HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

US/Canada Chinook Indicator Stock
Study and Restoration Program

Stillaguamish Summer/Fall Chinook

Stillaguamish Tribe

Stillaguamish Watershed
Puget Sound ESU

April 27, 2002
Modified: March 2, 2003

Version 2

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Stillaguamish US/Canada Chinook Indicator Stock Study and Restoration Program

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

Currently, only North Fork Stillaguamish Native summer chinook (Oncorhynchus tshawytscha) are under propagation. This stock is part of the listed Puget Sound ESU. Co-managers are evaluating the stock status, productivity and supporting environmental conditions for South Fork Stillaguamish fall chinook to determine the need for a natural stock restoration for the South Fork population.

1.3) Responsible organization and individuals

Indicate lead contact and on-site operations staff lead.
Name (and title): John Drotts, Natural Resources Director
On site lead: Kip Killebrew, Enhancement Biologist
Agency or Tribe: Stillaguamish Tribe
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Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:

The Washington State Department of Fish and Wildlife are co-operators with the Tribe through their involvement in providing the final acclimation and release location (Whitehorse Hatchery) for chinook from the Tribe's indicator stock study and restoration program.

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

Bureau of Indian Affairs 638 Funding-$105,000; US/Canada Indicator Stock Funding-$51,940. Hatchery staff include a enhancement biologist, hatchery manager and fisheries technician/office support person.

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

The following hatcheries are located within the Stillaguamish watershed (WRIA 05):

Stillaguamish Tribe's Harvey Creek Hatchery located 2 miles upstream of the mouth of Harvey/Armstrong Creek (WRIA 05.0126), which is located 15.3 miles upstream of the mouth of the Stillaguamish main stem (05.0001). Adult holding, spawning, incubation and early rearing occur at this facility.

Washington State Department of Fish and Wildlife's Whitehorse Hatchery located 1.5 miles upstream of the mouth of Whitehorse Springs Creek (WRIA 05.0254A), which is located 28 miles upstream of the confluence of the North Fork Stillaguamish (WRIA 05.0135) and the main stem Stillaguamish (WRIA 05.0001). Tagging and final rearing and release occur at this facility.

1.6) Type of program.

The Stillaguamish US/Canada Indicator Stock Study and Chinook Natural Stock Restoration Program are classified as an Integrated Recovery Program.

1.7) Purpose (Goal) of program.

The goals for this program are to provide technical information on harvest rates and locations, migration timing, and productivity for north Puget Sound summer/fall natural chinook populations and to insure the short-term preservation and long term restoration of the native Stillaguamish chinook populations/stocks to levels that will sustain fisheries, non-consumptive fish benefits and other related cultural and ecological values (STAG,2000).

In the context of these goals, it is possible that this program may transition from an integrated recovery program to an integrated harvest program and over time, when habitat recovery is complete be terminated all together.

This transition, from an integrated recovery to integrated harvest program, would occur in a situation where the natural population(s) have recovered enough natural productivity to have some level of stability above the critical population level, but not enough productivity to support directed fisheries on the populations. When this interim productivity level is reached, the natural stock restoration program would transition to an integrated harvest program contingent upon the implementation of selective, low impact commercial/tribal fisheries such as fish wheels, weirs, set net traps, tangle nets etc. and harvest rates being set at levels which do not impede the continued recovery of the natural population.

1.8) Justification for the program.

The indicator stock/restoration program will benefit the survival of the listed natural populations by increasing the general knowledge about harvest rates, migration and productivity information for north Puget Sound natural summer/fall chinook stocks. Specifically, it will help to provide all of the above information for North Fork Stillaguamish summer chinook, and in addition increase the total abundance of the population through the increased egg to smolt survival of the program fish (typically 70-80%). By comparison, egg to smolt survival for wild Skagit chinook outmigrants ranges from less than 1% during extreme flooding to 15% for optimal flow conditions (Seiler et al. 1998).

Progeny from the program have made up 30-60% of the returning natural spawners to the North Fork Stillaguamish (Rawson, 2000; Appendix A).

In the Washington State Conservation Commission's 2496 Limiting Factors Report for the Stillaguamish, technical staff from throughout the watershed identified 4 major factors limiting chinook salmon production and recovery in the Stillaguamish. Those factors included peak/low flow hydrology problems, elevated levels of fine sediment, loss of side channel habitat and high summer water temperatures (2496 Report, 1999).

7 out of 10 years during the 1980-90 period, fish have not been able to replace themselves due to poor productivity (Beamer et al, 1999). In comparing historic peak flows from the 1928-49 period to the period from 1972 to current, the 20-year flood event has now become the 2-year event. In comparing the 1950-71 peak flow period to the 1972 to current flow regime, the 5-year event has become the 2-year peak flow event (Beamer et al. in prep. .Appendix B) In any given year, there is a 50% probability that peak flows during incubation will reduce productivity to a level below that required for population replacement (Beamer et al. in prep). Sediment levels have increased between 200 to 1300% during peak flows (Beamer et al.1999). Over 1000 landslides within the basin have slipped more than 3 million cubic yards of sediment into the Stillaguamish (Perkins and Collins, 1997; Appendix C). Increased flows combined with increased sediment supplies have resulted in increases of up to 100% in bed elevation changes and 10 of the 14 largest flow events on record. These changes have resulted in a decrease in residual pool depth and an increase of up to 100% in potential scour and fill (PMFC, Pess and Benda, 1997). Increases in peak flow events over the last 20 years have occurred during a time that climatologists have characterized as warm and dry (Taylor and Mote, 1999). Even without any kind of harvest, Stillaguamish chinook would of made escapement only 3 out of the last 17 years (PMFC, 1997).

Preliminary analysis of broodstock sizes, escapements and tag returns by Michael Ford of National Marine Fisheries Service indicated that spawner to spawner ratios for project fish were approximately 8.0, 2.7 and 2.2 for brood years 1989, 1990 and 1991 respectively. While natural return ratios for the same brood years were approximately .9, .6 and .6 respectively (Appendix D).

In addition to increasing the total abundance of chinook, the program should also increase the number of natural origin recruits.

1.9) List of program "Performance Standards".

The goals for this program are to provide technical information on harvest rates and locations, migration timing, and productivity for north Puget Sound summer/fall natural chinook populations and to insure the short-term preservation and long term restoration of the native Stillaguamish chinook populations/stocks to levels that will sustain fisheries, non-consumptive fish benefits and other related cultural and ecological values (Stillaguamish Chinook Technical Recovery Framework, 2000 (SCTRF, 2000).

The following performance standards, indicators, and monitoring criteria are adapted from work by Marianna Alexandersdottir of the Northwest Indian Fisheries Commission and Production Review Committee of the Northwest Power Planning Council.

Specifically, the **performance standards** for the program are the conservation of genetic and life history diversity through the increasing total abundance of the composite population(s), where the increasing trend of NOR's is estimated to be greater than would of occurred without the program, and the resulting returning adults are genetically similar to those fish in the historic/baseline natural population(s). By rebuilding the natural spawning population(s) to a stable level above the critical point and with an increasing population trend line, the co-managers, in the short term, would transition to an integrated hatchery program where some limited level of harvest could occur without impeding recovery. As natural runs continue to rebuild to healthy sustainable populations, the natural stock restoration and integrated harvest programs would no longer be needed to support directed fisheries on the population(s).

1.10) "Performance Indicators" addressing benefits and risks.

See Table Below

Stillaguamish North Fork summer chinook - Integrated Recovery. Assist the recovery of summer chinook and maintain genetic diversity of naturally spawning populations.

Management Issues and Questions	Performance Standard	Performance Indicator	Comments – Monitoring program requirements
Are the program benefits being achieved?			
What are the measures of success for the program?	Achieve a natural origin (NOR) escapement of 700 fish for four consecutive years. If NOR escapement is below 500 for four consecutive years the program would be increased	Estimate escapement of summer chinook by origin (hatchery or natural spawner) in North Fork	1. Estimation of total escapement a. Survey method, counting spawning fish b. Broodstock counted as sampled 2. Estimate hatchery vs. natural origin spawners' a. All hatchery fish are tagged b. Broodstock and spawning fish are sampled for tags.
	Habitat is able to support population	Habitat indicators	Reference to Stillaguamish technical advisory group (STAG) report. Sept. 2000[1]
Is the hatchery program providing a buffer for catastrophic events in habitat during duration of NOR in freshwater?	The recruits per spawner for the hatchery origin chinook are above 2.0.	Estimate the recruits per spawner for natural and hatchery origin fish.	1. Estimation of total return and location of spawning for each group, hatchery and natural origin 2. requires a tag group and estimation of exploitation rates Hatchery fish are tagged 3. All fisheries and spawning escapement sampled
	The natural smolts per spawner is monitored	Estimate index of abundance of natural smolts per spawner for natural origin chinook	1. Juvenile trap provides an estimate of abundance of outmigrating natural smolts. 2. Natural and hatchery origin smolts can be separated due to mark on hatchery fish.
What are the genetic effects on the naturally spawning population?			
How is effective population size and genetic diversity affected?	Contribution rates of hatchery origin adults to the naturally spawning population are representative of total population.	Estimate contribution rate of hatchery adult returns to naturally spawning population	1. Mark on all hatchery releases 2. Sample spawning population for marked fish 3. Estimate total escapement
	Contribution rates of natural origin adults to the	Estimate contribution rate of hatchery adult returns to hatchery broodstock.	1. Mark on all hatchery releases 2. Sample broodstock for marked fish

[1] STAG. 2000. Technical assessment and recommendations for chinook salmon recovery in the Stillaguamish watershed. 135pp.

