipose fins in addition to other marks and tags, such as thermal otolith marks and coded-wire tags. This proportion will gradually be increased to a 100% adipose fin marking rate on Tulalip Chinook by broodyear 2011, provided certain

conditions prevail as follows:

If the pre-release mortality rate of marked Chinook remains low, if excessive differential adult returns or mortalities of marked versus unmarked hatchery Chinook to the terminal area are not observed, and if significant increases in interceptions of Tulalip or Wallace River Hatchery Chinook production do not occur in fisheries north of the US/Canada border, the fraction of Chinook that are adipose fin mass-marked at Tulalip Hatchery will be increased to 80% beginning with broodyear 2008, and to 100% beginning in broodyear 2011 (exclusive of fish left unmarked due to double-index tagging or other agreed monitoring and research studies).

This increased mass-marking will not help to accomplish the harvest objectives described in Section 1.7, Purpose of Program, which are to provide harvest opportunities for Tulalip Tribal members in a terminal area fishery. However, it will address the Federal mass-marking mandate and it will provide additional Chinook salmon for harvest in preterminal, non-Indian sport fisheries and other directed and incidental Treaty and non-Treaty Chinook salmon fisheries in southeast Alaska, British Columbia, the Washington coast, and in Puget Sound preterminal areas, which is a secondary objective of this program.

The past contribution of Tulalip Chinook production releases (mostly fall Chinook) to the total Chinook harvest in Tulalip Bay has ranged from 90.4% to 97.2% in the past ten years observed (1993 to 2002; see the table below), averaging 95% (Rawson, Kraemer, and Volk 2001). Only limited information is currently available for summer Chinook released by the Tulalip enhancement program because the first release of mass thermally-marked Skykomish Chinook from the Bernie Kai-Kai Gobin Salmon Hatchery was initiated in 1999 (broodyear 1998). Since fall Chinook have been cultured and released longer than the native Skykomish stock, more complete data are available on their contribution to the terminal area fishery:

Estimates of the contribution of Tulalip Hatchery Chinook to the Area 8D fishery, based on recoveries of thermally-marked otoliths and coded-wire tags, 1997-2002 (Rawson, Kraemer, and Volk 2001 and subsequent unpublished data).

Year	Hatchery %
1997	93.0%
1998	95.6%
1999	97.2%
2000	94.9%
2001	96.7%
2002	97.1%
Average:	**95.8%**

The above information has been incorporated into the comanagers' Fishery Regulation Assessment Model (FRAM) so that incidental harvest of listed populations in Area 8D will be included with all other incidental harvest of listed populations (K. Rawson pers. comm.).

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

The only fisheries directed at Tulalip fall Chinook are conducted in terminal Area 8D during the time that adult hatchery fish return to Tulalip Bay (approximately late-May through September each year). The Tulalip Tribes open a net fishery for Tribal members approximately three days per week. The Washington Department of Fish and Wildlife (WDFW) opens a recreational hook and line fishery four days per week. Catch in the net fishery is recorded on fish tickets, and catch in the sport fishery is estimated from catch record cards.

Catch estimates for 1988 through 2004 are as follows:

Year	Area 8D Net	Area 8D Sport
1988	1,405	*
1989	2,438	*
1990	4,220	*
1991	4,001	*
1992	3,102	*
1993	3,714	*
1994	4,688	1,404
1995	8,013	2,279
1996	11,386	2,791
1997	8,376	2,902
1998	7,125	*
1999	15,368	511
2000	7,663	1,192
2001	6,062	1,708
2002	5,465	**
2003	8,903	**
2004	5,987	**

*No Tulalip special area fishery occurred in these years.
** Estimates are not yet available.

Harvest rates on Chinook released by the Tulalip enhancement program will be managed to be as close to 100% as possible. This is possible because adults return to Tulalip Bay where hatchery returns are concentrated and are targeted by the terminal area fishery. In addition, the streams entering the Bay do not produce any other spawning populations of anadromous salmon, and in recent years, the hatchery rack has been left closed, which has increased the harvest rate.

Future management of Tulalip summer Chinook will continue to focus on harvesting as close as possible to 100% of the hatchery production while minimizing the impact of fisheries directed at hatchery-produced fish on listed populations. We will continue to thermally mass-mark this production and sample fisheries for otoliths to evaluate the success of our management at achieving these objectives. Additionally, a portion of this production (currently ~100,000 fingerlings) will be coded-wire tagged each year, funding permitting, to provide additional data on fishery contribution and otolith mark recognition quality assurance.

Exploitation rates on listed populations are evaluated by the comanagers based on total exploitation in all fisheries as described in the comanagers' Puget Sound Chinook Management Plan. The contribution of incidental harvest of listed populations in the Area 8D fishery to overall exploitation rates is estimated with the FRAM model, which has been calibrated based on recent years' otolith samples and recoveries of coded-wire tags. In future years, we anticipate that overall exploitation rates on listed populations affected by the Area 8D fishery will continue to be less than the comanagers' guidelines. We will continually evaluate exploitation of these populations in the Area 8D fishery through ongoing collection of otolith and coded-wire tag data.

3.4) Relationship to habitat protection and recovery strategies.

Work groups in the Stillaguamish and Snohomish watersheds are currently in the process of assessing the major factors affecting natural salmon production and are developing habitat management plans to facilitate Chinook salmon recovery. Initial recommendations for the Snohomish basin are described in the Snohomish Basin Salmon Conservation Plan (Snohomish Salmon Recovery Forum 2005).

The Legislature, in 1999, created the Salmon Recovery Funding Board (SRFB). The Shared Strategy for Salmon Recovery is a collaborative effort to protect and restore salmon runs across Puget Sound. Both of these bring together the experience and viewpoints of Puget Sound Tribes, State and Federal natural resource agencies, local governments, non-government organizations and citizens. The SRFB provides grant funds to protect or restore salmon habitat and assist related activities that produce sustainable and measurable benefits for fish and their habitat. The Shared Strategy process helps identify what is needed in each watershed to recover salmon habitat through watershed recovery plans, which are now part of the draft Puget Sound Salmon Recovery Plan submitted to NOAA Fisheries on June 30, 2005.

The comanagers are also following a harvest management plan for Puget Sound Chinook salmon as previously described. All operations of the Bernie Kai-Kai Gobin Salmon Hatchery are consistent with the above plans.

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 animal species on Tulalip Hatchery fingerling Chinook 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 Chinook survival rates through predation on newly-released, emigrating juvenile fish in nearshore marine and estuarine areas. Certain avian and mammalian species may also prey on juvenile Chinook while the fish are rearing at the hatchery site if these species are not excluded from the rearing areas. Species that could potentially negatively impact juvenile Chinook through predation include the following:

- Avian predators including mergansers, cormorants, belted kingfishers, great blue herons, and night herons.
- Mammalian predators, including mink, river otters, harbor seals, and sea lions.
- Piscine predators, including steelhead, cutthroat trout, and coho salmon.

Rearing and migrating adult Chinook originating through the program may also serve as prey for large, mammalian predators in marine areas, nearshore marine areas and in the Skykomish River watershed, to the detriment of population abundance and the program's success in augmenting harvest. Species that may negatively impact 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:

Listed juvenile and adult Chinook salmon might be negatively impacted by this program. The potential for piscine predation or competition is driven in part by relative body size, time of overlap, and densities of program and natural fish. Predation by subyearling Tulalip Chinook salmon on naturally-produced Chinook in the Snohomish basin is considered to be a low risk because the size of program fish is not much different from natural out-migrants, and program Chinook are not released until mid- to late-May each year. In a recent literature review of Chinook salmon food habits and feeding ecology in Pacific Northwest marine waters, Buckley (1999) concluded that cannibalism and intra-generic predation by Chinook salmon are rare events. Competition among program and natural 0+ Chinook is considered to be a moderate risk because both stock components likely share the same predator base and because their out-migration timing does overlap. Monitoring is focusing on finding out whether or not program Chinook enter the Snohomish estuary or reside in nearshore marine areas, and what are the relative abundances, temporal, and spatial overlap among natural and hatchery juvenile Chinook in this region.

The size, timing, and spatial and temporal overlap among local, ESA-listed and hatchery-origin juvenile out-migrant populations have been monitored annually since 2001 in out-migration studies in the Stillaguamish River (Griffith et al. 2001, Griffith et al. 2003, Griffith et al. 2004), the Skykomish River (Nelson and Rawson 2001, Nelson, Kelder and Rawson 2003, Nelson and Kelder 2005a and 2005b), the Snoqualmie River (Nelson and Kelder 2002, 2004a, 2004b), and in the Snohomish River estuary, nearshore marine areas, and pocket estuaries (Tulalip Tribes and NOAA Fisheries).

These studies are providing better information on the level of interaction between hatchery-origin summer Chinook subyearlings released into Tulalip Bay with natural-origin, juvenile Chinook in estuarine and nearshore habitats so that we can assess the extent to which any overlap between these species might occur after hatchery fish are released. Rdsults from this monitoring will provide direction for applying adaptive management as needed to limit the potential for adverse hatchery-induced ecological effects of program coho on listed Chinook salmon.

Although potential direct impacts of released program subyearling predation or competition on listed Chinook salmon juveniles have not been identified as of this date, based upon findings from the smolt trapping operations described above, estuarine and nearshore residency of listed Puget Sound Chinook salmon juveniles may overlap with that of juvenile coho released by this program. The ecological effects of this overlap in timing between hatchery-origin subyearling Chinook and natural-origin, listed Chinook salmon juveniles, and the actual degree of interaction resulting from this overlap, are unknown at this time.

Relative size and temporal overlap are important factors that may affect predation on natural Chinook fry from program coho. Nelson and Kelder (2002) found that the mean fork length of 0+ Chinook fry egressing from the Snoqualmie River increased in size from a mean of 42 mm in late April to a mean of 71 mm by the middle of June in 2001. Increases in body length of 0+ Chinook fry were not observed until the first week in May that year.

To examine natural Chinook fry growth (fork length) patterns during this period, size and out-migrant timing data collected in smolt trapping efforts by the Tulalip and Stillaguamish Tribes in the Skykomish, Snoqualmie, and Stillaguamish Rivers were analyzed for 0+ Chinook out-migrants captured from 2001 through 2003 (Attachment 1). Data for the Skykomish and Snoqualmie Rivers was taken from Tulalip reports (Nelson and Rawson 2001, Nelson and Kelder 2002, Nelson, Kelder and Rawson 2003, Nelson and Kelder 2004a, 2004b, 2005a and 2005b) and from smolt trapping reports and data provided by the Stillaguamish Tribe for 0+ Chinook out-migrants also captured from 2001 through 2003 (Griffith et al. 2001, Griffith et al. 2003, Griffith et al. 2004). Smolt trapping data from the Snoqualmie and Skykomish River progress reports are preliminary and should not be cited or used without permission by the Tulalip Tribes.

Fork lengths were measured from 4,033 0+ Chinook captured before May 21 ("Early") and from 760 captured after May 21 ("Late") in the Skykomish River in 2001-2003, and weighted means were calculated to be 43.0 mm and 57.9 mm, respectively. Fork lengths were measured from 1,287 0+ Chinook captured before May 21 ("Early") and from 512 captured after May 21 ("Late") in the Snoqualmie River in 2001-2003, and weighted means were calculated to be 43.9 mm and 59.8 mm, respectively.

Since weighted mean fork lengths were found to be within 1-2 mm between 0+ Chinook emigrating from the Skykomish and Snoqualmie Rivers during these early and late periods from 2001 through 2003, the length data was combined from a total of 6,592 0+ Chinook captured from the Skykomish and Snoqualmie traps for all three years and analyzed. The overall weighted mean fork length for "Early" Chinook fry was 43.2 mm and 58.7 mm for "Late" Chinook fry.

Mean fork lengths were calculated for 0+ Chinook emigrants captured before May 24 ("Early") and after May 24 ("Late") from Stilliguamish River smolt trapping data among 15-17 different sampling periods each year from 2001-2003. While 0+ Chinook were found to be, on average, larger than Chinook fry emigrating from the Snohomish system during the same time periods, they were also observed to experience a significant increase in size later in May each year, increasing from a mean of 50.4 ± 0.9 mm to a mean fork length of 69.1 ± 0.3 mm after May 24 for the 2001-2003 out-migration years.

Since the out-migration timing of natural Chinook 0+ fry does temporally overlap with the release timing goal for Tulalip program coho, their juvenile estuarine and nearshore residency may also overlap. However, the presence of program Chinook in the Snohomish estuary, and any temporal or spatial overlap with natural-origin Chinook has not yet been identified in estuarine or marine waters. Many Chinook samples have been collected in recent years throughout the out-migration period, and from numerous areas in freshwater and in upper and lower sloughs and mainstem areas in the Snohomish basin. Gut contents will be analyzed from these samples after they are checked for the presence of the Tulalip otolith mark (present in 100% of Tulalip Chinook that have been released), as well as CWT's, scales, and adipose fin clip status.