Management Issues and Questions	Performance Standard	Performance Indicator	Comments – Monitoring program requirements
	broodstock are representative of total population.		
	Genetic diversity of the composite spawning population is maintained.	Estimate genetic diversity for hatchery broodstock and naturally spawning populations.	Indicators for genetic diversity in the hatchery and natural populations will be measured using morphometrics and genetic sampling.
Are rearing and release strategies producing fish that will be successful in the wild?			
Hatchery operations are successful	Egg to release survival is over 70%, and total production is 220,000	Estimate egg to release survival in hatchery	In-Hatchery monitoring plan
Are hatchery fish in the same health condition as wild fish at release	Hatchery fish are in the same health condition as wild fish	Monitor health of hatchery and wild fish	1. Wild fish are sampled by USFWS at smolt trap (up to 50 smolts) 2. NWIFC also monitors hatchery fish health monthly.
Do hatchery and natural origin chinook have similar life-history and morphological characteristics?	Size composition of hatchery releases are similar to the natural origin juveniles	Estimate the size distribution of hatchery and natural juveniles and test the null hypothesis that they are not significantly different.	1. Measure juveniles prior to release 2. Sample and measure natural and program origin juveniles, at smolt trap
	Time of release and outmigration are similar for hatchery and natural origin juveniles	Estimate the mean and variance of outmigration for both components of the total outmigration and test the hypothesis that there is no difference.	1. Sample at smolt trap juveniles during outmigration for tags.
		Estimate the proportion of natural and hatchery origin fish that are yearling	1. Estimate % outmigrants that are yearling by size, and estimate % yearling that are program fish by wanding. 2. Estimate % yearling in adult return using scales, and estimate % that are hatchery origin wanding. .
	Age and sex composition of adult returns are similar to the natural origin adults	Estimate the age and sex composition of hatchery and natural adult returns and test the null hypothesis that they are not significantly different.	1. Sample hatchery and adult returns for age and sex status. Requires a weighted sampling scheme as broodstock and spawning adults are sampled separately. 2. Identify all hatchery fish by tag status.

Management Issues and Questions	Performance Standard	Performance Indicator	Comments – Monitoring program requirements
	Time of adult spawning of hatchery and natural origin adults are similar	Estimate the mean and variance of adult spawning time for hatchery and natural origin fish and test the null hypothesis that they are not significantly different.	Use carcass sampling to estimate spawning times for spawners on the spawning grounds.
	Hatchery and natural origin chinook are distributing over same areas for spawning	Estimate the proportional distribution of hatchery and natural origin spawning adults and test the hypothesis that they are not significantly different.	1. Spawner surveys collect tag data by reach in the river 2. Hatchery origin fish are marked
Is the broodstock collected so that life-history traits are preserved?	The age, sex and size compositions of the broodstock are similar to the total escapement.	Estimate the age and sex composition of hatchery and natural origin broodstock and test the null hypothesis that they are not significantly different. .	1. All hatchery origin fish are marked 2. All broodstock are sampled for age and sex by origin. 3. Spawning surveys collect data on age, sex, size and location.
Are there impacts on other chinook populations?			
What is the stray rate to South Fork chinook spawning areas?	The South Fork chinook spawners are not impacted by North Fork hatchery returns	Estimate the contribution of NF summers to SF spawners	1. Requires sampling of SF chinook spawners

1.11) Expected size of program.

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

During typical marine, estuarine and freshwater temperature conditions, the target is to obtain 65 males and 65 females, with a release goal of 220,000. When stressful/lethal warm water conditions exist in the ocean, estuarine and freshwater (Appendix G), the target broodstock level is increased to 75 males and 75 females to meet the 220,000 fish-tagging goal with reduced survival levels.

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location. (*Use standardized life stage definitions by species presented in* Attachment 2).

Life Stage	Release Location	Annual Release Level
Eyed Eggs		
Unfed Fry		
Fry		
Fingerling	WDFW Whitehorse Hatchery North Fork Stillaguamish	220,000 for volitional release during the months of April, May and June with fish ranging between 150 to 80 fish per pound.
Yearling		

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

Stillaguamish chinook abundance (1980-1997) has ranged from a low of 350 to high of 1600. 1976 was the last year that an escapement of 2000 was met with 1984 being the low escapement of 350. A steep decline in escapement from 1976 to 1984 has rebounded to escapements averaging 900 from 1985 through 1993. A natural stock restoration program was implemented in 1986. Currently, the restoration program fish make up 30% to 60% of the escapement to the North Fork Stillaguamish. The majority (80%) of Stillaguamish River chinook production occurs in the North Fork Stillaguamish. Limited spawning occurs in Boulder River and Squire Creek, which are tributaries to the North Fork.

The south fork of the Stillaguamish is estimated to produce on average 20% of the total chinook production for the watershed. That production is made up of later timed chinook that are currently identified as a fall component.

North Fork Summer Chinook
Reconstruction of total recruitment and recruits per spawner(Rawson, Appendix A)

Brood Year	Original Escapement	Subsequent Escapement	Broodyr Exp. Rate	Recruitment	Recruits Per Spawner
1986	980	505	.66	1,505	1.54
1987	1,065	695	.46	1,278	1.20
1988	516	654	.64	1,832	3.55
1989	537	458	.82	2,544	4.99
1990	575	488	.67	1,457	2.53
1991	1,331	486	.53	1,040	.78
1992	486	596	.38	959	2.06
1993	583	585	.50	1,165	2.07

North Fork Summer Chinook
Natural and Program Fish Survival Rates (Rawson, Appendix A)

Broodyear	Recruits per spawner	Supplementation Survival Rate
1986	1.54	1.31%
1987	1.20	0.63%
1988	3.55	1.10%
1989	4.99	0.97%
1990	2.53	1.70%
1991	0.78	0.09%
1992	2.06	0.31%
1993	2.07	0.40%

Program goals are to ensure that the spawner replacement ratio is higher for the artificially propagated fish than for the wild fish, total abundance of chinook increases and natural origin recruits numbers increase. Preliminary draft analysis by Michael Ford indicates that spawner replacement goal was being met for the 1989-91 broodyears (See Draft Risk Assessment, Appendix D). Although the total increase in abundance has marginally improved, the Stillaguamish chinook populations have not seen a similar decline in total numbers that other adjacent watershed have during the same period. Research by Beamer and Pess have documented that peak flow events have reduced spawner numbers for natural fish below replacement levels for 7 of the ten years between 1980-92.

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

Small-scale releases using native broodstock were initiated during the 1981-83 period. The US/Canada Chinook Indicator Stock Program and the Stillaguamish Chinook

Natural Stock Restoration Program began in 1986.

1.14) Expected duration of program.

The short term interim time frame for the program is 8 to 12 additional years to rebuild the North Fork natural spawner population to a level where there are 4 consecutive years with natural origin recruit spawner escapements of 700 fish or greater. When this interim target is met, the co-managers will evaluate stopping the natural stock restoration program to assess the stock's ability to recover naturally (STAG, 2000).

Depending on co-managers evaluation of the population's ability to recover itself, a decision may be made to transition the natural stock restoration program to an integrated hatchery program.

The long term time frame for the program is that it will continue either as a natural stock restoration program or an integrated hatchery program until such time as the natural spawning chinook populations/stocks have increased to self sustaining levels that will sustain fisheries, non consumptive fish benefits and other related cultural and ecological values (STAG, 2000).

1.15) Watersheds targeted by program.

The Stillaguamish watershed (WRIA 05) is the targeted watershed for this program. The current focus of the program is the North Fork Stillaguamish (WRIA 5.0135) and it's tributaries.

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

The main alternative to the natural stock restoration program is the recovery of natural production through improved habitat conditions and reduced harvest. Reduced harvest levels on these stocks have been in place since 1991 without significant improvements to overall escapement (Rawson, pers.comm.2000). Further reductions have been implemented and are scheduled (see section 3.3). The watershed is characterized as a low elevation basin situated in geologically unstable glacial deposits with one third of the watershed in the rain on snow zone. Basin wide habitat degradation has resulted in only 11% of the Stillaguamish riparian forests being intact and in a fully functioning condition. Eleven of the 27 sub-basins identified in the Stillaguamish watershed have more than 70% degraded riparian forests. Eight of these sub-basins have more than 90% riparian degradation(Pollack, 1997; (Appendix C). Greater than 70% of the whole watershed had been logged at least once since the turn of the century (Pollack, 1997). Loss of riparian function has impacted basin hydrology resulting in the 20 year flood event that existed in 1928-49 period now being the 2 year flood event (Beamer et.al. in prep.) In conjunction with increased surface flows and decreased riparian cover, 1000 landslides have developed inputting over 3 million cubic yards of sediment into the

Stillaguamish and it's tributaries (Perkins and Collins, 1997).

Changes in hydrology and sediment levels have impacted channel morphology reducing pool frequency and depth, increasing channel width, increasing scour and fine sediment entombment and increasing summer low flow temperatures.

Expected climate changes over the next 15-30 years to warmer and wetter conditions(Taylor and Mote, 1999) have a high probability of exacerbating current hydrology and sedimentation problems within the basin (Killebrew, pers.comm.).

Both the riparian degradation and landslide activity are basin wide and will require an extended time period to recover/restore and extensive amounts of money. Hydrologic function and root strength are not fully restored to stands of timber until they reach a minimum of 25-50 years of age.

Initial restoration and recovery plans are being implemented and additional basin wide plans are under development. However, the watershed scale of habitat degradation combined with the cost to restore impacted habitat will limit the speed of recovery. The natural stock restoration program is intended to support natural spawning within the basin until such time that survival and productivity improve to self-sustaining, healthy levels.

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

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

Finalized HGMP will be used to implement 4 (d) rule.

Authorizations include the Puget Sound Salmon Management Plan and the Boldt decision.

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

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

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

The following stock descriptions are taken directly from the Stillaguamish Technical Chinook Recovery Framework developed by the Stillaguamish Technical Assessment Group.

STILLAGUAMISH CHINOOK STOCK DESCRIPTION

The Stillaguamish chinook have been divided into two distinct stocks (SASSI, 1993). These are a summer stock and a fall stock. This division was based on spawning timing and differences in geographical distribution. Subsequent genetic work has confirmed the validity of this separation. The summer stock is found in the North Fork of the Stillaguamish while the fall stock found primarily in the South Fork. The Stillaguamish chinook have been managed for natural production with a combined escapement goal of 2,000 adults for the two stocks.

The adults from the summer stock are seen in the North Fork as early as late May with numbers of adults increasing through July and August. Spawning activity begins in late August; usually around the 25^{th}. Spawning peaks about mid-September and continues past mid-October. The fish are found through out the North Fork (RM 0.0 to 34.4) as well as the larger tributaries. The bulk of the spawning occurs in the main North Fork between RM 14.3 and 30.0 (Deer Creek to Swede Heaven bridge). Boulder River and Squire Creek are the two most important spawning tributaries though chinook are also found in French, Deer, and Grant creeks; especially during wetter falls when tributary flows are up.

The summer stock generally makes up about 80% of the total Stillaguamish basin chinook escapement. The status of this population was classified as Depressed in the 1993 SASSI effort. The escapement goal for the basin has not been met since 1976. Escapements since 1993 have not improved significantly; especially when the escapement of just naturally produced fish is examined. It appears that in spite of the ongoing supplementation effort the population is just holding stable. It is too early to tell with any certainty that the recent (1998 and 1999) reduction in fishing rates with lead to increased escapements thought that is certainly the hope.

The life history of the summer stock in particular and the Stillaguamish chinook in general is typical of most Puget Sound stocks. Puget Sound chinook have been classified as having an ocean type life history (nearly all the rearing occurs in the marine environment). This is contrasted with populations with stream type life histories; that is extended (a year or more) fresh water rearing, (an example of this type of population would be fish from the Upper Columbia). The vast majority (about 95%) of the young Stillaguamish chinook migrate as smolts within a few months of hatching. The out migration begins in February and continues through spring with a few continuing their out migration through August. These young migrating smolts are often call fry (little in river growth), fingerling (some in river growth), age 0 and/or sub 1s (migrating during the first growing season at less than 1 year of age). The reminder of the population (about 5%) migrate after a full year of rearing in the river and are typically called yearlings, age 1 and/or sub 2s. The yearling out migration is typically later than the younger fish with most of it occurring during April, May and June.

The fall stock is found in the main stem river, South Fork, Jim Creek, Pilchuck Creek, and lower Canyon Creek. The river entry timing of these fish is much later than that of the summers with most fish entering the system in August and September. Spawning typically takes place from mid-September through October with peak activity in early to mid-October. The origin of the Stillaguamish fall chinook is unknown. Their origin is confounded by the regular releases of "Green River type" fall chinook from the late 1950's to the early 1970's. The impacts from these releases are unknown. In the last twenty-five years there have been no releases except from the Stillaguamish tribal facility, which has generally worked North Fork summers. The fall population generally accounts for about 15% to 20% of the basin's escapement. The status of this population is also classified as depressed based on chronically low escapements.

Whenever chinook populations in the North Puget Sound region is discussed the question of whether or not spring chinook exist in the basin comes up. The anecdotal reports indicate that spring chinook may have been present in the Stillaguamish system. Today there are no documented spring chinook populations in the basin though occasional early redds have been seen in Canyon Creek; an area of reported possible spring chinook use. It is unclear whether the fish reported in the river in the spring of the year were true spring chinook or just the first of the entering summer chinook. As mentioned previously adults thought to be summer fish are seen in the North Fork consistently in late May or early June. There is little habitat in the Stillaguamish basin that one would classify as typical spring chinook habitat except possibly the upper reaches of Canyon Creek and the South Fork above Granite falls; an area above historical anadromous fish use.

GENETIC INFORMATION

In discussing the genetic diversity of salmon populations they are typically broken into broad categories. The first is call **stock** which is defined as "a group of interbreeding individuals that is genetic distinct and substantially reproductively isolated from other such groups". The next level of the hierarchy is **genetic diversity unit** (GDU) which is defined as "a group f genetically similar stocks that is genetically distinct from other such groups. The stocks typically exhibit similar life histories and occupy ecologically, geographically, and geologically similar habitats. A GDU may consist of a single stock." The final and broadest is call **major ancestral lineage** (MAL) which is defined as "a group of one or more genetic diversity units whose shared genetic characteristics suggest a distant common ancestry, and substantial reproductive isolation from other MALs. Some of these groups are likely the result of colonization and diversification preceding the last period of glaciation." (Busack and Marshall, 1995).

The Stillaguamish chinook, which is thought to consist of two stocks, is part of the larger Puget Sound MAL. This MAL consists of 5 GDUs: South Sound summer/falls, South Sound spring, North Sound summer/fall, South Fork Nooksack spring, and North Fork Nooksack spring. The Stillaguamish chinook are on the cusp between the two summer/fall GDUs in the MAL. Recent work indicates that the Stillaguamish fall chinook genetically align most closely with the South Sound Chinook which includes such stocks as the Green River Falls and the Snohomish summer and fall stocks (Marshall, 1997. Appendix E). It is not known whether this relationship is the result of past planting practices or is a reflection geologic, ancestral relationships.

The Stillaguamish summer stock genetic background is contrasted with the fall stock. It aligns genetically with the North Sound summer/fall GDU. The fish are similar to the Skagit Summer stocks (Appendix E). This may not be surprising given the potential connection between the Skagit and Stillaguamish basins via the Sauk river in recent geological times.

Both the broodstocking area and the release site are within the range of current natural chinook spawning within the North Fork Stillaguamish.

Scale analysis between 1985 and 1991 exhibited the following age class structure: 2 yr. olds-4.91%, 3 yr. olds-31.91%, 4 yr. olds-54.72, and 5 yr. olds-8.46%. During the 85-91 period, 95% of the chinook were sub yearling outmigrants (WDF, 1993. Appendix F).

The North Fork Stillaguamish chinook will be directly affected by the natural stock restoration program through spawner surveys, broodstocking efforts, the release of smolts and returning adult fish from the program

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

The Stillaguamish population of bull trout, South Fork Stillaguamish fall chinook and populations of natural spawning chinook within the adjacent watersheds where Stillaguamish natural and program fish stray into. These primarily include the Skagit, Snohomish and Nooksack watersheds.

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

1. **Describe the status of the listed natural population(s) relative to "critical" and "viable" population thresholds** (*see definitions in "Attachment 1")*.

   The Washington Dept of Fish and Wildlife defined North Fork Stillaguamish as depressed in the 1993 SASSI report. Beamer and Pess documented that 7 out of the 10 years between 1980 and 1992, North Fork Stillaguamish chinook were not able to replace themselves due to poor survival from increased flooding. Under current habitat and hydrologic conditions, North Fork Stillaguamish chinook have a 50% chance in any given year of being exposed to flow events that correspond to survival rates where the stock does not replace itself (Beamer et. all. in press). Stillaguamish estimated total adult production to Washington exceeded the escapement goal in only

3 out of the last 17 years (PMFC, 1997). The percentage of program fish making up the North Fork spawning population has increased from 5% during 1989 to an estimated 60% during the 1999 return year. NMFS determined that for North Fork summer chinook, "hatchery operations are essential for recovery, and without them, the stock(s) would likely further decline and go extinct (NMFS, 1999)."

Based on the above information/ documentation, and basin wide habitat degradation and loss, this stock is close to a critical population threshold. The co-managers are evaluating changing the stock status in SASSI from depressed to critical (Rawson, pers. comm.).

South Fork Stillaguamish fall chinook escapments have ranged from a low of 72 to a high of 253 fish during the 1988-99 period. This population meets the critical threshold as defined by the NMFS in the Biological Opinion for the US/Canada treaty.

2. 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.

Stillaguamish North Fork Summer Chinook
Reconstruction of total recruitment and recruits per spawner

Brood Year	Original Escapement	Subsequent Escapement	Broodyr Exp. Rate	Recruitment	Recruits Per Spawner
1986	980	505	.66	1,505	1.54
1987	1,065	695	.46	1,278	1.20
1988	516	654	.64	1,832	3.55
1989	537	458	.82	2,544	4.99
1990	575	488	.67	1,457	2.53
1991	1,331	486	.53	1,040	.78
1992	486	596	.38	959	2.06
1993	583	585	.50	1,165	2.07

Source of data: Rawson, 2000. Appendix A

3. 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.

Year	NF Escp	SF Escp
1985	1148	75
1986	980	188
1987	1065	148
1988	516	72
1989	537	207
1990	575	196
1991	1331	128
1992	486	153
1993	583	136
1994	667	96
1995	599	176
1996	993	251
1997	930	226
1998	1292	248
1999	845	253

Source of Data: Washington State Department of Fish and Wildlife, C. Kraemer.

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.

Return Year	% Natural Spawners on Spawning Grounds
1988	100.0%
1989	95.0%
1990	92.8%
1991	92.3%
1992	86.9%
1993	65.2%
1994	68.4%
1995	71.9%
1996	68.9%
1997	65.9%
1998	47.6%
1999	40.0%*preliminary estimate

Source of data: Rawson, 2000; Appendix A

2.2.3) <u>Describe hatchery activities, including associated monitoring and evaluation and research programs, that may lead to the take of listed fish in the target area, and provide estimated annual levels of take</u> *(see "Attachment 1" for definition of "take")***.**

1. 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.

The target area is defined as the North Fork Stillaguamish between river mile 10 and river mile 30.