(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 other salmonid species and trout present in the Snohomish basin through natural and hatchery production. Juvenile fish of these species may serve as prey items for program Chinook in estuarine and marine areas after Tulalip Chinook are released into Tulalip Bay.

Decaying carcasses of spawned adult fish may contribute nutrients that increase productivity in the watershed, providing food resources for the emigrating Chinook.

Salmonid adults that return to the Snohomish Basin, and any seeding efforts using adult salmon carcasses, may provide a source of nutrients and stimulate stream productivity. Many watersheds in the Pacific Northwest appear to be nutrient-limited (Gregory et al. 1987; Kline et al. 1997) and salmonid carcasses can be an important source of marine derived nutrients (Levy 1997). Carcasses from returning adult salmon have been found to 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). Addition of nutrients has also been observed to increase the production of salmonids (Slaney and Ward 1993; Slaney et al. 2003; Ward et al. 2003).

(4) Salmonid and non-salmonid fishes or other species that could be positively impacted by the program:

Freshwater and marine fish species that prey on juvenile fish could be positively impacted by the Chinook program. Nutrients provided by decaying Chinook carcasses may also benefit fish in freshwater. These species include northern pike minnow, coho salmon, cutthroat trout, steelhead, Pacific staghorn sculpin, and numerous marine pelagic fish species. Predators, such as river otters, mergansers, cormorants, staghorn sculpin, cutthroat trout, and dolly varden trout are occasionally observed consuming juvenile salmon in their final grow-out pond in Tulalip Creek and after they are released into Tulalip Bay. Adult and sub-adult fish from this program may be prey for killer whales (*Orcinus orca*), which have been shown to prefer Chinook salmon over other prey (Osborne 1999, Krahn et al. 2002). The ecological impacts of these summer Chinook salmon on other species in estuarine or marine waters is unknown at this time.

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.

Well water, and/or creek water will be used at the Wallace River Hatchery for incubation of summer Chinook eggs to the eyed stage, then Tulalip Hatchery well water will be used to incubate the eyed eggs until hatching and subsequent alevins will remain on well water until they are ready to be ponded. After swim up fry are ponded, combined flows of the east and west forks of Tulalip Creek will comprise the influents for early rearing raceways and other larger raceways and hatchery ponds specifically designated for rearing juvenile Chinook, before they are transferred into the lower Tulalip Creek pond (supplied by Tulalip Creek surface water) until their release directly into Tulalip Bay.

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.

Water withdrawal and screening do not affect listed natural fish because there are no listed salmonids present in Tulalip Creek. Effluent discharge is highly unlikely to affect listed natural fish in marine waters adjacent to the outlet of Tulalip Creek. The effect, if any, is not quantified, but catch data suggest that approximately 95% of all adult Chinook in Tulalip Bay are unlisted hatchery fish.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Broodstock collection is actually part of the Wallace River Hatchery HGMP. Broodstock will be collected and sorted by return timing into three holding and ripening ponds at the Wallace River Hatchery. The Wallace River is located within WRIA 7, stream number 0942. The Wallace River Hatchery is located at river mile 4.0 of the Wallace River, and stream mile 0.0 of May Creek. In the past at the Wallace River Hatchery, summer Chinook were distinguished from fall Chinook based upon their return timing back to the Wallace River facility. Generally, Chinook returning before mid- to late-August were taken as summer Chinook, and after September 1 as fall Chinook, but these dates shifted somewhat from year to year depending on run timing, which in turn was believed to be affected by marine and river harvest patterns, river flows and possibly other factors.

The expectation now is that all of the regional Chinook production can be identified as of the 2005 adult return. Broodstock will continue to be collected from adults returning before September each year, although marked adults can now be identified as originating from the summer stock, and at some point, Wallace River Hatchery may begin selecting marked adults that return later as long as they are identified as summer Chinook stock.

For many years, not all of the regional Chinook production was marked or tagged to enable their identification from other non-indigenous fall Chinook. This is not the case any more, which will aid broodstock selection for only native Skykomish summer Chinook in upcoming years. Fall Chinook releases from the Wallace River Hatchery were completely discontinued after broodyear 1997. All Wallace River Hatchery summer Chinook are now either adipose fin mass-marked and/or coded-wire tagged, denoting their Skykomish summer stock origin. All Tulalip Chinook are otolith marked, approximately 100,000 will be coded-wire tagged, and most will be adipose fin mass-marked in addition. The adipose fin marking rate will be increased to 100% by 1011, as previously described, presuming the conditions previously described and as defined in the new draft 2005 Tulalip-WDFW hatchery MOU continue to be met for meeting escapement and fishery needs.

The Wallace River Hatchery has two adult Chinook collection facilities. The first is an in-stream trap located on May Creek. The trap measures 70' at its widest point and is 110'. in length. There are two step-type ladders located on the lower end of the trap and a picket-type rack located at the upper end of the pond. The trap is dependent on the natural flow of May Creek for its water supply. The second trapping facility consists of a series of 3 100' X 20' X 6' adult capture ponds. A weir is placed across the Wallace River the first week in June and remains in place until October 1st each year. This is done to encourage Chinook migration up the Denil-style fish ladder that supplies the adult ponds. Adults are also passed above the weir for natural spawning, as previously described. Water is pumped from the Wallace River to supply inflow to the adult-holding ponds.

Fertilized summer Chinook eggs taken at the Wallace River Hatchery will be incubated in Heath incubators on May Creek (WRIA 7, stream number 0944) surface water to the eyed stage. They will then be shocked, mortalities picked, and the healthy eyed eggs will be transported to the Bernie Kai-Kai Gobin Tulalip Tribal Salmon Hatchery. After their disinfection with buffered iodophor, they will be incubated on Tulalip Hatchery well water.

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

Eyed eggs will be transported from the Wallace River Hatchery to the Bernie Kai-Kai Gobin Salmon Hatchery in clean, wet, burlap sacks, which will be insulated from the wind and cold during the transport.

5.3) Broodstock holding and spawning facilities.

Please see the WDFW Wallace River Hatchery HGMP. Summer Chinook broodstock will be held in three different adult capture raceways, based upon their return timing, until they become sexually mature and are removed for spawning. Spawning facilities are located at the ends of these raceways. Natural-origin Chinook will be tagged to identify their origin (Sunset Falls vs Wallace River) and time of capture.

5.4) Incubation facilities.

At the Wallace River and Tulalip Hatcheries, Skykomish River summer Chinook will be incubated in Heath vertical stack incubators. At the Wallace River Hatchery, these incubators are sixteen trays high. At the Tulalip Hatchery, the incubators are eight trays high. These incubators will be supplied with 4 gpm.

5.5) Rearing facilities.

Skykomish Chinook will be reared at the Tulalip Hatchery and lower Tulalip Creek pond. Upon emergence, swim up fry will be ponded outside in early rearing troughs at the Tulalip Hatchery, where they will be reared to a weight of approximately 400 fish per pound (just

above one gram whole body weight). Due to rearing space limitations at the Tulalip Hatchery, Chinook fry will then be transferred to a large asphalt pond specifically designated for rearing juvenile Chinook. After coded-wire tagging and mass-adipose fin-marking in April each year, Chinook will be transferred to the lower Tulalip Creek pond.

5.6) Acclimation/release facilities.

Lower Tulalip Creek pond functions as an acclimation and final rearing pond for this stock. It is an earthen pond which gives the juvenile Chinook a much more natural environment prior to release. In this pond, Chinook fingerlings learn to prey upon live organisms, and learn to avoid natural predators. The pond is created by a dam and screened fish ladder on the downstream end. It is oval-shaped, and is approximately 160 feet wide by 120 feet long. Its depth varies from zero at the shoreline to approximately five meters deep in the center portion of the pond. Summer Chinook will be reared in this pond until they reach a weight of 80 fish per pound (5.6 grams). This occurs by early- to mid-May each year, when they will be released at high tide into Tulalip Bay.

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

None.

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.

1) All phases of the culture operation from handling broodstock, to spawning, egg fertilization and incubation, and fish rearing will be supervised by properly-trained hatchery workers.

2) The stock will be reared in a location (Tulalip Creek) that is remote from naturally-spawning Snohomish River Chinook stocks, and thus can't be accidentally released into the river with them.

3) The incubation systems of the Wallace and Tulalip Hatcheries are equipped with low water alarms and back-up water supplies.

4) Both hatcheries have well trained staff on duty 24 hours per day, seven days per week.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1) Source.

In the past, Chinook returning to the hatchery before mid- to late-August were assumed to be summer Chinook and after September 1st, as fall Chinook. These dates shifted somewhat from year to year depending on run timing, which in turn was believed to be affected by marine and river harvest patterns, river flows and possibly other factors. The expectation now is that since all fall Chinook (primarily of Green River stock origin) releases from the facility were completely discontinued after broodyear 1996, and all hatchery Chinook released on-station after this were either mass marked and/or coded-wire tagged denoting their Skykomish summer Chinook stock origin, all marked/tagged hatchery returns in the future will be identifiable as to their summer Chinook origin.

This will make it possible to identify hatchery-origin summer Chinook at the hatchery and on the spawning grounds to better measure their contribution rates and provide adequate integration with natural-origin Chinook. This will reduce the possibility of deleterious genetic effects on the native summer Chinook populations in the Snohomish basin that might result from the inability to identify hatchery fish and assess straying rates and subsequent genetic introgression.

The current DNA composition of hatchery- and natural-origin Chinook in the Snohomish basin is being analyzed. The genetic composition of returns to Wallace River Hatchery are being analyzed by their return timing and by their hatchery vs natural origins, which will enable regional managers to assess whether past selection methods have worked to cull fall Chinook from the hatchery stock and whether current broodstock have the genetic composition of the natural Skykomish Chinook population, relative to their return timing.

Adult hatchery Chinook returns to the Wallace River Hatchery will continue to be otolith- and adipose fin mass-marked and coded-wire tagged to denote their origin. Since broodyear 2000, WDFW has fully funded an indicator stock program using summer Chinook fingerling production at Wallace River Hatchery. 200,000 fingerlings will be released from the Wallace River Hatchery annually with an adipose fin clip and coded-wire tag and an additional 200,000 fingerlings will be released with coded-wire tags but without the adipose fin clip. This combination of marking and tagging results in 100% of the Wallace Hatchery Chinook being identifiable as to their hatchery origins.

In the past, Chinook returning to the hatchery before mid- to late-August were assumed to be summer Chinook, and after September 1st, fall Chinook. These dates shifted somewhat from year to year depending on run timing, which was also believed to be affected by marine and river harvest patterns, river flows and possibly other factors. The expectation

now is that since all fall Chinook releases were discontinued from Wallace hatchery after broodyear 1997, and since then, all hatchery stock released on-station have been either adipose-mass marked and/or coded-wire tagged denoting their Skykomish summer stock origin, all marked/tagged hatchery returns in the future will be of summer stock origin.

6.2) Supporting information.

6.2.1) History.

The Wallace River Hatchery summer Chinook stock was originally recruited from native Skykomish River summer Chinook that returned to the fish passage facility at Sunset Falls on the Skykomish River in the early 1970s. Since that time, the only source of summer Chinook eggs has been adult fish that return to the traps at the Wallace River Hatchery (see section 6.1 above). There is a considerable history of introductions of out-of-basin fall Chinook stocks into the Snohomish system, however, the fall Chinook program was discontinued, effective with broodyear 1997. Nearly all introductions were of Green River fall Chinook origin.

6.2.2) Annual size.

2,350 adult summer Chinook (55%: 45% male: female) are needed for the combined Wallace River Hatchery on-station releases and for the Tulalip Hatchery Chinook program. The annual egg take goal for the Tulalip program is 1.8 million eyed Skykomish Chinook eggs, that are representative of the abundance, return and spawn timing of natural-origin Chinook in the Skykomish basin, for a release of approximately 1.7 million summer Chinook subyearlings annually into Tulalip Bay. The Wallace program requires an additional 1.5 million eggs to release 1.0 million subyearlings and 250,000 yearling annually.

Despite the increase in egg demand due to Tulalip shifting production to solely summer Chinook, it is anticipated that the current on-station release levels at Wallace will be adequate to provide adult returns necessary for both broodstock and terminal area fisheries. Therefore, the on-station release numbers at Wallace River Hatchery will not be increased. The egg take from native Skykomish Chinook returns will be adjusted by the comanagers if it is not sufficient to meet on-station release, egg transfer goals, or terminal fishery expectations.

In further recognition that there may be shortfalls of Skykomish River Chinook eggs on low return years to provide eggs for on-station releases and for the 1.8 million eyed egg transfer to the Tulalip Hatchery, a worst case scenario contingency plan is to collect additional later-timed Chinook returning to the Skykomish basin to supplement any shortfalls in the production egg take of native stock.

After making every effort to collect enough Skykomish Chinook eggs to meet on-station and production egg transfer goals to Tulalip, if it is still not possible to collect enough eggs

within the basin, a secondary contingency plan, developed by the comanagers, describes the intent to collect additional Chinook eggs from other WDFW facilities if necessary.

However, returns to the Wallace River rack over the past four years (2000-2003), have averaged 4,564 ± 469 (mean ± SEM), suggesting that it will not be necessary to collect fish from elsewhere when only 2,350 total Chinook are needed for broodstock. And, since 300-700 will be of natural-origin (see next section), that means only 1,640 to 2,040 total hatchery-origin fish will be needed for broodstock. The recent average of 4,564 is between 2.2- to 2.8 - fold higher than the maximum number (1,640-2,040) of hatchery-origin Chinook broodstock needed.

Also, hatchery escapement trend is steadily increasing the five-year average prior (1995-1999) was only 1,898 ± 184, which is 2.4 times less than the recent average and 3 times less than the most recent escapement of 5,687 in 2003. Natural-origin escapements have been increasing in recent years as well which provide additional fish for integrated broodstock as well.

A sufficient proportion (~100,000 fingerlings) of the Tulalip summer Chinook hatchery production released into the Snohomish basin will be both adipose fin-clipped and coded-wire tagged, and all production will be differentially otolith mass-marked to enable accurate stock assessment in the fishery, in regional hatchery escapements, and on the spawning grounds. Assessment of adult straying and contribution rates to escapement, based on sampling of carcasses and reading of otoliths, will be done using methods described in Rawson et al. (2001) complimented by recovery of coded-wire tags.

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

No broodstock will be collected at Tulalip Hatchery; however, since this program relies on Skykomish River Chinook collected for broodstock and spawned at the Wallace River Hatchery, past broodstocking practices are discussed below, along with a description of new comanager policies for broodstock integration and upstream passage.

The Wallace Hatchery Summer Chinook program was initiated with indigenous summer Chinook broodstock captured at the Sunset Falls trap, located on the Skykomish River. Past levels of natural Skykomish River broodstock returning to the hatchery and incorporated into the hatchery population were poorly documented. With the beginning of mass marking (1998 BY for yearlings and 2000 BY for fingerlings), otolith marking and coded-wire tagging, 100% of returning hatchery-origin Chinook from the Snohomish region will be identifiable with one or a combination of these marking and tagging methods.

Because significant numbers of Wallace River Hatchery-origin Chinook are found in natural spawning areas in the Snohomish basin (Rawson, Kraemer, and Volk 2001), broodstock spawned for on-station releases at the Wallace River Hatchery will be managed

as a fully-integrated hatchery program to reduce the risk of loss of fitness to the natural population.

One important part of transitioning from a partially- to fully-integrated program is to use only in-basin broodstock for the hatchery. This step has already been completed at the Wallace River and Tulalip Hatcheries, where out-of -basin Chinook, primarily fall Chinook of Green River origin, have been eliminated for releases as well as for use as broodstock.

Regional comanagers have agreed on a detailed protocol for implementing broodstock integration with natural-origin Skykomish Chinook to maintain adequate gene flow between the wild and hatchery groups to achieve the intent of a fully-integrated program.

Integration will be accomplished by infusing a proportion of natural-origin Skykomish Chinook into the broodstock used for on-station egg takes at Wallace River Hatchery at a level equal to or greater than the proportion of hatchery-origin Chinook that spawn in the wild in the Skykomish system.

Broodstock collected for the Tulalip Chinook program will not be infused with wild Chinook. Because the Wallace River program provides eggs for the Tulalip Hatchery, integration of the Tulalip program will be "one generation out", meaning that, although mainly hatchery-origin Chinook returning will be used to provide eggs to Tulalip, the Tulalip broodstock will be considered to be integrated because its brood source will be from an integrated hatchery program the previous generation. Because Chinook from the Tulalip program have not contributed substantially to natural spawning aggregations in the Skykomish population (the 1997 to 2001 average was 2.0%), the one generation out approach is adequate for the Tulalip program.

Collection of natural-origin Chinook for incorporation into the Wallace River Hatchery broodstock will be limited to only two components of the Skykomish population: the Wallace River and the upper South Fork Skykomish River. These areas were chosen due to the ability to limit the impact of broodstock collection on Skykomish natural Chinook production and evaluations that suggest that removals will not inhibit recovery efforts (see Section 6.3 for additional details), as well as in consideration of logistical considerations: broodstock collection can be immediately implemented at these sites because trapping structures are already in place on the Wallace River weir and Sunset Falls fish passage facility to enable broodstock collection.

In addition to the evaluations and considerations described in Section 6.3, potential impact to the listed Skykomish Chinook population will be limited because naturally-spawning Chinook from these two sub-basins together comprise only approximately 15% of the potential spawning of the Skykomish population under current conditions (see table in section 6.3), thus leaving the great majority of the current natural spawning capacity invulnerable to this broodstock collection. Also, natural-origin Chinook returning to the Wallace River weir (as distinguished from those that spawn in natural spawning areas)

have not been included in natural escapement estimates in the past and therefore will not impact natural escapement. Furthermore, the comanagers have established strict guidelines for collection of natural-origin Chinook from the Sunset Falls and Wallace traps, designed so that the productivity of spawning habitats above these traps will not be impaired.

We have established a range of 300 to 700 natural-origin broodstock (NOB, see the Table below for the definition of this and other terms) to contribute to the hatchery broodstock at the Wallace River Hatchery. This range is based on the theoretical concept of the proportion of natural influence (PNI), which compares the natural-origin contribution to the hatchery brood stock with the hatchery-origin contribution to the natural spawning population (Ford 2002). The HSRG recommends that we strive for a minimum PNI of 0.5, and work toward a PNI of 0.7. Based on a need for 750 effective spawners for the Wallace River Chinook on-station release, assuming a 40% average contribution of Wallace River Hatchery fish to the Skykomish natural spawning population (Rawson, Kraemer, and Volk 2001, and subsequent analyses), and using the definition of PNI, the range of 300 to 700 for NOB results in NOB proportions ranging from 40% to 93.3%, corresponding to a range of 0.5 to 0.7 for PNI.

Wallace River Hatchery-origin broodstock can be identified the absence of the adipose fin, the presence of a coded-wire tag, or both. Hatchery-origin broodstock will be collected at the Wallace River weir, which is annually placed at approximately river mile 4 of the Wallace River adjacent to the hatchery. Natural-origin broodstock will be collected from both the Wallace River weir or the Sunset Falls trap. The protocol for the number of NOB to take from each location is shown in the table below. It is also important to note that if, in any year, either pre-season or in-season run size information indicates that the critical escapement level for the Skykomish population will not be reached, the broodstocking protocol will be modified to assure that the collection of NOB from Wallace River and Sunset Falls will not cause NOS to go below the critical level.

The maximum transfer of 20% of the Sunset Falls return from the NOS to the NOB category is a conservative guideline designed to limit the effect of taking natural-origin fish into the hatchery. We evaluated this guideline in two ways. First, an analysis of past return data revealed that if the 20% removal was applied to the observed Chinook numbers that have passed over Sunset Falls in the recent 20-year period, it would have resulted in a range of 346 to 929 NOS in the upper South Fork Skykomish (see table in Section 6.3). The lower end of this range is still greater than the maximum sustainable yield escapement for this area from current conditions using EDT analysis (see table in Section 6.3).

Thus, we expect that under this protocol, the MSY escapement level for the upper South Fork Skykomish would be exceeded the great majority of the time. We also used a very simple simulation model to project the NOS above Sunset Falls if this protocol were in place, assuming that the population dynamics of this area operated according to the Beverton-Holt spawner-recruit parameters estimated in the EDT analysis (see table in Section 6.3). This analysis suggested that the NOS above Sunset Falls would equilibrate at

approximately 860, well above the current conditions MSY escapement level of 332 and in the top quarter of the past 20 years of observations (see table in Section 6.3).

Management of the Wallace River Chinook broodstock will also include a protocol for passage of adult Chinook above the Wallace River weir into approximately 3.8 miles of spawning habitat in the upper Wallace River. Controlling the number of HOS allowed into this area will increase the degree to which the fish produced from this segment are adapted to the natural environment. The comanagers have initially established a minimum seeding number of 400 spawners (in the form of 200 Chinook pairs) to be passed above the Wallace River rack for natural spawning, based on recent years' trial fish passage work. Natural-origin Chinook arriving at the Wallace River weir that are not needed as NOB will be passed above the rack.

If there are not sufficient numbers of natural-origin Chinook to achieve the minimum upstream passage goal of 200 pairs, then the remainder will be collected from hatchery-origin fish arriving at the weir that are not needed for hatchery broodstock. All excess, natural-origin, adult Chinook salmon arriving at the Wallace River weir will be passed into the upper Wallace River, even if the number of 400 effective spawners would be exceeded. Note, in this case, there would be zero hatchery-origin fish passed above the weir.

Terms used in describing integrated hatchery programs.

Abbreviation	Parameter	Description
NOB	Natural origin brood stock	Natural origin fish used in hatchery brood stock
HOB	Hatchery origin brood stock	Hatchery origin fish used in hatchery brood stock
NOS	Natural origin spawners	Natural origin fish spawning in the wild
HOS	Hatchery origin spawners	Hatchery origin fish spawning in the wild
pNOB	Proportion natural origin brood stock	NOB/(NOB + HOB)
pHOB, pNOS, pHOS defined similarly		
PNI	Proportion of natural influence	pNOB/(pHOS+pNOB)

Protocol for collection of NOB from Sunset Falls trap and Wallace River weir:

1. Take 20% natural-origin Chinook at Sunset Falls trap throughout their return timing.

2a. If this number is less than 150, take sufficient natural-origin Chinook from Wallace River weir to make 300 NOB (the ratio of Wallace : Sunset, when Sunset NOB < 150, may exceed 1.0 in these instances of low NOB abundances).

2b. If this number is greater than 150, then take an equal number of NOB from Wallace River (the ratio of Wallace : Sunset, when Sunset NOB > 150, will not exceed 1.0).. NOTE: in 2a and 2b, if there are not sufficient NOB from Wallace to make the minimum 300 NOB, then the total NOB in that year will be the number taken from Sunset Falls plus

the total available at Wallace. Additional brood stock will be of hatchery-origin.

3. If at any time, the total expected NOS for the Skykomish population is less than the critical escapement level defined in the Chinook harvest management plan, then the above will be readjusted to assure that the NOS will exceed the critical escapement.

6.2.4) Genetic or ecological differences.

Protein electrophoresis conducted by Marshall (1997), which are the only genetic tests done on Skykomish Chinook to date, indicated that Wallace River Hatchery summer Chinook (and therefore Tulalip summer Chinook) were not significantly different (G-test and cluster analysis; $p > 0.05$) than the native Skykomish River summer Chinook salmon population. Marshall (1997) examined the genetic composition of the Wallace River Hatchery summer Chinook stock, and compared samples collected from early-returning Chinook in 1987, 1988, and 1993 ($n = 259$), with late-returning (presumed to be fall Chinook) Wallace Hatchery Chinook collected in 1987 ($n = 106$), Green River Hatchery fall Chinook collected in 1987 and 1988 ($n = 200$), and with natural-origin summer Chinook samples collected from various key spawning aggregations throughout the Skykomish watershed in 1987, 1988, 1989, 1993, and 1996 ($n = 444$).

While it continues to be suspected that past transfers of out-of-basin fall Chinook (releases of which have been terminated at Wallace and Tulalip Hatcheries) may have lead to genetic divergence from the native summer Chinook stock, results from the only genetic analysis to date did not reveal any apparent genetic differences among natural-origin Chinook and the early-returning Wallace River Hatchery summer Chinook stock. The author concluded that since the Skykomish Hatchery summer Chinook population was initiated from Skykomish River summer Chinook, close genetic relationships between the hatchery and natural populations would be expected.

Samples collected from the late-returning fall Chinook hatchery stock were found to be significantly different ($p < 0.05$) from the early-returning summer Chinook hatchery stock as well as significantly different than natural-origin Skykomish Chinook, but they were not found to be significantly different (G-test and cluster analysis; $p > 0.05$) from the Green River Hatchery fall Chinook stock. However, to reiterate, fall Chinook hatchery production is no longer occurring at Wallace River or Tulalip Hatcheries, and it is believed that remnants from the plants did not survive in significant numbers to contribute substantial abundance.

The current genetic composition of hatchery- and natural-origin Chinook in the Snohomish basin is being analyzed using more sensitive DNA methods as part of a new DNA baseline for Chinook salmon all along the Pacific coast. The genetic composition of returns to Wallace River Hatchery will be analyzed by return timing and by hatchery vs natural origin, which will enable regional managers to more accurately assess genetic makeup of the hatchery population relative to return timing, and to get a current analysis of genetic

composition now that the old fall Chinook programs at Tulalip and Wallace Hatcheries have been phased out.