The activities listed below occur during July, August and September of each year on the North Fork of the Stillaguamish between river miles 10 and 30. These activities have a high potential to temporarily disturb chinook in their holding and spawning areas. No permanent impacts from these activities have been observed during the 14 years that the research has been conducted.

Population size, habitat condition and utilization snorkel assessments that occur prior to broodstocking result in stress to adult chinook holding in pools when snorkelers disturb them out of their holding positions. These snorkel assessments occur, on average, once every 10 days.

Foot surveys for redd counts and carcass sampling disturb chinook holding in spawning areas. These surveys occur, on average, once every 7 days.

Broodstock collection of listed chinook has a high potential for take of the listed species. Fish are captured using a small mesh gill nets drifted down through holding pools. Some fish that are initially caught in the net break free and may suffer scale loss and stress related impacts. Actual mortalities of escaped fish have not been observed. During years were warm water conditions exist; captured fish die during the holding and transport process. Broodstocking occurs 4 to 8 times during the August/September period.

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

Because this species was just recently listed, we have had no past "takes" of this species. However, there have been mortalities associated with the operation of the program.

The natural stock restoration program has mortalities associated with the transportation and holding of adult fish. During periods of cool ocean, near shore and river water temperatures, pre-spawning mortalities range from 3% to 8%. During stressful environmental conditions where ocean, near shore and in river water temperatures are at stressful/lethal levels (Appendix G), pre-spawning mortalities range from 12% to 32%.

Egg to smolt survivals have ranged from a low of 18% during a flow/alarm failure to a high of 87% with most years having survivals in the range of 70% to 80%.

Please refer to Appendix H (1986-99 mortalities for Stillaguamish natural stock restoration program) for additional information.

- 3. **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).**

Please see **Table 1** for potential take information.

4. 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.

Broodstocking take will not exceed 150 total fish or no more than 30% of the estimated North Fork spawning population during low census years. Should initial stressful environmental conditions exist where more than 25% of the captured chinook are lost during transport and holding, then broodstocking activities would cease until those conditions return to more normal levels.

Should egg to smolt mortalities exceed 50% within the hatchery, co-managers will evaluate holding the remaining fish to yearling size to maximize the return of adults from that genetic population.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

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

The Stillaguamish US/Canada Indicator Stock Study and Natural Stock Restoration Program will be operated consistent with the guidelines being developed by the co-managers in the Draft Comprehensive Chinook Plan, the Puget Sound Salmon Management Plan, and the Puget Sound ESU-wide hatchery plan currently being developed.

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

Co-manager's disease policy, US/Canada Indicator Stock Program, the Boldt decision, Puget Sound Management Plan

3.2) Relationship to harvest objectives.

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 following section of the HGMP is taken directly from the Stillaguamish Technical Chinook Recovery Framework (STAG,2000).

1. Annual Management Forums

Chinook salmon from Puget Sound are harvested throughout their entire period of marine residency in a plethora of fisheries ranging geographically from Alaska to the ocean off the Washington coast and inside Puget Sound. In most cases, fishing mortality on Stillaguamish chinook is incidental to fisheries targeting other stocks or species. Hook-and-line and net fisheries have not directly targeted Stillaguamish chinook since the early 1980s. In marine waters there have been no directed fisheries in Port Susan since 1984; marine hook-and-line recreational fisheries have been reduced over the years, and directed take stopped several years ago. Even with the cessation of directed fishing, incidental harvest rates can be significant. The harvest management challenge has been to find ways to allow fishing on abundant stocks and species while minimizing the mortality of key wild management units, such as Stillaguamish chinook.

Harvest management is controlled by the Pacific Salmon Treaty (PST), state/tribal North of Falcon Process (NOF), Pacific Fishery Management Council (PFMC), and from co-management under the Puget Sound Salmon Management Plan (PSSMP). Under the PST, quotas limiting the maximum harvest in each fishery control the rate of harvest by mixed-stock intercepting fisheries in Alaska and Canada. For fisheries in Puget Sound waters, the treaty requires that savings realized by reductions in the intercepting fisheries bypassed through to the spawning grounds rather than augmenting fishery harvest levels.

The United States and Canada are currently negotiating a new chinook annex to the PST, which will require all fisheries to be responsive to fluctuations in the abundance of key management units, including Stillaguamish chinook. This will provide better responsiveness of intercepting fisheries to poor returns of Stillaguamish chinook, but it remains to be seen whether the restrictions will be sufficient to maintain sufficiently low exploitation rates to allow for rebuilding.

2. Tribal Fisheries Impacting Stillaguamish Chinook

Stillaguamish chinook are vulnerable to fishing mortality throughout the year in the usual and accustomed fishing areas of many of the treaty tribes. However, in response to conservation concerns, tribal fisheries are closed in most areas and during times when Stillaguamish chinook are present. In 1999, there were no tribal fisheries specifically directed at Stillaguamish chinook. The few tribal fisheries directed at chinook, captured Stillaguamish fish at low rates. A number of tribal fisheries have an incidental mortality of chinook, including Stillaguamish fish, while in pursuit of other salmon species.

Tribal chinook-directed fisheries include: the Stillaguamish Tribe's subsistence fishery (not opened in 1999, limited to 25 fish or less in prior years); the Tulalip Tribe's fishery in Area 8D, directed at Tulalip Hatchery chinook; the treaty troll fishery in the Strait of Juan de Fuca; and the treaty ocean troll fishery.

Incidental harvest of Stillaguamish chinook occurs in in-river tribal fisheries directed at:

3. Pink (odd-years only) and coho.
4. Marine terminal area fisheries, directed at pink (odd-years only) and coho.
5. Marine preterminal area fisheries (primarily in the San Juan Islands and Strait of Juan de Fuca), directed at pink (odd-years only) and sockeye.

Some incidental harvest of Stillaguamish chinook also occurs in the mixed-stock fishery in Area 10 directed at South Sound coho.

3. Harvest Profile

Given the reduced fisheries planned in all areas for 1999, spawning escapement is expected to comprise 76% of the combined adult-equivalent harvest, plus escapement for the Stillaguamish chinook management unit[1]. The fishery-related impacts are spread among several fishing sectors (Figure 5). As described above, these are mostly incidental impacts in fisheries that have been mitigated to one degree or another to minimize mortality of chinook stocks of concern.

[1] The information presented here is taken from FRAM model run 0799.

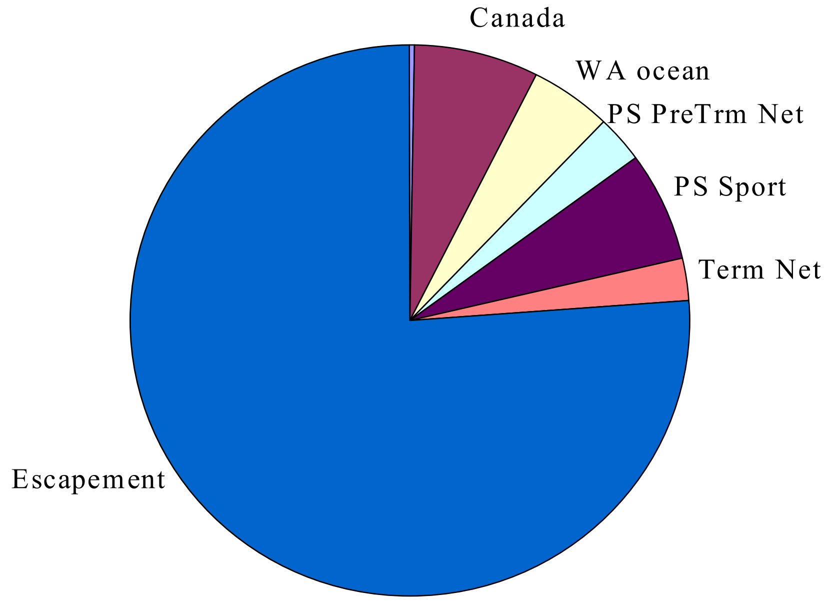

Figure 5: Stillaguamish harvest impacts by sector (1999).

The situation for 1999 is in marked contrast to earlier years when fisheries, although typically limited to incidental impacts only, were not as greatly restricted for chinook impacts as they were in 1999 (Figure 6). Figure 6 shows the distribution of adult equivalent fishing mortality for the Stillaguamish chinook management unit averaged over the 1980 through 1986 brood years[1]. In this case, the spawning escapement comprised 45% of the total. The harvest-related impacts were largely in Canadian and Puget Sound sport fisheries, and it is mostly due to reductions in these fisheries that we see the larger escapement fraction predicted for 1999.

[1] The information on distribution of fishing mortality is taken from Puget Sound Salmon Stock Review Group (PSSSRG 1992) Assessment of the status of five stocks of Puget Sound chinook and coho. Overall fishing mortality is taken from PSSSRG 1997 update. Both reports are available from the Pacific Fishery Management Council in Portland, OR.

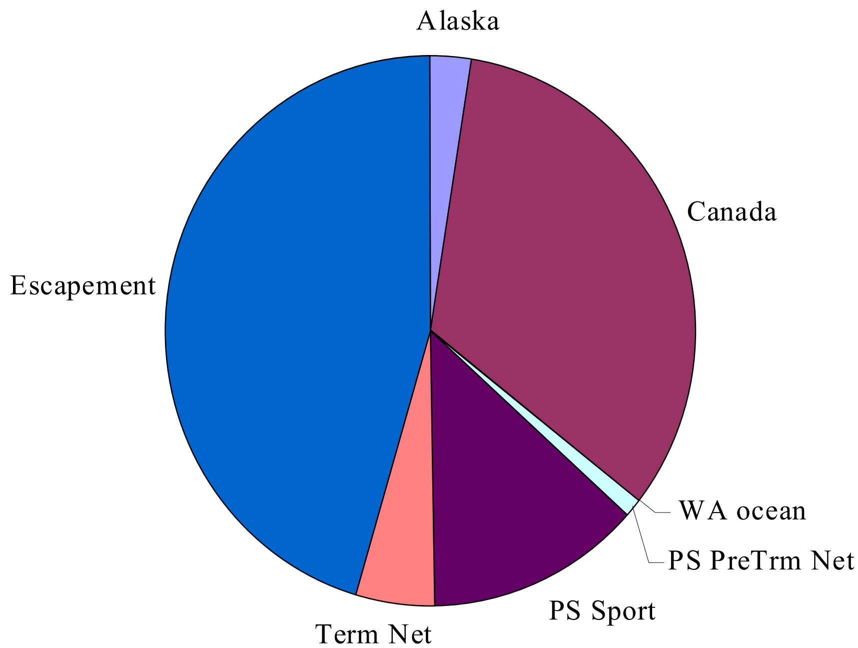

Figure 6. Stillaguamish chinook harvest averaged over the 1980-1986 brood years.