In addition, this updated genetic analysis will help to shed light on whether past broodstock selection methods at Wallace River Hatchery, that were based on only collecting summer Chinook broodstock from early-returning (prior to either August 15th or at the latest, September 1st each year), were successful in culling fall Chinook from the broodstock pool and whether current broodstock continue to retain the genetic composition of the natural Skykomish Chinook population, relative to their return timing. This study has direct application to hatchery management as it will provide insight on broodstock collection methods and integration strategies.

6.2.5) Reasons for choosing.

Skykomish summer Chinook are native to the Snohomish basin and are the locally-adapted stock. This stock was chosen to replace the fall Chinook hatchery stock, of Green River origin, which was the primary Chinook stock cultured and released from the Wallace River Hatchery prior to 1997. This choice greatly minimizes adverse genetic and ecological differences between program fish and natural-origin Chinook in the Snohomish basin.

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.

All fingerling Chinook produced at Tulalip Hatchery are 100% otolith-marked, a portion are also coded-wire tagged, and a significant portion are also adipose fin mass-marked. A new Tulalip-WDFW draft MOU Agreement calls for 70% of broodyear 2004 Tulalip Hatchery Chinook and coho to be mass-marked by removal of adipose fins in addition to other marks and tags, such as thermal otolith marks and coded-wire tags. This proportion will gradually be increased to a 100% adipose fin marking rate on Tulalip Chinook by broodyear 2011, provided certain conditions prevail, as previously described.

All summer Chinook fingerlings produced at Wallace River Hatchery, the only other Chinook hatchery program in the Snohomish region, are currently mass marked (adipose - fin clip only), coded-wire tagged, or both. This combination of mass adipose fin and otolith marking and coded-wire tagging allows for 100% of the regional Chinook hatchery return to be identifiable.

As previously described in Section 6.2.3, the comanagers have refined a plan to integrate, on average, 40% to 93.3% natural-origin Chinook into the hatchery broodstock in order to maintain genetic integration with the natural Snohomish River summer Chinook population. This amounts to integrating between 300 - 700 natural-origin Skykomish

Chinook into the Wallace River Hatchery broodstock each year, given annual escapements are sufficient as described below. These adults will come from the Wallace River weir and the Sunset Falls fish trap located on the upper South Fork Skykomish River. Regional fall Chinook hatchery programs have been eliminated.

As mentioned in Section 6.2.3, summer Chinook broodstock at Wallace River Hatchery will be fully-integrated to result in a proportion of natural influence (PNI; Ford 2002) of 0.5 to 0.7, which will reduce the risk of loss of fitness to the natural population due to hatchery fish spawning in the wild and wild fish spawning in the hatchery. Potential impact to the Skykomish population was evaluated by the comanagers and it is believed that broodstock mining effects on natural spawning aggregations where natural brood fish will be collected will not hinder recovery or significantly impact natural Skykomish Chinook spawning aggregations in the impacted subwatersheds where the collections will occur, as described below.

Overall reductions in abundance from removals of adult Chinook for broodstock will be limited because naturally-spawning Chinook from the two sub-basins where the fish will be collected together comprise only about 15% of the average Skykomish Chinook escapement under current conditions, not affecting the majority of the natural escapement. Also, natural-origin Chinook returning to the Wallace River weir (as distinguished from those that spawn in natural spawning areas) have not been included in natural escapement estimates and were not allowed to spawn naturally in the past and therefore removal of some of these fish will not impact natural escapement. On the contrary, 200 pairs of natural-origin Chinook will be passed upstream when they are available, while hatchery-origin Chinook will not be allowed upstream unless they are needed to augment the 200-pair escapement goal for the upper Wallace River

Furthermore, the comanagers have established strict guidelines for collection of natural-origin that are designed so that the productivity of Chinook in the subwatersheds affected will not be impaired. Those protocols for collection of NOB from the Sunset Falls trap and Wallace River weir are the following:

1. Take a maximum of 20% of the natural-origin Chinook arriving at the Sunset Falls trap throughout their return timing. The maximum transfer of 20% of the Sunset Falls return from NOS to NOB is a conservative guideline designed to limit the effect of taking natural-origin fish into the hatchery. The comanagers evaluated this guideline in two ways. First, an analysis of past return data revealed that if the 20% removal was applied to observed Chinook numbers that were passed above Sunset Falls in the recent 20-year period, it would have resulted in a range of 346 to 929 NOS in the upper South Fork Skykomish (see table in Section 6.3). The lower end of this range is still greater than the maximum sustainable yield escapement for this area from current conditions using EDT analysis (see table in Section 6.3).

Thus, we expect that under this protocol, the MSY escapement level for the upper South Fork Skykomish will be exceeded all or a great majority of the time. The comanagers also used a very simple simulation model to project NOS escapement above Sunset Falls when this protocol is implemented, assuming that the population dynamics of this area operates according to Beverton-Holt spawner-recruit parameters estimated in EDT analysis (see table in Section 6.3). This analysis suggested that NOS above Sunset Falls would equilibrate at approximately 860, well above current conditions MSY escapement level of 332 and in the top quarter of the past 20 years of observations.

It is also important to note that if, in any year, either pre-season or in-season run size information indicates that the critical escapement level for the Skykomish population will not be reached, the broodstocking protocol will be modified to assure that the collection of NOB from Wallace River and Sunset Falls will not cause NOS to go below the critical level.

2a. If the available number of natural origin Chinook from Sunset Falls is less than 150, take sufficient natural-origin Chinook from Wallace River weir to make 300 NOB (the ratio of Wallace: Sunset, when Sunset NOB < 150, may exceed 1.0 in these instances of low NOB abundances).

2b. If this number is greater than 150, then take an equal number of NOB from Wallace River (the ratio of Wallace: Sunset, when Sunset NOB > 150, will not exceed 1.0).

Note: In 2a and 2b, if there are not sufficient NOB from Wallace River to make the minimum 300 NOB, then the total NOB in that year will be the number taken from Sunset Falls plus the total available from Wallace. Additional Chinook needed for broodstock will be of hatchery-origin, taken from the Wallace River rack.

3. If at any time, the total expected natural-origin spawners (NOS) for the Skykomish population is less than the critical escapement level defined in the Chinook harvest management plan, then the above will be re-adjusted to assure that the NOS will exceed the critical escapement.

Below are numbers of Chinook salmon passed at Sunset Falls in previous years and numbers that would have been passed if 20% were removed; 1993-2004.

Year	No. Chinook Passed	NOS if 20% Removed
1993	630	504
1994	531	425
1995	1,035	828
1996	860	688
1997	699	559
1998	572	458
1999	722	578
2000	790	632
2001	1,161	929
2002	942	754
2003	889	711
2004	716	573

Results of EDT analysis on components of the Skykomish Chinook population.

Population	Scenario	Diversity index	Productivity	Capacity	Eq. Abundance	MSY Esc
Upper SF Skykomish	Current conditions	89%	5.8	1,366	1,131	332
	Historic potential	100%	13.4	3,659	3,386	726
Upper Wallace	Current conditions	100%	7.2	309	266	72
	Historic potential	100%	18.3	1,006	951	180
Remainder of Skykomish	Current conditions	77%	3.7	10,132	7,400	2,529
	Historic potential	99%	14.5	48,750	45,397	9,432
Entire Skykomish Population	Current conditions	85%	4.4	11,692	9,013	2,918
	Historic potential	100%	16.0	50,983	47,806	9,550

SECTION 7. BROODSTOCK COLLECTION

This was previously described in Sections 6.23 and 6.3.

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

Eyed eggs will be provided for this program from Wallace River Hatchery Chinook that have been integrated with the natural population, one generation removed.

7.2) Collection or sampling design.

This was previously described in Sections 6.23 and 6.3. Skykomish summer Chinook will be collected from natural-origin fish (40% to 93.3% NOR's) returning to Sunset Falls and Wallace River traps, complimented by hatchery-origin summer Chinook 6.7% to 60%) that are 100% marked/tagged and identifiable that return to the Wallace River weir.

7.3) Identity.

Broodstock providing eggs for this program will be integrated one generation removed; where 40% to 93.3% will be of natural Skykomish Chinook origin, and the remainder of hatchery-origin, as denoted by 100% marking and tagging, utilizing a combination of otolith and adipose fin mass-marking and coded-wire tagging.

7.4) Proposed number to be collected:

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

For the 2.0 million green eggs (1.8 million eyed eggs) required for the Tulalip Hatchery Chinook program, a collection of 1,285 Chinook at Wallace River Hatchery would, on average, produce 586 females, of which 471 would survive to be viable female spawners to produce 2.0 million green eggs for the Tulalip Chinook program (factors used in this calculation were previously described in Section 1.12. Therefore, the broodstock collection goal at the WDFW Wallace River Hatchery for the Tulalip Tribal enhancement program is approximately 940 effective spawners at a 1:1 ratio, which will consist of mostly hatchery-origin summer Chinook that are one generation removed from full genetic integration with the target natural population.

Additional summer Chinook broodstock will be collected at the Wallace River Hatchery for on-station releases, requiring a total of 3.5 million green eggs or roughly a return of 2,250 total Chinook to the hatchery would be required, on average, to produce 1,026 females, resulting in 824 viable female spawners yielding 3.5 million green eggs for both the Wallace and Tulalip Chinook programs (see Section 1.12 for additional details).

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

most recent years available:

7.5) This program was initiated in 1998, so it is only possible to list collections since that time. Also, no broodstock are collected under this program. Only eyed eggs are provided, and the exact numbers of broodstock collected to provide those eggs were not logged, but their numbers can be inferred with fair precision given average historic survival rates listed previously in Section 1.12. Numbers of eggs and inferred numbers of broodstock collected to achieve the annual egg takes are shown in Section 9.1.1. The Tulalip fall Chinook program was reduced in broodyear 2003 and discontinued in broodyear 2004. It was replaced with summer Chinook, which accounts for the significant egg take increase beginning in 2003, and corresponding increase in the inferred broodstock collection shown in Section 9.1.1.

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

Please see the WDFW Wallace River Hatchery summer Chinook fingerling and yearling HGMP's.

7.7) Fish transportation and holding methods.

Broodstock for this program return to the Wallace River or Sunset Falls traps in the Skykomish basin, where they will be transferred from the river to one of three holding ponds based upon the month of their return timing (June, July, or August).

Once spawned, fertilized, and from the Bernie Kai-Kai Gobin Tulalip Tribal Salmon Hatchery in wet burlap bags.

7.7) Describe fish health maintenance and sanitation procedures applied.

See the Wallace River Hatchery HGMP for fish health maintenance and sanitation procedures applied to broodstock. Since this program relies on those procedures, however, the following methods will be employed to prevent disease transmission in adult Chinook broodstock at Wallace River Hatchery.

Pre-spawning adults will be inoculated with antibiotics to minimize potential vertical transmission (from parent to offspring) as well as horizontal transmission (from fish to fish) of infectious fish pathogens. Formalin will be used to control external parasites and *Saprolegnia* sp. fungal growth on adult Chinook broodstock during holding. Additionally, all adult female Chinook will be sampled for the presence of *Renibacterium salmoninarum*, the causative agent of bacterial kidney disease.

Extensive use of iodophore disinfectant will be used to disinfect equipment during spawning procedures and eggs after fertilization. When the eyed eggs are brought to Tulalip, they will receive a second disinfection in iodophor when they are placed into

Heath incubators before final incubation, hatching, and emergence.

7.8) Disposition of carcasses.

Spawned and un-spawned carcasses that have not been exposed to antibiotics or chemical treatment, that are in excess of numbers of fish needed for passing into natural spawning areas at Wallace River Hatchery, will typically be sold to a fish buyer; otherwise, all carcasses will be buried on-station at Wallace River Hatchery.

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.

Risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects were previously described in Sections 6.2.3 and 6.3 (regarding broodstock integration) and in other previous sections that dealt with changing the source of broodstock to the native population of summer Chinook. To minimize the potential for adverse genetic effects to listed natural fish (from, for example, straying and spawning with their wild counterparts), the broodstock source at the Wallace River and Tulalip hatcheries was previously changed from non-native fall Chinook to indigenous Skykomish River summer Chinook.

The risk of fish disease amplification will be minimized by following sanitation, fish health maintenance, and pathogen monitoring guidelines as described in the Salmonid Disease Control Policy of the Fisheries Comanagers of Washington State (NWIFC and WDFW 1998).

SECTION 8. MATING

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

No Chinook will be spawned at Tulalip Hatchery in this program; however, the procedures at Wallace River Hatchery are described below.

8.1) Selection method.

Random, representative broodstock will be selected, incorporating NOS.

8.2) Males.

No back up males or repeat spawners will be used. Jacks will be spawned at a rate of 2% over the spawning season.

8.3) Fertilization.

A five-by-five matrix spawning protocol (effective sex ratio 1:1) will be conducted to maximize the effective population size.

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.

See Sections 6.2.3 and 6.3 for more details on risk aversion measures that will be applied to minimize the likelihood for adverse genetic and ecological effects to listed natural fish.