4. Historic Fishery Impacts/Harvest

From the 1977 brood year through the 1991 brood year, exploitation rates[1] (ERs) in the Stillaguamish summer/fall chinook salmon management unit are estimated to have declined steadily from approximately 70% to approximately 50% (PSC 1998). The absolute ER estimated by the PSC model include a high level of uncertainty because factors such as incomplete assessment of CWT fish escapement and differential harvest rates on different sizes, ages, and sexes are not considered in the model[2]. However, the trend is clear despite a gauntlet of mixed-stock fisheries operating, in some cases, for several years on the same brood of chinook; managers have been successful in achieving harvest rate reductions.

It is likely that ERs have declined further for subsequent brood years due to both preterminal and terminal area restrictions on fishing implemented in 1997. Retention of

[1] This is a so-called "AEQ" exploitation rate, computed from the model used by the Pacific Salmon Commission's chinook technical committee. It measures all sources of fishing-induced mortality (including both retention and non-retention mortality) as (R-E)/R, where R is the total number of fish that would have returned to spawn naturally in the absence of fishing and E is the estimated natural spawning escapement.

[2] The models should be revised to reflect the rates of exploitation on older fish and on females to better assess the fisheries' success is getting numbers of eggs on the spawning grounds.

chinook salmon is not currently allowed in recreational fisheries in the Stillaguamish/Port Susan terminal area (including the river and nearby marine waters), except in specific locations and times when hatchery-produced fish can be targeted with minimal impact on wild chinook salmon. In the Stillaguamish/Port Susan terminal area the commercial net fishery directed at wild chinook salmon has not been opened since 1984. Incidental harvest in net fisheries directed at other species or harvestable hatchery fish is carefully monitored and planned so that total impact rates will stay below guideline levels.

Despite the ER reductions, spawning escapements have not improved appreciably due to concurrent declines in marine survival and freshwater productivity (PFMC 1997).

Based on coded wire tag recoveries between 1986 and 1990, the harvest distribution for Stillaguamish River chinook production was the following: Canadian fisheries caught 41%, United States mainland 37.6%, Alaska 4%, and 21% of the chinook were escapement back to the river. During the 1990-1994 period, the Alaskan catch was 9%, Canadian 41%, United States mainland 17%, and escapement 33%. Chinook mortality due to harvest can be assigned to two primary activities: 1) recreational harvest and 2) commercial harvest. These impacts can be further delineated based on the geographic location where mortality occurs. In general, all harvest related mortality takes place in Alaska, British Columbia (BC), or Washington State (Figure 3). Alaska's harvest is primarily commercial, while the harvest of Stillaguamish origin chinook in BC and Washington is primarily recreational; however, there is a considerable commercial component typically as bycatch during other fisheries such as sockeye and coho (Figure 4); poaching numbers are unknown.

North Fork Stillaguamish Summer Chinook
Harvest Rate Information

Brood year	Brood year AEQ Exploitation rate
1986	66%
1987	46%
1988	64%
1989	82%
1990	67%
1991	53%
1992	38%
1993	50%

Return year	Return year AEQ Exploitation rate
1999	24% (FRAM Model Run 0799 Preseason Forecast)
2000	15% (FRAM Model Run 05sp Preseason Forecast)

Source of the information: Rawson, 2000;Appendix A and Rawson, pers. comm.

5. Future Pattern of Fisheries

Co-managers will develop recovery goals for Stillaguamish chinook salmon expressed in terms of the four components described above: abundance, productivity, population structure, and diversity. Specific values of the recovery goals will be derived from models relating restored habitat conditions to these components. Based on the historical condition of chinook salmon in the system, recovery to historical levels should result in healthy, harvestable populations.

Once recovery has occurred, fishery plans will be designed with the following principles in mind:

- Harvest-related mortality rates will be at or below levels that would jeopardize the ability of the populations to maintain themselves in a healthy condition without human intervention.
- All sources of harvest-related mortality will be considered in developing and evaluating harvest management plans.
- Harvest management plans will include risk buffering, such that the probability of over harvest in any one year or on any one brood is held to a low level.
- Harvest management goals will be designed so that important population characteristics, such as average fish size, age distribution, geographical distribution of escapement, adult timing distribution, etc. will not be considerably altered due to harvest-related mortality.
- Harvest levels or rates may be as high as the level that will, over the long term, provide the maximum level of harvest, given the above constraints. This will define the maximum sustainable harvest (MSH) for this management unit.

3.3) Relationship to habitat protection and recovery strategies..

Factors on Why Stillaguamish Native Summer Chinook Have Declined

Population of Washington State has gone from 432,500 in 1895 to 5.4 million in 1995(DNR,1996).

Within the Stillaguamish watershed the population has gone from est. 700 in 1847 to 18,300 in 1967 up to an estimated 38,000 in 1997 (Sno.Co.,1999).

Within Puget Sound, loss of 171 acres a day of private forest land to conversion (DNR, 1996).

Population increases have resulted in significant changes in land use of the Stillaguamish watershed.

87% loss of tidal estuary area to farming conversion (Collins, 1997).

83% loss of old growth forest area to logging (Pollack, 1997).

76% loss of freshwater wetland area to all types of land conversions (Gersib, 1997).

76% of the watershed has been logged at least once since the turn of the century (Pollack, 1997)

83% loss of main stem beaver pond habitat due to diking and land conversion (Collins, 1997)

17% of the forests have been permanently lost to land use conversion (Pollack, 1997).

37% loss of main stem channel area due to diking (Collins, 1997)

38% loss of pool habitat in the North Fork Stillaguamish (Pess and Benda, 1994)

21% fine sediments (<.841mm) on both the North and South Fork Stillaguamish (Johnson, 1968).

1000 landslides in logged areas of the watershed have slipped more than 3 million cubic yards sediment into the streams and rivers that make up the watershed (Perkins and Collins, 1997).

"Increases in sediment supply have been coupled with large peak flow events over the last 20 years. The result is increases of up to 100 % in bed elevation changes from 1986-94, which correspond to a 6-fold increase in sediment supply and 10 of the 14 largest flow events on record. This combination resulted in a decrease in residual pool depth, as well as an increase of up to 100 % in potential scour and fill (PFMC, Pess and Benda, 1997)."

Between 1980 and 1992 chinook recruitment was less than 1.0 70% of the time. This indicates that chinook could not replace themselves 7 out of 10 years during that period (Pess and Benda, 1994).

If peak flows occurred more than twice and were larger than a 5-year recurrence interval prior to December 15th, then chinook recruitment was less than 1.0 and the fish were unable to replace themselves (Beamer et al. in press).

Human/Agricultural needs for permitted water withdrawals from the river now total over 652 cubic feet per second. These withdrawals exceed the river summer low flows in some years (Stevenson, pers. comm).

Human/Agricultural waste seeping into to streams and rivers cause significant bacterial contamination problems (2496 Report).

The combination of land clearing, increased sediment, wetland losses and water withdrawals cause significant biologically harmful warming of summer river water temperatures. Summer water temperatures in the North Fork frequently exceed 70 (2496 Report; Appendix G).

The build up of sediments(primarily sand) in northern Port Susan have contributed to shallow water conditions which cause water temperatures to rise above 70 F during some periods of the year (Klopfer, pers.comm.; Appendix G)

Potential impacts from the loss of reproductive fitness due to the out- planting of more than 9 million chinook smolts and fry from outside the watershed between 1952 through 1973 (SCTRF, 2000).

Potential impacts from the loss of reproductive fitness due to a 15-year natural stock restoration program (SCTRF, 2000).

Regional increases in the population have had significant impacts on the number of Stillaguamish chinook harvested.

Past harvests by more than 700,000 sport and commercial fishermen from the US and Canada have contributed to the decline of chinook runs within the basin. Current harvest restrictions have significantly reduced catch of Stillaguamish origin chinook (see Harvest **section 3.3** above).

Major ecological changes in the ocean environment have occurred. Climatic shifts in weather and ocean currents have redistributed and changed the predator and prey species that salmon interact with (Pearcy, 1992). Additional years of El Nino (Appendix F) events have compounded the impacts of decadal climatic weather and ocean changes(Pearcy, 1997). Some tagged chinook stocks have seen a 6 fold decrease in marine survival during El Nino periods (Pearcy, 1997).

Habitat Restoration Efforts Within the Watershed and Expected Benefits

Stillaguamish, Tulalip Tribes and Sno. Co. Engineer Log Jam/Pool Restoration Project—recreates six large constructed logjams for chinook holding and juvenile rearing areas (Stevenson, pers.comm.).

US Army Corps of Engineers Main Stem Side Channel Reconnection Projects—Reconnects or improves water flow through six major ox bows and side channels in the lower main stem of the Stillaguamish which will provide critical over wintering rearing area and spring flood refugia areas to juvenile salmonids (Gilbrough, pers. comm.)

Tribal/County Impassable Culvert Replacement Project—Begin replacement of more than 40 blocking culverts within the Stillaguamish watershed. Will provide additional tributary refugia and rearing area for all salmonids during high winter flows (Stevenson, pers. comm.)

WDFW Habitat Projects—37 completed habitat restoration/improvement projects within the basin (Barkdall, pers.comm.)

US Forest Service/DNR Road Decommissioning---More than 33 miles of logging roads decommissioned within the watershed (Chang and Stevenson, pers.comm.)

US Forest Service Restoration Projects— 20 completed habitat restoration/improvement projects : culvert removal, gravel additions, sediment traps, fish ladder, rearing ponds (Chang, pers.comm.)

Stream riparian/fencing restoration projects by Stilly/Sno Regional Fisheries Task Force and the local conservation district and the Tribes (Ward, pers. comm.)

Local Conservation District has worked with dairy farms within the watershed and in a recent review, all 14 farms checked met state and federal animal waste control guidelines (Baker, pers.comm..).

Improvements to timber harvest activities through the Timber, Fish and Wildlife Agreement, DNR HCP's, WA. State FPA permits and the Northwest Forest Plan.

Improvements to farming practices through NRCs Best Management Practices for farming activities.

Improvements to water quality through implementation of the EPA's Federal Clean Water Act, Wa. St. DOE water quality criteria, State HPA permits, Corps of Engineers Wetlands permits.

Improvements to development activities through the Wa. St. Growth Management Act and the Sno. Co. Critical Areas Ordinance.

Purchases of conservation easements by Snohomish/King Co. Land Conservation Group

Note: Specific information on chinook juvenile/adult production improvements exist for many of the above projects, but elaborating these is beyond the scope of this document.

3.4) Ecological interactions.

(1) Based on research by Hawkins of WDFW, there is a potential impact to both wild 0+ chinook and out migrating program fingerlings from yearling steelhead, coho, chinook and cutthroat smolts, both wild and hatchery (Hawkins, 1998). Curt Nelson of the Tulalip Tribes has documented bass and sunfish in the Stillaguamish river (Nelson, pers.comm.). Both these non-native species are potential predators to hatchery and wild chinook fry and fingerlings. There are large rookeries of both double breasted cormorants, and blue herons in the area that may prey upon out migrant chinook (Kraemer, pers. comm.). There are populations of king fishers, mergansers and several gull species that forage on chinook fry and fingerlings. There are several large haul out sites at the mouth of the Stillaguamish and Snohomish where more than 400 harbor seals have been counted (NOAA, 1997). Harbor seals have been documented by several researchers to capture and consume both adult and juvenile salmonids including chum fry (NOAA, 1997).

(2) Several researchers have documented increased predation by birds, mammals and other fish on both hatchery and natural rearing chinook salmon, due to the increased concentration of recently released hatchery outmigrants (Allendorf et al.1997;Wood.1987). There has been some evidence of carrying capacity limitations for out migrant salmonids in estuary of the Columbia river. Research by Beamish et al. (1998) on the relationship between hatchery/wild production and large-scale shifts in marine productivity has shown evidence for a limitation on marine carrying capacity for coho and chinook during poor ocean productivity periods. The transfer of pathogens from hatchery fish to wild populations has occurred the Western US in conjunction with the spread of whirling disease.

(3) Bilby and Bisson have documented the positive correlations between increased freshwater productivity and increases in salmon spawning biomass and nutrient transfers. Increasing populations of other salmon species will provide additional primary productivity that may benefit both hatchery and natural chinook fry and outmigrants.

(4) Increases in the numbers of returning adult chinook would provide additional nutrient input to the freshwater and riparian ecosystem that would benefit all associated species.

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.

Incubation and early rearing water comes from a 65 foot deep well providing 150 gpm, while main water supply is an intake structure in Harvey Creek. Water temperatures for the well range 48 to 50 F. Surface water temperatures range from 35 to 58 F and dissolved oxygen levels range from 8.2 to 14.1 ppm.

Flow rates:

Harvey Creek Hatchery
Incubation stacks 3 to 5 gpm per stack (well water)
Smaller circular tanks 45 to 65 gpm (surface)
Larger circular tanks 150 to 200 gpm (surface)

Whitehorse Hatchery
Raceways provide up to 200 gpm (spring fed)
Gravel pond up to 1200 gpm (spring fed)

Whitehorse Spring has a flow range of 90 gpm in drought years to peak flows of 2800 gpm in the spring. Typical flows during the time chinook are rearing don't drop below 800 gpm. Dissolved oxygen levels range from 7 ppm to 10.5 ppm and temperatures range from a low of 41 F to highs of 55 F.

During low flow or drought conditions, chinook are put on reuse water from the steelhead pond. During drought conditions water must be pumped and aerated numerous times to keep oxygen levels above the critical point. The co-managers are working diligently at trying to obtain additional first pass water for the chinook by adding a drilled well at the Whitehorse facility.

The following water characterization data comes from Don Klopfer of the Stillaguamish Tribe's Natural Resources Department. Detailed chemical analysis of each source is available upon request.

Well/Spring Water characterizations

Harvey Creek Hatchery well water and Whitehorse Hatchery spring water are groundwater sources with no known surface water influences. Harvey Creek Hatchery well water is soft water and Whitehorse Hatchery spring water is very soft water. Whitehorse Hatchery spring water has an estimated 50% less buffering capacity than Harvey Creek Hatchery well due to significantly less total mineral content. Seasonal changes and characterizations for these two water sources have not been documented

Surface Water Characterizations

The North Fork Stillaguamish River at Whitehorse and Harvey/Armstrong Creek at the Harvey Creek Hatchery are predominately surface water sources with limited ground water influences. Both of the above surface water sources are characterized as very soft with limited mineral content. Seasonal variations are similar for both sources with the percentage of groundwater influence increasing during summer low flows.

Based on preliminary, conventional water quality data analysis, there are not significant chemical differences in any of these water sources for the purposes of fish rearing.

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

The Harvey Creek hatchery has 1/8-inch diameter circular perforated screen at its intake structure and currently meets level one NPDES discharge standards for facilities rearing less than 10,000 pounds annual production.

The WDFW Whitehorse Hatchery meets both NMFS and WDFW fish screening criteria with the spring source classified as pathogen free water. The hatchery meets current NPDES standards for in line settling for effluent.

All water used for fish rearing at both facilities is returned to receiving waters very close to where it was withdrawn.

SECTION 5. FACILITIES

5.1) Broodstock collection facilities (or methods).

Broodstock are captured in-river (within holding pools) by entanglement with small mesh (4 in.) gill net. Once fish are removed from the net, they are transferred to 4ft.x 4ft. x 8 ft. soft mesh holding pens and then moved, using wet burlap bags to the fish transport truck.

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

Transportation of chinook occurs in standard hatchery insulated fiberglass fish hauling truck. Maximum hauling numbers are 40 fish per 860 gallons of water. Compressed oxygen is provided during transport. Spare oxygen tanks are carried on the truck and oxygen flow to the tanks can be monitored from the cab while driving.. Salt is added during transport as a therapeutic treatment. Hauling times do not exceed 2 hours from loading to unloading. Upon arrival at the hatchery, females are anesthetized and vaccinated to prevent the transfer of bacterial kidney disease to the offspring and then kept in separate covered circular tanks until ready to spawn.

5.3) Broodstock holding and spawning facilities.

The Harvey Creek Hatchery has 6 discrete holding ponds for keeping broodstock separated by sex and for sorting ripe and unripe fish. Four 13 ft. diameter by 4 ft. deep circular tanks have a volume of 450 cubic feet and a flow of 45 to 65 gallons per minute. Two 20 ft. diameter by 4 ft. deep circular tanks have a volume of 940 cubic feet and a flow of 150 to 200 gallons per minute. Surface water from Harvey Creek is used for all circulars.

5.4) Incubation facilities.

Incubation occurs in vertical heath trays that are supplied with well water from a 65 foot deep well. Water flows from the well into a de-gas tower and then to a head box where individual valves control flow rates of 3 to 5 gallons per minute per 8 tray stack. Trays are double stacked and a second intake line adds additional water to the bottom eight trays

5.5) Rearing facilities.

Early rearing

Swim up fry are transferred to 4 shallow netart early rearing troughs that are 24 ft. long, 3.6 ft. wide and 1.5 ft. deep. Well water serves these troughs and ranges from 15 to 25 gallons per minute per trough. Fry are reared in these troughs for approximately 30 days and then transferred outside to above ground circular tanks.

Beginning in 2002, as a result of successfully obtaining an HSRG Hatchery Reform Grant, new early rearing troughs will be installed that will double the available early rearing space.

Late rearing

Fish are reared at the Harvey Creek Hatchery in covered, dark brown circular tanks. These tanks provide continuous current, color and cover more representative of in-river holding pool habitat. Fish are more evenly distributed throughout the container and food tends act more like natural stream drift than in a conventional raceway.

In March fish are transferred to Whitehorse Hatchery located at RM 30 on the North Fork Stillaguamish River. The facility contains has a series of spring fed gravel ponds with predator control nets. Chinook are initially moved up to two raceways that are each 10 ft. wide X 50 ft. long X 2.5 ft. deep with flows of 200 gpm per raceway.

5.6) Acclimation/release facilities.

The fish are tagged during the first part of April and transferred to a larger, gravel bottom pond, which measures 58 ft. wide X 175 ft. long X 5 ft. deep with flows from 800 to 1000 gpm. Fish are released volitionally starting in mid-May, and the volitional release occurs in 5 to 7 days and then forced release occurs for the few remaining fish in the pond.

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

During the 1986 season, 17,000 swim up fry were lost to an overflowing rearing trough and in 1997, 179,750 alevins were lost to low flows and an alarm system failure. In each case, significant modifications and improvements were made to minimize the re-occurrence of the same problems.