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.

This summer Chinook program was initiated in broodyear 1998. From the 1998 return through the 2002 return, egg take and release levels remained low. Tulalip summer Chinook eyed egg takes from 1998 through 2002 were 185,893 ± 14,625 (mean ± SEM), and mean fish release levels were 171,634 ± 18,218, range 117,315 to 195,000 fingerlings. Beginning with broodyear 2003, full production was initiated. Egg takes in 2003 and 2004 were 1,714,741 and 1,846,095, respectively, and releases were 1,641,763 and 1,254,059, respectively (see table below).

Fall Chinook releases were reduced from approximately 1.5 million in years previous to broodyear 2003 (2004 release) to 245,934 in release year 2004 and were discontinued in release year 2005 (broodyear 2004).

Species	Hatchery	Brood Year	Eyed Egg Take	Release Date(s)	Size (fpp)	Ad/ & CWT	Ad/ No CWT	Unmarked CWT Only	Unmarked No CWT	Total	% Adipose Marked[1]	% Otolith Marked	% CWT
0+ Sum Chin.	Tulalip	2003	1,714,741	5/6/2004	80	84,623	8,557	4,437	1,544,146	1,641,763	5.68%	100.00%	5.42%
0+ Sum Chin.	Tulalip	2004	1,846,095	5/4/2005	80	108,269	762783	185	383007	1,254,059	69.46%	100.00%	8.65%

1. Initial proportion marked was 70%, this is the proportion massa marked that was released after accounting for clip retention.

Broodyear	No. Eyed Summer Chinook Eggs Transferred to Tulalip	No. Estimated Effective Female Spawners Required	No. Estimated Females Collected	Total Estimated No. Summer Chinook Collected
1998	127,414	30	37	82
1999	200,000	47	59	129
2000	202,050	48	59	130
2001	200,000	47	59	129
2002	200,000	47	59	129
2003	1,714,741	403	502	1,102

Using average fecundity (4,250 eggs per female), average female holding survival rate (80.3%), and average female sex ratio (45.6%) for Wallace River summer Chinook broodstock from 1995 through 2002, a return of 2,250 total Chinook to the hatchery would be required, on average, to produce 1,026 females, resulting in 824 viable female spawners to yield 3.5 million green eggs for both the Wallace and Tulalip Chinook programs.

Tulalip Hatchery will receive eyed Skykomish Chinook eggs from the Wallace River Hatchery for this program. Please see the WDFW Wallace River Hatchery HGMP for additional information regarding broodstock and egg survival goals. Currently, it is projected that 2.0 million green eggs incubated at Wallace River Hatchery will yield 1.8 million eyed eggs for transfer to Tulalip (which equates to 90.0% green-to-eyed egg survival). Of the 1.8 million eyed eggs, the Tulalip Tribes' release goal is 1.7 million subyearling smolts into Tulalip Bay (equating to a 94.4% eyed egg to released subyearling smolt survival rate, or an 85.0% green egg-to-subyearling smolt survival rate goal).

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

Surplus eyed summer Chinook eggs have typically not been transferred to Tulalip Hatchery; however, the transfer in 2004 was slightly higher than the eyed transfer goal due to different inventory methods at the two hatcheries. The higher number, 1,846,095 as shown in the table in Section 9.1.1, was estimated at Tulalip by weighing all of the eggs and sample counting representative aliquots. This estimate was used instead of the Wallace estimate because more eggs were used in the sample counts. Also, water weight was carefully controlled when the eggs were weighed at Tulalip, which was likely the cause for differing estimates at the hatcheries.

Final incubation and ponding mortalities, other in-hatchery mortalities, and bird-related mortalities at Tulalip reduce the eyed egg number further each year, and the remaining fish will be released. On occasion, this may result in releases that are just slightly above the release goal, depending on which inventory one uses, but more often than not the releases have been below the release goal. To date, no surplus fish above the release goal have been released. All subyearling Chinook were weighed and sample-counted at Tulalip in 2005 from the 2004 brood, revealing that only 1,254,059 survived to the release (73.13%). Particularly high merganser predation was observed in the asphalt rearing pond prior to transferring tagged fish to the final rearing and release pond above Tulalip Bay.

9.1.3) Loading densities applied during incubation.

The loading density will be 6,000 eyed Chinook eggs per Heath incubation tray at Tulalip.

9.1.4) Incubation conditions.

Eyed Chinook eggs will be incubated on 47-degree Fahrenheit (8.3 degrees C) well water at the Bernie Kai-Kai Gobin Salmon Hatchery, except during extended power outages when east fork Tulalip Creek water will be used. In addition, water temperatures will be modified according to a schedule using chillers to apply thermal otolith marks. Both water sources will be at or near oxygen saturation upon entry to Heath stacks and the effluent will be above 90% saturation when it leaves the stacks.

Eyed Chinook eggs received from WDFW for this program will be disinfected in a 100 ppm iodophor solution for ten minutes after they are placed into the Heath incubator trays, before pathogen-free well water is turned on. Green eggs will be disinfected for one hour after fertilization in this same concentration of iodophor.

9.1.5) Ponding.

Skykomish Chinook fry will be ponded when they are at or near to full yolk absorption (near to full button-up). Dates of ponding will vary according to the exact number of thermal temperature units (TU's) accumulated in eyed eggs at the time a particular batch is transferred from the Wallace River Hatchery.

9.1.6) Fish health maintenance and monitoring.

Eyed eggs will be treated prophylactically in Heath incubators with a 1,667 ppm formalin drip treatment for 15 minutes, three times per week, to control growth of opportunistic *Saprolegnia* sp. fungus. Vexar matting will be placed in the bottom of the Heath trays to provide substrate for alevins to hold in during yolk absorption, which conserves their energy, improves growth and size at emergence, and reduces abrasion of yolk sacs. All dead eggs will be removed from egg lots held at the Wallace River Hatchery after shocking and prior to transfer to Tulalip. No further dead egg removal will be done from this stage until ponding.

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.

Native stock culture and integration reduces the risk of introducing and amplifying unwanted genetic traits from non-local Chinook populations. Backup water supplies and alarm systems reduce the possibility for hatchery disasters.

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.

The overall survival rate from spawning to release will average to be approximately 80%.

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

Juvenile rearing densities will be held under 0.5 pounds of fish per cubic foot.

9.2.3) Fish rearing conditions

Before juveniles reach one-half pound of fish per cubic foot of rearing space, they will be transferred from small outdoor raceways (15m X 1.3m X 0.9m; 18m^3 or 600ft^3) into a larger outdoor asphalt pond (46m X 18.3m X 0.9m; 764 m^3 or 26,992 ft^3). While being reared in this pond, approximately 100,000 juvenile summer Chinook will be coded-wire tagged and externally marked with adipose fin clips (5.9% of the total release if the 1.7 million release goal is achieved).

An additional number of Chinook will be mass-marked by removal of adipose fins, in addition to other marks and tags, such as thermal otolith marks (100%) and coded-wire tags, to achieve an overall adipose fin marking rate of 70%, effective with the 2004 brood, which was released in 2005. This proportion will gradually be increased to a 100% adipose fin marking rate on Tulalip Chinook by broodyear 2011, provided certain conditions prevail as previously described in Sections and 3.3 and 6.3. If the 1.7 million release goal is achieved, 70% amounts to 1,190,000 clipped subyearlings, which includes the 100,000 that will be clipped and CWT'ed. Each year, all of the fish will be weighed and sample-counted into the marking and tagging trailers to determine how many fish must be marked.

After tagging and marking, they will be combined with other unmarked Chinook and transferred to the lower Tulalip Creek pond (190m X 40m X 6m; 1,960 m^3 or 69,295 ft^3. Rearing densities will remain below one-half pound of fish per cubic foot of rearing space (final density at release will be < 0.3 lb/ft^3) and conditions will resemble natural habitat, as described in Sections 5.6 and 9.2.9.

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.

This data is currently being compiled and centrally-located in several databases.

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

This data is currently being compiled and centrally-located in several databases.

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*).

Feed Type / Size	Fish Size Fish Per Pound (fpp)
BioVita (BioOregon) / Size 0 mash	2700 – 530 fpp
BioVita (BioOregon) / Size 1 crumble	530 – 300 fpp
Nutra Plus (Scredding) / Size 2 crumble	300 – 197 fpp
Nutra Fry (Scredding) / 1.2-1.5 mm pellet	197 – 80 fpp

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

Eyed eggs will be treated with an iodiphor treatment at the time they are placed in incubators as previously described. Incubating eggs will be prophylactically treated with a 1,667 ppm formalin drip treatment for 15 minutes, three times per week, to control growth of opportunistic *Saprolegnia* sp. fungus.

Each year, Northwest Indian Fisheries Commission (NWIFC) fish pathologists will screen a representative number of adults returning to Tribal hatcheries for pathogens that may be transmitted to the progeny. The exact number of fish that will be tested from each stock is specified in the Salmonid Disease Control Policy of the Fisheries Comanagers of Washington State. The NWIFC pathologists will work with hatchery crews to prevent or minimize pre-spawning mortality of brood fish to maximize egg fertilization and survival.

Preventative care will also be promoted through routine juvenile fish health monitoring. Pathologists will conduct fish health exams at each of the Tribal hatcheries on a monthly basis from emergence until release. Monthly monitoring exams will include an evaluation of rearing conditions as well as sampling small numbers of juveniles to assess their health status and to detect infectious pathogens of concern. Diagnoses will be reported to the Hatchery Managers and the Enhancement Biologist along with any recommendations for improving or maintaining fish health, and preventing or controlling disease.

No vaccines have been administered in the past at this hatchery; however, in light of the greatly increased handling and stress that is now required to weigh all of the fish and mass-adipose fin-mark the fish a minimum of 70%, increasing to 100% by 2011, it may become necessary to treat the fish with antibiotics and/or give them a vaccine to provide enhanced immunity against vibriosis and other pathogens after they are released into the marine

environment.

This is being considered after many Chinook released in 2005 exhibited skin lesions and extensive descaling after mass-marking up until their release. Release and subsequent adjustment to seawater is already physiologically-stressful enough without the additional trauma that is being induced on the fish from handling and mass-marking, right before their release into seawater. Chinook subsequently captured in Tulalip Bay, in nearshore marine areas, and in the Snohomish estuary exhibited descaling after the hatchery release at Tulalip. While their origins have not yet been determined from reading otoliths on sample fish collected, it is suspected that these were scratched up, mass-marked Chinook subyearlings that originated from Tulalip.

Pathologists will work with the Enhancement Biologist, Hatchery Managers and Technicians to ensure that drugs, chemicals, and vaccines will be dispensed properly during treatments. The entire health history for each hatchery stock will be maintained in a relational database called AquaDoc.

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

Not available.

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

All program fish will be transferred to the lower Tulalip Creek pond, a natural earthen pond that is 764 m^3 or 26,992 ft^3. They will be held in this pond at relatively low density (< 0.3 lb ft^3 for a minimum of 30 days prior to release into Tulalip Bay. The characteristics of this pond closely mimic natural rearing conditions, including overhead cover, earthen substrate, natural feed supplementation, in-column structure, natural inflow, natural camouflage coloration/pond color, and presence of natural predators. Program fish will develop natural morphology and behavior, including more natural body coloration, predator avoidance and natural feeding behaviors, by adapting to these natural environmental conditions, which will minimize the influence of the artificial culture environment and which is thought to increase their post-release survival.

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.

Use of native broodstock, proper mating strategies, natural rearing, and \rearing for a relatively short period (several months to the fingerling or subyearling stage), minimizes the potential for adverse genetic and ecological effects that may result from the artificial rearing environment.

SECTION 10. RELEASE

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

program.

10.1) Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Fingerling	1,700,000	80 fish/lb.	May 5-15	Tulalip Bay

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

Stream, river, or watercourse: Tulalip Bay
Release point: Tulalip Creek lower pond
Major watershed: WRIA 7 (Snohomish)
Basin or Region: Puget Sound

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

The first summer Chinook fingerling release was in 1999, from broodyear 1998.

Brood Year	Release Year	AD/CWT	AD Only	CWT Only	Unmarked and Untagged	TOTAL RELEASED	Percent Ad Clipped	Percent CWT	Percent Marked
1998	1999	105,232	12,083	0	0	117,315	100.00%	89.70%	100.00%
1999	2000	99,251	81,489	0	4,460	185,200	97.60%	53.60%	100.00%
2000	2001	75,003	7,038	1,948	111,011	195,000	42.10%	39.50%	100.00%
2001	2002	92,381	4,643	1,380	90,615	189,019	51.30%	49.60%	100.00%
2002	2003	73,163	18,109	2,563	94,265	188,100	48.50%	40.30%	100.00%
2003	2004	84,623	8,557	4,437	1,544,146	1,641,763	5.68%	5.42%	100.00%
2004	2005	108,269	762,783	185	383,007	1,254,059	69.46%	8.65%	100.00%
				Averages for all years:		**538,637**	**59.23%**	**40.97%**	**100.00%**

All fish were released at 80 fpp.

See also: http://www.nwifc.wa.gov/CRAS for tag and mark release numbers for this program.

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

See above table and descriptions below.

10.5) Fish transportation procedures, if applicable.

Not applicable. All releases were/will be on-station.

10.6) Acclimation procedures.

A valve from the lower Tulalip Creek pond to Tulalip Bay will be opened during incoming higher high tide, preferably in the evenings or at night when high tides occur. This will

allow for several hours of mixing of marine and fresh water prior to Chinook moving from lower Tulalip Creek pond to Tulalip Bay at high tide.

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

A thermal mark has been placed on all Tulalip Chinook since 1993. In addition, 100,000 have received unique CWT's since fingerling summer Chinook releases were initiated with the 1998 broodyear. We will continue to place differential, thermal marks on otoliths of 100% of the Tulalip Chinook production.

We will continue to coded-wire tag approximately 100,000 Skykomish Chinook per year, given that funds are available, with a target release goal of 1.7 million subyearling Chinook annually. This tagging provides for necessary assessments of directed and incidental fishery impacts on hatchery- and natural-origin Chinook and for differentiation of incidental impacts on other listed Chinook stocks, survival rates, straying rates, and hatchery- and natural-origin contribution rates to natural and hatchery escapements in the Snohomish region. These methods will continue to be evaluated through sampling of the terminal area fishery for otoliths and coded-wire tags.

All summer Chinook released from the Bernie Kai-Kai Gobin Salmon Hatchery have been mass- (otolith) marked since this stock was first released from Tulalip Hatchery in 1998. All Tulalip Chinook that will be coded-wire tagged will also be adipose fin-clipped (100,000 annually). A 2003 MOU Agreement (dated June 1, 2003) that addressed terms and conditions agreed to by WDFW and the Tulalip Tribes for mass-marking Chinook salmon at Wallace River and Tulalip Hatcheries recently expired.

However, the comanagers have agreed to new terms of a successor MOU Agreement, which is about to be signed by the parties in 2005 (dated April 7, 2005), which describes current understandings and agreements concerning summer Chinook programs at Tulalip and Wallace River Hatcheries. This MOU outlines new comprehensive hatchery protocols and changes, such as appropriate stocks to be used, mass-marking to be approved at both hatcheries, conditions and methods for conducting mass-marking, sampling, and selective fisheries, new production numbers, NOR integration, upstream passage and broodstocking protocols, etc.

Meanwhile, the comanagers are operating under the conditions of the new MOU Agreement (i.e. Tulalip mass-marked broodyear 2004 hatchery Chinook at the agreed upon 70% level in the new MOU) to continue joint hatchery operations incorporating the new, innovative changes that have addressed all or nearly all of the remaining hatchery reform issues involving Snohomish region Chinook salmon hatchery programs.

The new Agreement calls for 70% of broodyear 2004 Tulalip Hatchery Chinook and coho to be mass-marked by removal of adipose fins in addition to other marks and tags, such as

thermal otolith marks and coded-wire tags. This proportion will gradually be increased to a 100% adipose fin marking rate on Tulalip Chinook by broodyear 2011, provided certain conditions prevail as follows:

If the pre-release mortality rate of marked Chinook remains low, if excessive differential adult returns or mortalities of marked versus unmarked hatchery Chinook to the terminal area are not observed, and if significant increases in interceptions of Tulalip or Wallace River Hatchery Chinook production do not occur in fisheries north of the US/Canada border, the fraction of Chinook that are adipose fin mass-marked at Tulalip Hatchery will be increased to 80% beginning with broodyear 2008, and to 100% beginning in broodyear 2011 (exclusive of fish left unmarked due to double-index tagging or other agreed monitoring and research studies).

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

To date, no surplus fish above the release goal have been released. On occasion, egg takes may be slightly higher than the collection goals due to different inventorying methods at Wallace River and Tulalip Hatcheries. These could result in surplus egg takes and subsequent releases that are somewhat above the release goal, depending on which inventory is used. But, more often than not, natural and predator-induced mortalities during rearing are expected to result in releases that are below the release goal, which has been the case in all years to date. The four-year average release number will be $\leq$ 1.7 million.

10.9) Fish health certification procedures applied pre-release.

Monthly fish health monitoring exams, as described in Section 9.2.7, will be conducted by a fish pathologist from the NWIFC up until the time of release. Fish will be examined within two weeks of their scheduled release, but preferably after tagging, mass-adipose fin-marking and handling has been completed. The exam will include an assessment of mortality rate, fish behavior, general condition, and rearing and marking/tagging conditions. A necropsy will be performed on representative fish from the population, including moribund and dead fish if these are available. An attempt will be made to determine factors contributing to mortality or likely to contribute to mortality post-release mortality.

Parasites will be routinely screened for by microscopic examination of gills and skin. Bacterial or viral assays might be conducted at the discretion of the pathologist if there is evidence of an infectious disease problem. Depending upon the findings of the exam, a recommendation will be made to either release the fish as planned if they are healthy, or if disease or infectious fish pathogens are present, treatments will be applied as necessary to regain fish health prior to release.

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

At Tulalip Hatchery, it is possible to change or supplement the hatchery water source to protect Chinook stocks under culture. Personnel have the ability to choose from well water, west fork, or east fork Tulalip Creek water in the event of flooding, water system failure, or extreme drought. Flooding is not an issue at the hatchery or Tulalip Creek pond. However, recent droughts have caused low dissolved oxygen in lower Tulalip Creek pond, so it is possible that future droughts could necessitate aeration supplementation or even possibly premature release if flows drop extremely low and aeration cannot rectify the situation. This would only occur in the last few weeks of rearing prior to release and after the fish have already been clipped and tagged.

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.

This is program is operated like a segregated program; however, the broodstock are integrated one generation out and the program is classified as integrated. No anadromous fish inhabit Tulalip Creek. Imprinted fish are released directly into marine waters. All of the fish are marked differentially, a representative portion are coded-wire tagged, and 70% to 100% will also be externally-marked, making all of the fish identifiable as juveniles and adults. An extensive juvenile trapping program has been implemented since 2001 to identify the origins, spatial distribution, habitat use, timing, and relative occurrence of juvenile Chinook and other salmonids and fishes. Extensive adult monitoring programs have been in operation for dozens of years in the terminal area, with improved methods to estimate hatchery- and natural-origin Chinook contribution rates to fisheries, hatcheries, and natural escapement in terminal areas (Rawson, Kraemer, and Volk 2001). Marked and tagged Tulalip Chinook will continue to be identifiable by annual, standard, fishery sampling in the U.S. and Canada.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

Note: annual accomplishment of monitoring and evaluation of performance indicators is contingent on availability of funding. As of 2005, most research, monitoring, and evaluation projects have been accomplished through acquiring Hatchery Reform and BIA self-governance funds specifically dedicated for hatchery reform and rehabilitation; however, this funding has faded every year since its inception, and the future for such essential funding is very uncertain at this time. If Hatchery Reform and salmon recovery are going to be successful, funding for these important projects must continue to be provided.

Performance Indicator (Section 1.10)	**Monitoring Plan Objective** (Section 11)	**Methods/Comments** (Section 11)
On average, the estimated survival rate for Tulalip Hatchery summer Chinook will remain above 0.005 to provide: • for the recruitment of 10,000 December Age-3 fish, and • an average terminal harvest rate of > 0.95.	Overall Tulalip summer-Chinook survival rate estimates will be available from reconstructed CWT recoveries beginning with broodyear 1998.	▪ CWT recoveries will be reviewed and analyzed annually to determine adult equivalent survival rates from tagged program fish. We will develop a model to relate terminal area return by age to overall survival by assuming that pre-terminal interception rates equal those for nearby indicator stocks. ▪ Stock and age composition for the terminal area fishery will be determined from weekly sampling of the fishery for scales, CWT's, and otoliths.
The overall survival rate of summer Chinook will not be significantly less ($p < 0.10$) than the survival rate previously observed for Tulalip fall Chinook. .	Comparative survival rate estimates will be compared as adult Chinook continue to return as a result of concurrent coded-wire tagging and differential otolith marking of Tulalip summer and fall Chinook (release discontinued after 2003), which began with broodyear 1998.	▪ Coded-wire tagging of 100,000 Tulalip summer Chinook subyearlings will continue annually, provided funding remains available. ▪ All fisheries must be sampled for coded-wire tags at appropriate rates (at least a 20% sampling rate for net fisheries, and at least a 10% sampling rate for other fisheries). ▪ Otoliths must be collected from at least 100 Chinook salmon per week in the Area 8D fishery for analysis in the laboratory.

Performance Indicator (Section 1.10)	**Monitoring Plan Objective** (Section 11)	**Methods/Comments** (Section 11)
Annual fisheries plans project exploitation rates below the comanagers' guidelines for Puget Sound Chinook management units.	FRAM or successor model will be used to make annual projections of impacts.	Model inputs estimating impacts of the Area 8D fishery will be updated annually based upon results of otolith and CWT sampling and analyses (see below for otolith sampling requirement).
Post-season assessments of exploitation rates on natural-origin, listed Stillaguamish and Snohomish Chinook will be below comanagers' guidelines.	▪ Post-season analysis of coded-wire tags (from indicator stocks), combined with analysis of otoliths collected from Area 8D (from the Tulalip Hatchery stock), will be conducted. ▪ Information from past concurrent coded-wire tagging of Tulalip summer and fall groups, beginning with broodyear 1998, will also be used for this effort as return data continues to come in.	▪ All fisheries must be sampled for coded-wire tags at appropriate rates (at least 20% sampled in net fisheries, at least 10% in other fisheries). ▪ Otoliths must be collected from at least 100 Chinook salmon per week in the Area 8D fishery for analysis in the laboratory.
The proportion of Tulalip-origin spawners in natural spawning areas will remain below comanagers' guidelines.	Estimate the annual contribution of Tulalip Hatchery Chinook to natural populations such that the upper bound of the 90% confidence interval is 10% contribution when the true contribution rate is 5%.	▪ Mass-mark all Tulalip Chinook production with differential otolith marks. ▪ Collect otoliths from at least 200 Chinook carcasses per population per year in the Snohomish and Stillaguamish watersheds for mark detection. ▪ See section 12 below for further information.

Performance Indicator (Section 1.10)	**Monitoring Plan Objective** (Section 11)	**Methods/Comments** (Section 11)
Evaluate the level of interaction of Tulalip Hatchery summer Chinook releases with natural-origin juvenile salmonids. Test the hypothesis that the time of peak abundance of Tulalip summer Chinook salmon and naturally-produced salmon in local estuarine and marine waters do not differ significantly.	Estimate the abundance, temporal and spatial distribution of natural salmon populations that may be present in Tulalip Bay and other local estuarine and marine waters. Estimate the timing of natural-origin Chinook fry and smolts out-migrating from local rivers.	The Tulalip Tribes are continuing extensive monitoring of natural- and hatchery-origin juvenile Chinook and other fish species in smolt trapping studies that have been conducted since 2001/02 in the Skykomish and Snoqualmie Rivers, Snohomish estuarine fyke netting and beach seining studies in upper and lower sloughs and in the Snohomish mainstem since 2001, and in new beach seining studies in nearshore marine and pocket estuaries (including Tulalip Bay). Also, the Stillaguamish Tribe has been conducting smolt trap monitoring in the Stillaguamish River since 2001.

Analysis of the use of hatchery-origin fingerlings for smolt trap efficiency trials
Smolt trapping and estuarine surveys of juvenile salmonids and other fish species will provide additional assessment of the status of all natural and hatchery-origin fish residing in the Snohomish basin and estuary.

Chinook smolt out-migration studies are currently underway in the Skykomish, Snoqualmie, and Stillaguamish systems. These smolt trapping activities, along with ongoing studies in the Snohomish estuary and nearshore marine habitats, which include beach seining and fyke netting, will continue to provide important information on the co-occurrence, out-migration timing, relative abundances, and relative size (fork lengths, whole body weights, and condition factors).

These studies also afford unique opportunities to collect biological samples (such as otoliths, scales, tissues for DNA, stomach contents for predation studies) of listed fish, program fish, and other fish present during the out-migration or during juvenile estuarine and nearshore residency. This will enable Co-managers to assess the extent to which any overlap might occur with juvenile program fish and other fish, including listed juvenile Chinook in freshwater, the estuary, or in the nearshore environment after program fish are released.

In addition to monitoring the release and natural out-migration in the smolt trapping studies, a portion of the hatchery summer Chinook fingerling release will be retained at Tulalip Hatchery to provide fish for Chinook trap efficiency trials. A total of 6,000 marked (Bismarck Brown) fingerlings will be retained, which will be used in six trap efficiency trials of 1,000 Chinook fingerlings each; three above the Skykomish trap and three above the Snoqualmie trap. Hatchery fish will be transported from Tulalip Hatchery to locations for release above the smolt traps for trap efficiency releases that will occur between March 1 through April 30 each year.