During periods of very warm water in the ocean, estuary and river, adult broodstock mortalities have been as high as 32%. Northwest Indian Fish Commission pathology staff are evaluating causes and changes that can be made to the program to further reduce handling mortalities during these stressful environmental conditions.

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

The Harvey Creek Hatchery has an extensive alarm system with triple flow sensors on the well and incubation/early rearing trough water system. The system was significantly up graded in 1997 after an alarm system failure that resulted in a significant loss of alevins for that broodyear. There are flow alarms on all gravity fed circular tanks with 2 central lines feeding each set of tanks. The alarm system includes a high water/flooding alarm to alert staff to possible flooding conditions. The hatchery is completely surrounded by a 6-foot high razor fence to restrict access. The main incubation well water pump has a double backup, with surface water being pumped by either a gasoline pump or the backup generator. Should the gravity feed water supply fail, the hatchery has multiple oxygen tanks, regulators and O2 stones to provide emergency oxygen until the flow problems can be resolved.

The Whitehorse Hatchery is on station facility with the hatchery manager living on site. The water supply is a screened gravity spring system with alarm sensors alerting staff to any flow problems to the ponds. Both the intake structures and outflow structures have continuous rotating screens to assure continuous flow through the pond. Electrically driven aeration exists for emergency use in the event of water flow problems.

Fish health specialists monitor the fish and operators of the facilities follow the current co-managers disease policy recommendations and guidelines.

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.

Only chinook captured on the North Fork Stillaguamish will be used for broodstock. The fish will be captured over most of the geographic range of their natural distribution and over a period of time reflective of their entry into holding water.

6.2) Supporting information.

6.2.1) History..

Broodstock collection began in 1980 with the capture of fish from the North Fork of the Stillaguamish River. From 1980 through 1986, the numbers of fish captured were generally less than 50 fish total.

6.2.2) Annual size.

During typical marine, estuarine and freshwater temperature conditions, the target is to obtain 65 males and 65 females, with a release goal of 220,000. When stressful/lethal warm water conditions exist in the ocean, estuarine and freshwater (Appendix G), the target broodstock level is increased to 75 males and 75 females to meet the 220,000 fish-tagging goal with reduced survival levels.

Typically, broodstocking takes less than 20% of the spawning escapement to the North Fork Stillaguamish. Reductions of natural spawners by this amount should not significantly reduce the ability of this population to recover. Given the poor habitat conditions and low survival rates of naturally spawning fish, removal of broodstock and the increased survival within hatchery is likely to keep the run from going extinct.

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

Between 30% to 70% of the fish captured in the broodstocking effort are marked fish from previous releases. Approximately 30% to 60% of the fish returning to the spawning grounds are marked program fish from the natural stock restoration program. Based on spawning ground survey recoveries, returning adult-tagged fish are found distributed throughout the current spawning habitat on the North Fork and it's tributaries.

Brood	Broodstock		% of Esc.	% Brdstk having	NF
Year	Males	Females	Captured for Brdstk	CWT tags	Escapement
1986	21	25	4.5%	0.0%	980
1987	42	49	7.9%	2.1%	1065
1988	7	9	3.0%	6.3%	516
1989	16	11	4.9%	33.3%	537
1990	49	17	10.3%	42.4%	575
1991	51	45	6.7%	50.0%	1331
1992	91	62	23.4%	53.6%	486

1993	108	61	22.5%	64.7%	583
1994	100	81	19.0%	58.6%	667
1995	78	11	12.9%	64.0%	599
1996	77	68	12.7%	51.0%	993
1997	78	79	14.4%	78.3%	930
1998	73	71	10.0%	69.4%	1292
1999	87	44	13.4%	N/A	845

Note: North Fork escapement numbers do not include broodstocked fish (Hendricks, WDFW, pers.comm.).

Source of data: Kip Killebrew, Stillaguamish Tribe and C. Kraemer, WDFW

6.2.4) Genetic or ecological differences.

There are no known genetic or ecological differences between the broodstock fish and the natural spawners (Appendix F). Broodstock are collected in the current spawning area of the natural spawners. Based on spawner/carcass surveys, returning tagged adults are found spawning throughout the current range of natural spawning within the North Fork Stillaguamish (Kraemer and Drotts per. comm.).

There is some documented straying into and out of the basin, and into and from adjacent watersheds. The author believes that this to be expected given the genetic evidence (Appendix E) and geologic evidence that the Stillaguamish was at one time, post glaciation, physically connected to both adjacent watersheds (Skagit and Snohomish basins).

6.2.5) Reasons for choosing.

Indigenous stock

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.

Geographic location is the main method for selecting the target population. Beginning in 2001, hatchery staff now read all coded wire tags prior to fertization and cull out any hatchery strays from other watersheds that are in the broodstock group to be spawned.

Spawning protocol consists of a 5 X 5 spawning matrix where eggs from 5 females (hatchery and natural origin) are pooled and spawned with 5 individual males with 5 different males used as a back up. The spawning protocol was selected to increase the effective breeding size of the population.

The risk of among population genetic diversity loss will be reduced by selecting the indigenous chinook salmon population for use as broodstock in the natural stock restoration program.

SECTION 7. BROODSTOCK COLLECTION

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

Adult Summer Chinook

7.2) Collection or sampling design.

Fish are captured in pools between river mile 15 and river mile 30. Broodstocking begins in early August and continues until early September. Fish are captured using a small mesh gill net drifted down through the holding pools located within the geographic area of spawning and during the main time period for fish holding in pools prior to moving up on to the spawning grounds.

Capture efficiency is unknown, but estimated to be in the range of 25%-75% depending on the circumstances (Drotts, pers.comm.).

Beginning in 2003, the tribe will be evaluating the use of an adult fish wheel trap as alternative method for collecting a broader representation of the naturally returning run and to reduce the repeated exposure of fish in holding pools to multiple broodstocking events.

7.3) Identity.

Hatchery origin fish are 100% CWT. There is no attempt to identify the difference between summer and fall chinook. Outside strays are culled from the broodstock group. Other salmon species are identified.

7.4) Proposed number to be collected:

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

During typical marine, estuarine and freshwater temperature conditions, the target is to obtain 65 males and 65 females, with a release goal of 220,000. When stressful/lethal warm water conditions exist in the ocean, estuarine and freshwater (Appendix G), the target broodstock level is increased to 75 males and 75 females to meet the 220,000 fish-tagging goal with reduced survival levels.

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

Year	Adults Females	Males	Jacks	Eggs	Juveniles
1988	9	7			
1989	11	16			
1990	17	49			
1991	45	51			
1992	62	91			
1993	61	108			
1994	81	100			
1995	11	78			
1996	68	77			
1997	79	78			
1998	71	73			
1999	44	87			

Data source: (Link to appended Excel spreadsheet using this structure. Include hyperlink to main database)

Source of data: Kip Killebrew, Stillaguamish Tribe; Appendix H

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

Surplus hatchery-origin males were killed and sampled for tags with the carcasses going to tribal elders unable to harvest chinook, the Sarvey Wildlife Recovery Center, or back into main stem Stillaguamish below the spawner/carcass survey areas for nutrient enhancement.

7.6) Fish transportation and holding methods.

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Transportation of chinook occurs in a standard hatchery insulated fiberglass fish hauling truck. Maximum hauling numbers are 40 fish per 860 gallons of water (1.3lbs per gallon). Compressed oxygen, at 10-14psi, is provided during transport. Sodium chloride (salt) is added at a .5% to .8% concentration as a therapeutic treatment to reduce handling stress, help maintain osmotic regulation and as a parasite/fungus control.

Co-managers are evaluating the possible usage, during transport, of low levels of anesthetic MS-222 to reduce activity levels and stress while transporting and off loading.

When the fish arrive at the hatchery, they are separated by sex. Beginning in 2002 all males and females will be anesthetized and receive a vaccination against bacterial kidney disease prior to being placed in a 20 ft. circular fiberglass tanks. The tanks have a complete cover made out of aluminum, with locked hasps and an intrusion alarm system. Flows range from 150 to 200 gpm for each tank. Males are held in an identical tank. Fish are held 2 to 4 weeks prior to spawning. Fish ripen and are spawned over variable times between Aug 27th and September 24th.

7.7) Describe fish health maintenance and sanitation procedures applied.

Females are vaccinated to prevent the transfer of bacterial kidney disease to the offspring and then kept in separate covered circular tanks until ready to spawn. Females are sampled for disease by pathology staff from the NWIFC. All broodstocking , transport, handling, and spawning equipment is disinfected with a solution of 100 ppm active iodine.

Currently, adult salmon are spawned in a dirt bottomed shed immediately adjacent to the stream and ponds with juvenile salmon in them. There is a high risk of spawning effluent reaching the stream or being transferred to one of the ponds. As a result of this risk, grant proposals have been submitted to rebuild the spawning shed at site located 100 feet from the stream and ponds.

7.8) Disposition of carcasses.

Non-injected carcasses are either given to tribal elders and staff or are returned to the main stem Stillaguamish below the spawner index/survey areas for stream nutrient enhancement. Injected carcasses are given to the Sarvey Wildlife Recovery Center where they are frozen and later used for wild animal rehabilitation. The wildlife center's consulting veterinarian has approved this use of these carcasses.

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.

Broodstocking in multiple locations at multiple times during the return of the run should minimize any biases towards catching a specific group of fish. Broodstocking occurs early in the morning to minimize handling stress due to warm water during the later part of the day. Fish are captured in the North Fork Stillaguamish where they have had time to adjust to freshwater conditions.

Beginning in 2001, hatchery staff implemented procedures to read all coded wire tagged broodstock prior to spawning and culled out any hatchery strays from outside the watershed.