While we will only be using 3,000 hatchery-origin Skykomish River summer Chinook in each river for trap efficiency trials, we evaluated the potential risk of these relatively small releases for up to 4,000 Chinook smolts into the Snoqualmie River that might contribute unwanted escapement of Skykomish-origin hatchery fish to the natural Chinook spawning population in the Snoqualmie. An analysis was performed to project how many of these released fingerlings might survive to contribute effective female spawners in the Snoqualmie.

As can be seen in the following text and table, an historic marine survival rate for fingerling Chinook was applied to the release of 4,000 to get recruitment prior to fisheries, followed by a fishery survival rate (1 – the projected exploitation rate), followed by a projected "stray rate" or proportion of the escapement that might return to the Snoqualmie instead of the Skykomish, followed by the historic female : male sex ratio, historic holding mortality, and projected proportion of females that might successfully mate.

The differential marine survival rate, as described on pages 29-32 in the 2003 Status Report of the Co-manager's 2003 Puget Sound Salmon Management Forecasts and Management Recommendations for the Stillaguamish-Snohomish Region (Tulalip et al. 2003), of .0043 was first applied to the release of 4,000 fingerling Chinook. Fingerling Chinook are modeled separately in the Fishery Regulation Assessment Model (FRAM) from yearlings and are forecasted separately due to different databases used in the analyses and because fish size, age, and year of release are different than yearlings. Since there were no recent coded-wire tag groups available to derive direct survival estimates for Wallace River fingerling Chinook, the fingerling chinook survival rate used in this estimate and in the 2003 forecast was based on Tulalip Hatchery fingerling releases. Adult equivalent recoveries, by age, based on coded-wire tag groups released for brood years 1986 to 1991, were used to derive a fingerling AEQ survival rate of 0.43% (Table 14; Status Report 2003).

Trap Efficiency Chinook Released Into Snoqualmie	Recruitment	Fishery Escapement	"Stray" Rate	Females entering the Snoqualmie River	Viable Female Spawners	Effective Female Spawners
Fingerling Skykomish River (Wallace River Hatchery) Chinook	Applied 0.43% historic marine survival rate, based on an AEQ recoveries, by age, of coded-wire tag groups from BY-1986-BY-1991	(Fishery Mortality @ 30%, or 70% Survival); Snohomish Chinook ceiling RER = 24%	Assumes 50% return to release stream vs imprint/ home stream	(Historic Sex Ratio; 45.6% Female)	(Historic Holding Mortality: 19.7%, or 80.3% Survival)	Proportion of females that successfully mate (assumes 50%)
4,000	17	12	6	2.7	2.2	1.1
Average natural chinook escapement to Snoqualmie River:		**1986 to 2002:**	**1427**	0.0008	= Proportion of trap efficiency fish that might contribute effective female spawners to the natural Snoqualmie River Chinook spawning population.	
		1988 to 2002:	**2356**	0.0005		

Next, a projected fishery mortality rate of 30% was inversely applied (a 70% survival rate was applied to the recruitment), followed by an assumed 50% stray rate of released fish that might return to the Snoqualmie, rather than the Skykomish where they were hatched, reared, and imprinted for the duration prior to their release, followed by the historic Skykomish summer Chinook female sex ratio of 45.6%, followed by the historic female holding mortality of 80.3%, finally followed by an assumed proportion of females (50%) that might successfully mate with other natural-origin Snoqualmie River Chinook.

The result of 1.1 projected viable female spawner was then divided into the average natural Chinook escapement into the Snoqualmie River (1986 to 2002 average is 1,427; more recent average from 1988 to 2002 is 2,356). The final projection is that the trap efficiency release of 4,000 Chinook fingerlings into the Snoqualmie River might contribute about 1 female spawner, which is approximately .0005 to .0008 of the average, natural spawning population in the Snoqualmie River.

Monitoring and evaluation will be undertaken in a manner which does not result in an unauthorized take of listed Chinook. Take guidelines for Chinook salmon juvenile trapping and seining projects have not been exceeded. For example, in the past two years of smolt trapping operations in the Skykomish and Snoqualmie Rivers, chinook mortalities

averaged less than one half of one percent of the chinook trapped (average was 6 chinook mortalities of an average of 1,544 Chinook salmon juveniles captured and released), which was .0002 of the all of the salmonids trapped (average was 6 chinook mortalities of an average of 73,825 salmonids captured and released).

River Trapped	Trapping Year	Total No. of Chinook Trapped	No. Chinook Mortalities	% Mortality of Chinook Trapped	Total No. of Salmonids Trapped	% Chinook Mortality of Total Salmonids Trapped
Skykomish	2003	3,467	14	0.40%	103,000	0.01%
Skykomish	2002	1,120	5	0.45%	176,000	0.00%
Snoqualmie	2003	911	1	0.11%	6,300	0.02%
Snoqualmie	2002	677	5	0.74%	10,000	0.05%
	Annual Means:	**1,544**	**6**	**0.42%**	**73,825**	**0.02%**
	Totals & Weighted Means:	6,175	25	**0.40%**	295,300	**0.01%**

Data provided by Tulalip Tribes from Nelson, Kelder, and Rawson (2001, 2002, and 2003). Unpublished reports.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Please see the preceding Section 11 for M&E projects that are also research projects. In addition, hatchery Chinook otolith marking and recovery M&E and research projects are being conducted, provided funding continues to be available for this, in order to distinguish juvenile and adult hatchery- and natural-origin Chinook to enable studies of ecological interactions among juvenile program and natural fish, and to measure contribution rates to fisheries, and hatchery and natural escapements.

This 100% marking, contingent on funding availability, is an essential complement to ongoing juvenile salmonid monitoring and research efforts in the river, estuary, and nearshore marine areas. It would not be possible to identify the origins of Tulalip Hatchery Chinook without differential otolith marking. Mass-adipose fin-marking does not help to accomplish essential identification of the origin of program fish. This is particularly true in the Snohomish basin or anywhere else where there are adipose-clipped program fish from more than one hatchery.

With adequate funding, the adult Chinook recovery program can continue to be implemented in the Snohomish basin to allow for evaluations of straying rates and contribution rates to fisheries and escapements. Annual accomplishment of research projects listed throughout this HGMP is contingent on availability of funding. As of 2005, most research, monitoring, and evaluation projects needed for this program have been accomplished primarily through acquiring Hatchery Reform and BIA self-governance

funds specifically dedicated for hatchery reform and rehabilitation; however, this funding has faded every year since its inception, and the future for such essential funding is very uncertain at this time. If Hatchery Reform and salmon recovery are going to be successful, funding for these important projects must continue to be provided.

Project 1. The purpose of the otolith marking and recovery project is to estimate the contribution rate of natural- and Tulalip Hatchery-origin summer Chinook to the terminal area fishery and to natural and hatchery Chinook spawning escapements in the Snohomish basin (Rawson et al. 2001).

Project 2) Juvenile smolt trapping in the Skykomish and Snoqualmie Rivers. The purpose of these projects is to annually document demographic, ecological, and biological data (estimate relative abundances, total smolt yields, migration timing, relative size: fork lengths, whole body weights, condition factors, ecological interactions, and other data pertaining to Chinook salmon, other juvenile salmonids, and other fish species out-migrating or co-occurring in the two main forks of the Snohomish River. Trap efficiency trials will be conducted with a small number of hatchery-origin fingerlings. An analysis of the potential interactions with natural-origin fish was done at the end of Chapter 11.

Project 3) Juvenile salmonid utilization of the Snohomish River estuary and nearshore marine habitats. The initial purposes of these studies were to determine if use of Snohomish River estuarine and nearshore marine habitats by juvenile Chinook salmon is correlated to life history type of the fish and attributes of the habitats. Habitat use is defined by measuring growth rates, diet, distribution, abundance, and types of habitats used. Life history patterns are indicated by both timing and fish size at upon entry to estuarine and nearshore marine habitats, and by fish origin. Attributes of habitats include the geographic position of habitat in estuarine and nearshore marine habitats, salinity, depth, and water velocity. Information is being gathered and analyzed in these monitoring and research studies on fish origins (Snoqualmie vs. Skykomish, hatchery vs wild), timing, and size of out-migrating/co-occurring juvenile Chinook, and type of sub-habitats utilized, as well as, a collection of scales and otoliths for age/origin determinations and comparisons with future samples of scales and otoliths from adult returns.

These studies are helping us to better understand and evaluate the level of interaction of hatchery-origin subyearling summer Chinook released into Tulalip Bay with natural-origin, juvenile Chinook and other juvenile fishes in estuarine and nearshore marine habitats.

Information is being gathered on relative out-migration timing, spatial overlap, and relative abundances of Tulalip summer Chinook salmon and naturally-produced juvenile Chinook salmon in the Snohomish estuary and nearshore marine areas including Tulalip Bay, which will help to assess the potential for adverse ecological interactions among natural-origin and program Chinook juveniles, such as competition or predation, upon release.
Project 4) Contribution of hatchery- and natural-origin Chinook salmon to ocean and freshwater fisheries and natural and hatchery spawning areas using egg and juvenile

program fish mass-otolith thermal-marking, coded-wire tagging, and fin-clipping concurrent with subsequent adult recoveries in fisheries and on spawning grounds.

12.2) Cooperating and funding agencies.

Please see Section 12.1 also regarding the relationship of funding to proposed research, monitoring, and evaluation programs in this HGMP. The Tulalip Tribes provide funding for all projects in this HGMP (adult otolith marking, freshwater smolt trapping, estuarine and nearshore marine trapping and seining, ecological interactions, adipose fin-marking, coded-wire tagging, and adult Chinook recovery programs in the Tribal fishery and throughout the Snohomish basin). NOAA Fisheries also provides funding for estuarine and nearshore marine trapping and seining, ecological interactions. WDFW cooperates in the otolith marking and provides a majority of the adult recovery data in hatcheries and on spawning grounds in the Snohomish basin, and participates in aspects of smolt trapping operations including providing fish for trap efficiency trials, studies of ecological interactions, adipose fin-marking, and coded-wire tagging.

Since project 1 began in 1998, funds have been provided through Pacific Salmon Treaty implementation, Hatchery Reform funding through the NWIFC, and a fishery research grant from NOAA. Some funds from the Tulalip Tribes fishery management contract with the BIA have also supported this project. The WDFW has provided brood stock collection and egg incubation, much of the adult salmon sample collection effort, and has cooperated in all phases of data analysis and interpretation. The Snohomish Public Utility District has also assisted in collecting otolith samples from adult Chinook salmon. NOAA Fisheries and the Tulalip Tribes have funded estuarine and nearshore marine sampling research, BIA Jobs in the Woods funding has supported Tulalip smolt trapping efforts, although additional funding is being sought for continuing this effort.

12.3) Principal investigator or project supervisor and staff.

Project 1) Otolith-marking and monitoring the contribution of hatchery- and natural-origin Chinook salmon to natural and hatchery spawning areas and escapement estimation for the Snohomish basin using thermal mass-marking of otoliths.

Principal Investigator: Kit Rawson, Senior Fishery Management Biologist.
Project Supervisors: Mike Crewson, Kit Rawson (Tulalip Natural Resources / Fisheries Department), Robert Skoog, Richard Young, and technician crew (Tulalip Natural Resources Department), and Aaron Bosworth (WDFW).

Project 2) Smolt trapping operations: Kurt Nelson, Kelly Henderson, Mike Crewson, Kit Rawson, Robert Skoog, and technician crew; Tulalip Natural Resources Department, Fisheries/Wildlife Department.

Project 3) Estuarine and nearshore marine environment habitat utilization and species

composition studies: Mindy Rowse and Kurt Fresh (NOAA Fisheries), Kelly Henderson, Robert Skoog, Mike Crewson, Kurt Nelson, Todd Zackey, and Kit Rawson (Tulalip Environmental / Natural Resources Department).

Project 4) Coded-wire tagging, adipose fin-marking, and adult mark/tag recoveries in fisheries and in hatchery and natural escapements. Purposes: Estimate directed and non-landed fishery mortality, conduct and evaluate DIT group performance, preserve integrity of the coded-wire tagging system, evaluate mark-selective fisheries and impacts on ESA-listed salmon stocks and other natural-origin salmonids, measure run timing, survival rates, migration patterns, and stray rates into other watersheds: Kit Rawson, Mike Crewson, and technician crew (Tulalip Natural Resources/Fisheries Department), Aaron Bosworth, Doug Hatfield, Ed Eleazer, Darin Combs, and technician crew (WDFW).

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

See Section 2 for the status of regional natural stocks affected by this program. Wallace River and Tulalip Hatchery summer Chinook stocks were categorized as Class 2a and 2b stocks, respectively, denoting that they are not substantially diverged from the local natural population and that they are part of the ESU.

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

For Project 1, otoliths of developing embryos will be thermally marked after their eye pigment becomes visible in incubating eggs and in newly-hatched alevins while they are held in hatchery incubators, by applying regular patterns of temperature variation in the water. Otoliths will be identifiable as to hatchery of origin and broodyear. Otoliths will be extracted from adult fish taken in the terminal area fishery, from carcasses on the spawning grounds, and from hatchery broodstock at Wallace River Hatchery. No live fish will be sampled for otoliths. Otoliths will be stored in 95% ethanol and later shipped to the WDFW Otolith Laboratory, where unique thermal marks will be identified using a compound microscope.

Publications, annual reports, draft summary reports, Biological Assessments and Opinions are available with these details for the other projects.

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

Otolith marking will occur during and after egg and alevin incubation at Tulalip Hatchery (November through January each year). Fishery sampling will occur from July through September annually. Spawning population sampling will occur from September through October each year. Sampling plans for the other studies were previously described and included in the aforementioned reports and assessment documents.

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

Live, eyed Chinook eggs will be thermally-marked according to standard methods developed by the WDFW Otolith Laboratory. Thermal marking patterns on otoliths will be made by temporally controlling periods of incubation water temperature change ($\Delta \approx 3.5$ °C), alternated by periods of normal water temperature. Care and maintenance of live fish, eggs, holding durations, transport methods, and other details for the other studies were previously described and included in the aforementioned reports and assessment documents.

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

Expected take of listed fish will be minimal or zero in research projects. Take of listed adult Skykomish Chinook salmon for broodstock integration at Wallace River Hatchery is not projected to impede salmon recovery efforts for the Skykomish population. Evaluations were considered such as MSY escapement requirements for specific subwatersheds that would be principally affected by natural spawner broodstock collection for integration under current conditions using EDT, as described further in Sections 6.2.3 and particularly in Section 6.3.

Fishery and hatchery rack sampling involves zero take of listed populations. Spawning ground sampling will be conducted either from rafts, which have zero mortality, or by foot surveys, which involves no or very minimal mortality due to possible disturbance of Chinook redds. Samplers are aware of the location of natural Chinook redds and make every effort to avoid these during sampling of carcasses. Overall mortality to listed populations will be negligible from these projects or other actions described in this HGMP.

Expected type and effects of take and potential for injury or mortality related to the other research projects described above in this section were previously described and included in the aforementioned reports and assessment documents, and in the Wallace River Hatchery fingerling and yearling summer Chinook HGMP's.

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).

Negligible, please see above. See Sections 6.2.3 and 6.3 for specific Chinook broodstock collection goals, methods, and evaluations.

12.10) Alternative methods to achieve project objectives.

Not applicable. Conducting no M&E and research actions was the previous alternative, which was rejected and replaced with the Hatchery Reform monitoring projects described above.

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

Negligible mortality will occur to any species due to these research projects. Negligible mortality of other juvenile salmonids is thoroughly documented in the smolt trapping and estuarine trapping and seining projects.

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.

Samplers conducting foot surveys on the spawning grounds are trained to recognize and avoid natural redds and live fish. Risk aversion measures to minimize adverse effects to listed fish as a result of the proposed research activities were previously described above or in the aforementioned reports and were specified in the assessment documents.

SECTION 13. ATTACHMENTS AND CITATIONS

Bilby, R.E., B.R. Fransen, and P.A. Bisson. 1996. Incorporation of nitrogen and carbon from spawning coho salmon into the trophic system of small streams: evidence from stable isotopes. Can. J. Fish. Aquat. Scit. 53: 164-173.

Buckley, R. 1999. Incidence of Cannibalism and Intra-generic Predation by Chinook Salmon in Puget Sound, Washington. Progress Report for Washington Department of Fish and Wildlife, Resource Assessment Division, RAD 99-04. Olympia, WA.

Fausch, K.D. 1988. Tests of competition between native and introduced salmonids in streams: what have we learned? Canadian Journal of Fisheries and Aquatic Sciences 45:2238-2246.

Gregory, S.V., G.A. Lamberti, D.C. Erman, K.V. Koski, M.L. Murphy, and J.R. Sedell. 1987. Influence of forest practices on aquatic production. In E.O. Salo and T.W. Cundy (editors), Streamside management: forestry and fishery interactions. Institute of Forest Resources, University of Washington, Seattle, Washington.

Griffith, J., R. Rogers, J. Drotts, and P. Stevenson. 2001. 2001 Stillaguamish River smolt trapping project. Stillaguamish Tribe of Indians, Arlington, Washington.

Griffith, J., R. Rogers, J. Drotts, and P. Stevenson. 2003. 2002 Stillaguamish River smolt trapping project. Stillaguamish Tribe of Indians, Arlington, Washington.

Griffith, J. N., J. Drotts, R. Rogers, and P. Stevenson. 2004. 2003 Annual Report of smolt trapping operations on the Stillaguamish River. Stillaguamish Tribe of Indians.

Kline, T.C., J.J. Goring, Q.A. Mathisen, and P.H. Poe. 1997. Recycling of elements transported upstream by runs of Pacific salmon: I d15N and d13C evidence in Sashin Creek, southeastern Alaska. Can. J. Fish. Aquatic Sci. 47: pp136-144.

Krahn, M. M., P. R. Wade, S. T. Kalinowski, M. E. Dahlheim, B. L. Taylor, M. B. Hanson, G. M. Ylitalo, R. P. Angliss, J. E. Stein, and R. S. Waples. 2002. Status Review of Southern Resident Killer Whales (*Orcinus orca*) under the Endangered Species Act. U. S. Dept. of Commerce, NOAA Technical Memorandum NMFS-NWFSC-54, Washington, DC, 133 pages.

Levy, S. 1997. Pacific salmon bring it all back home. BioScience 47: pp 657-660.

Mathisen, O.A., P.L. Parker, J.J. Goering, T.C. Kline, P.H. Poe, and R.S. Scalan. 1988. Recycling of marine elements transported into freshwater systems by anadromous salmon. Verh. Int. Ver. Limnol. 23: pp 2249-2258.

SECTION 13. ATTACHMENTS AND CITATIONS (CONTINUED)

Nelson, K. and K. Rawson. 2001. 2000 Skykomish River Chinook and coho outmigration study, annual report No. 01-1. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K. and B. Kelder. 2002. 2001 Snoqualmie River Chinook and coho out-migration study, annual report No. 02-5. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K., B. Kelder, and K. Rawson. 2003. 2001 Skykomish River Chinook and coho out-migration study, annual report No. 03-6. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K. and B. Kelder. 2004a. 2002 Snoqualmie River Chinook and coho out-migration study, annual report No. 04-1. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K. and B. Kelder. 2004b. 2003 Snoqualmie River Chinook and coho out-migration study, annual report No. 04-3. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K. and B. Kelder. 2005a. 2002 Skykomish River Chinook and coho out-migration study, annual report No. 05-1. Tulalip Natural Resources Department, Tulalip, WA.

Nelson, K. and B. Kelder. 2005b. 2003 Skykomish River Chinook and coho out-migration study, annual report No. 05-3. Tulalip Natural Resources Department, Tulalip, WA.

NWIFC and WDFW. 1998. Salmonid Disease Control Policy of the Fisheries Comanagers of Washington State. Northwest Indian Fisheries Commission and Washington Department of Fish and Wildlife. Revised March 17, 1998. 22pp.

Osborne, R. W. 1999. A historical ecology of Salish Sea "resident" killer whales (Orcinus orca) with implications for management. PhD dissertation. University of Victoria, Victoria, British Columbia.

Puget Sound Indian Tribes, and Washington Department of Fish and Wildlife. 2004. Comprehensive management plan for Puget Sound Chinook: Harvest management component. Northwest Indian Fisheries Commission, Olympia, Washington, USA, 247 pages.

SECTION 13. ATTACHMENTS AND CITATIONS (CONTINUED)

Puget Sound Salmon Management Plan. 1985. United States vs. Washington. 1606 F. Supp. 1405.

Rawson, K, C. Kramer, and E. Volk. 2001. Estimating the Abundance and Distribution of Locally Hatchery-Produced Chinook Salmon Throughout a Large River System Using Thermal Mass-Marking of Otoliths. NPAFC Technical Report No. 3. Pp. 31-34.

Rawson, K. 2000. Stillaguamish Summer Chinook: Productivity Estimates from Coded-Wire Tag Recoveries and A Simple Model for Setting Interim Exploitation Rate Objectives. Tulalip Fisheries, 7615 Totem Beach Rd., Marysville, WA 98271.

Ruckelshaus, M., K. P. Currens, R. Fuerstenberg, W. Graeber, K. Rawson, N. J. Sands, and J. B. Scott. 2004. Independent populations of Chinook salmon in Puget Sound. Draft report. National Oceanographic and Atmospheric Administration (NOAA), Northwest Fisheries Science Center, Seattle, WA,. http://research.nwfsc.noaa.gov/cbd/trt/popid.pdf.

Salmon and Steelhead Inventory (SaSI). 2002. Salmon and steelhead inventory - 2002. Introduction, Summary Tables, and North Puget Sound, South Puget Sound, Hood Canal and Strait of Juan de Fuca volumes. Fish Program, Science Division. Washington Department of Fish and Wildlife. Olympia, WA.

Slaney, P.A., B.R. Ward. 1993. Experimental fertilization of nutrient deficient streams in British Columbia. In G. Schooner and S. Asselin (editors), Le developpmente du saumon Atlantique au Quebec: connaitre les regles du jeu pour reussir. Colloque international e la Federation quebecoise pour le saumon atlantique, p. 128-141. Quebec, decembre 1992. Collection Salmo salar no1.

Slaney, P.A., B.R. Ward, and J.C. Wightman. 2003. Experimental nutrient addition to the Keogh River and application to the Salmon River in coastal British Columbia. In J.G. Stockner,(editor), Nutrients in salmonid ecosystems: sustaining production and biodiversity, p. 111-126. American Fisheries Society, Symposium 34, Bethesda, Maryland.

Snohomish Basin Salmon Recovery Forum. 2005. Snohomish River Basin Salmon Conservation Plan. Snohomish County Department of Public Works, Surface Water Management Division, Everett, WA.

SECTION 13. ATTACHMENTS AND CITATIONS (CONTINUED)

Snohomish Basin Salmonid Recovery Technical Committee. 1999. Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan. Snohomish County Surface Water Management, 2731 Wetmore Ave. Ste. 300, Everett, WA 98201-3581.

Stillaguamish Implementation Review Committee (SIRC). 2005. Stillaguamish Watershed Chinook Salmon Recovery Plan. Snohomish County Department of Public Works, Surface Water Management Division, Everett, WA.

Tulalip Tribes and Washington Department of Fish and Wildlife. 1981. An Agreement Between the Tulalip Tribes and the Washington Department of Fisheries Concerning the Tulalip Tribes Salmon Hatchery. Tulalip Indian Tribes, 7615 Totem Beach Road, Tulalip, WA 98271-9714.

Tulalip Tribes and Washington Department of Fish and Wildlife. 1997. Memorandum of Understanding. Tulalip Tribes, 7515 Totem Beach Road, Tulalip, WA 98271-9714.

Washington Department of Fisheries, the Stillaguamish Tribe, and the Tulalip Tribes. 1992. Draft Stillaguamish/Snohomish Equilibrium Brood Document. Tulalip Tribes, 7515 Totem Beach Road, Tulalip, WA 98271-9714.

Snohomish Basin Salmonid Recovery Technical Committee. 1999. Initial Snohomish River Basin Chinook Salmon Conservation/Recovery Technical Work Plan. Snohomish County Surface Water Management, Everett, WA.

U.S. District Court of Western Washington. 1976. United States v. Washington, 384 F, Supp. 312.

United States v. Washington, No. 9213 Phase 1 (sub no. 85-2) Order Adopting Puget Sound Management Plan, 1985

Ward, B.R., D.J.F. McCubbing, and P.A. Slaney. 2003. Evaluation of the addition of inorganic nutrients and stream habitat structures in the Keogh River watershed for steelhead trout and coho salmon. . In J.G. Stockner,(editor), Nutrients in salmonid ecosystems: sustaining production and biodiversity, p. 127-147. American Fisheries Society, Symposium 34, Bethesda, Maryland.

Washington Department of Fish and Wildlife and Tulalip Tribes. 1997. Memorandum of Understanding (MOU). Olympia, Washington.

SECTION 13. ATTACHMENTS AND CITATIONS (CONTINUED)

Washington Department of Fish and Wildlife and Puget Sound Treaty Tribes, 2002, "Puget Sound Chinook Salmon Hatcheries, Resource Management Plan", a component of Comprehensive Chinook Salmon Management Plan, August 23, 2002. 103 pages.

Wipfli, M.S., J. Hudson, and J. Caouette. 1998. Influence of salmon carcasses on stream productivity: response of biofilm and benthic macroinvertebrates in southeastern Alaska, U.S.A. Can J. Fish. Aquatic Sci. 55: pp 1503-1511.