Beginning in 2003 tribal staff will be evaluating the use of an adult fish wheel to capture needed broodstock and enumerate escapement. This alternative method may allow for the capture of a broader sub-sample of the spawning population and reduce stress to fish that are not captured, but are holding in pools where broodstocking occurs.

SECTION 8. MATING

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

8.1) Selection method.

Fish are checked once a week to determine ripeness based on previous experience with maturation. Ripe fish that are ready are randomly spawned using the 5 X 5 spawning matrix (see section 8.3).

8.2) Males.

Both adult males and jacks are used randomly in the spawning process. Jacks are used in similar numbers to what have been found in previous spawner surveys. There is a separate backup male used from the day's ripe fish for each primary male.

8.3) Fertilization.

Each female and each male's gametes are initially placed in a separate container. Five individual females are then combined into one bucket and re-divided back into 5 buckets giving a sub sample of 5 females in each bucket. An individual male is added to each bucket of eggs for initial fertilization and then 5 males are each moved one bucket to the right and used again as a separate backup fertilization. In summary, 10 males (5 primary, 5 backup) are used for each 5 pooled females.

8.4) Cryopreserved gametes.

No cryopreserved gametes are used at this time.

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.

When the program first began, one to one crosses were used for the fertilization protocols. Concerns about the over representation of a small group of spawners in the next generation led to the current spawning protocols. The 5:5 crossing with 65 males and 65 females per year meets the guideline of having an effective spawning population (Ne) greater than 250 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.

For specific yearly survival rates please see the table in **section 9.2.1.**

Expected survival from fertilization to ponding is 80 to 90%. Lower survival rates (70-80%) are associated with stressful environmental conditions for returning adults associated with warm ocean, near shore, and in river water temperatures (see Appendix G for environmental temperature data).

The target green egg take goal varies with environmental conditions. During normal water temperatures, the goal is to collect 290,000 green eggs. When reduce survival is expected because of stressful conditions, the goal is increased to 340,000.

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

In the past, all eggs were reared to fingerling stage, tagged and released.
Because these hatchery fish and their progeny are part of the listed species, we are unable to destroy any surplus eggs or fry. The proposal would be to continue tagging and releasing any surplus production contingent upon working closely with National Marine Fisheries Service to determine the best strategy for those surpluses.

9.1.3) Loading densities applied during incubation.

Loading densities range from 6,000 to 7,000 eggs per vertical Heath tray with flows of 3 to 5 gallons per minute per stack. Eggs are typically in the range of 1320 to 1390 per pound.

9.1.4) Incubation conditions.

Incubation water is well water that is run through a packed column to add oxygen. Dissolved oxygen levels range between 10 and 11 ppm. Loading densities are within the standards currently used by most hatcheries. Silt management is not required unless surface water is used in an emergency where well water is not available. Well water temperatures typically range between 49 and 50 F.

9.1.5) Ponding.

Button up and ponding occurs when there is approximately a 1mm belly slit remaining on the majority of the alevins in a given incubator tray. Typically, button up occurs when the alevins have between 1600 to 1650 Fahrenheit temperature units. Button up fry are manually transferred from incubation trays to early rearing troughs beginning the 1st week of December and continuing through the 1st week of January. Button up fry are typically 1000/lb and 38 mm in length when feeding begins.

9.1.6) Fish health maintenance and monitoring.

Eggs are given a pre-fertilization rinse with a 1.37% solution of sodium bicarbonate to reduce broken eggshell de-activation of sperm and increase fertilization success (Wilcox, 1984).

Eggs are treated on an as needed basis with hydrogen peroxide at 500 ppm for 15 minutes or formalin at 1600 ppm for 15 minutes to control fungus development.

Coldwater disease and coagulated yolk are the primary problems seen at the hatchery. The problems are not consistently seen and typically do cause major losses of alevins and fry.

Non-viable eggs are removed at the eyed stage after shocking using a Jensorter Model WB-4 optical egg sorter. Remaining dead eggs are removed and counted at the time of 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.

Vexar substrate is used to reduce yolk sac abrasion and increase the size of ponded fry. There is a triple alarm system in place with a back up well, generator and surface water pump available in the event of water flow interruption from the primary well.

Eggs are incubated on pathogen free, clear well water to reduce the potential loss from using surface water with high levels of silt.

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.

BY	Green egg to ponding	Green egg to release	Comments
1986	0.77	0.55	
1987	0.85	0.83	
1988	0.85	0.82	
1989	0.93	0.78	Adults found to have Frunculosis
1990	0.91	0.86	
1991	0.89	0.87	
1992	0.46	0.44	Adult broodstock elevated water temps, numerous disease problems
1993	0.83	0.75	Coagulated yolk probems and coldwater disease
1994	0.88	0.72	Coldwater disease
1995	0.76	0.71	
1996	0.74	0.73	
1997	0.19	0.18	Alarm failure, flow loss
1998	0.88	0.67	BKD
1999	0.91	0.84	preliminary

Source of data: Kip Killebrew, Stillaguamish Tribe; Appendix H

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

Current early rearing densities exceed recommended targets by greater than 100%. Final rearing densities are less than .10 lbs. per cubic foot and less than 4 lbs. per gallon per minute. The goal is to maintain all rearing and pre-release densities for flow below 1.2 lbs/GPM/inch and to maintain all rearing conditions for space below .25 lbs./cubic ft./inch.

9.2.3) Fish rearing conditions

Chinook fry are transferred out to the 20 ft. diameter circular fiberglass tanks during January. Fish are monitored for growth typically twice a month and have fish health checks once per month until release. The fish are on Harvey Creek surface water and experience temperatures ranging between 38 F to 50F during their rearing time. Dissolved oxygen levels are monitored monthly at the hatchery intake. Tanks are cleaned on an as needed basis using a standard swimming pool type vacuum system.

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.

January 1st, fry are at 1000/lb and 38 mm in length.
February 1st, fry are at 470/lb and 45 mm in length.
March 1st, fry are at 300/lb and 56 mm in length.
April 1st, fry are at 170/lb and 65 mm in length.
May 15th, fingerlings are at 80/lb and 83 mm in length.

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

This program rears only fingerlings and no energy reserve data is available for this stock at this time.

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*).

As swim up fry, fish are fed BioDiet Starter 7 times a day at approximately 4% B.W./day. At 400/lb, fry are fed BioDiet Grower 4 times a day at approximately 2.5% B.W./day. When fish reach 100/lb, they are fed BioMoist Feed 3 times a day at approximately 2.3% B.W./day.

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

Each year, fish pathologists screen a representative number of adults returning to tribal hatcheries for pathogens that may be transmitted to the progeny. The exact number of fish to be tested from each stock is specified in the Co-managers Salmonid Control Policy. Pathologists work with hatchery crews to help avoid pre-spawning mortality of brood fish to maximize fertilization and egg survival.

Preventative care is also promoted through routine juvenile fish health monitoring. Pathologists conduct fish health exams at each of the tribal hatcheries on a monthly basis from the time juveniles swim-up until they are released as smolts. Monthly monitoring exams include an evaluation of rearing conditions as well as lethal sampling of small numbers of juvenile fish to assess the health status of the population and to detect pathogens of concern. Results are reported to hatchery managers along with any recommendations for improving or maintaining fish health. Vaccine produced by the TFHP may be used when appropriate to prevent the onset of two bacterial diseases (vibriosis or enteric redmouth disease). In the event of disease epizootics or elevated mortality in a stock, fish pathologists are available to diagnose problems and provide treatment recommendations. Pathologists work with hatchery crews to ensure the proper use of drugs and chemicals for treatment. The entire health history for each hatchery stock is maintained in a relational database called AquaDoc. (Northwest Indian Fisheries Commission Fish Pathology pers.comm.)

Co-managers disease policy and guidelines are followed disease treatment and sanitation procedures.

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

There is no smolt developmental indices data available for this stock.

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

Early rearing occurs in circular dark brown fiberglass tanks with covers over the top. The constant current and cover are more representative of in river pool habitat. Feed acts more like drift and fish distribute themselves out more evenly than in straight raceways. Nets are periodically removed to allow predator exposure to king fishers.

Final acclimation occurs in a large gravel bottom, spring fed pond at the Whitehorse Hatchery, which runs directly into the North Fork Stillaguamish in the same area as naturally spawned fish rear and migrate from. Fish have access to significant populations of terrestrial and aquatic insects. Although the ponds are covered with bird netting, there are periodic limited exposures to smaller fish eating ducks.

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

More natural rearing methods are used which include circular covered tanks with constant flow and a large gravel pond with natural feed and predator exposure.

Fish are released in an area of the North Fork near where natural spawning and rearing occur giving the fish a similar downstream migration distance to the natural fish.

Fish will be reared to sub-yearling smolt size to mimic the natural fish emigration strategy and to minimize the risk of domestication effects that may be imparted through rearing to yearling size.

Planned future improvements (contingent on funding) include: Harvey Creek Hatchery-- upgrading back up generator (completed 2001); reduce early rearing densities by rebuilding existing troughs (new troughs on line the fall of 2002); construction of a new spawning shed; addition of wood and cobble cover to circular tanks. Whitehorse Hatchery—construction of a new well and dedicated water line (proposed for 2002); asphalt acclimation pond and add large wood/ cobble structures.

SECTION 10. RELEASE

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

Currently, all fish are coded wire tagged and released from the WDF&W Whitehorse Hatchery at a size and time which mimics the peak time for naturally spawned outmigrants based on limited outmigrant studies by WDF, Stillaguamish and Tulalip Tribes. These fish are released volitionally starting in May at a size that ranges from 150-80 fish per pound.

10.1) Proposed fish release levels. (Use standardized life stage definitions by species presented in Attachment 2. "Location" is watershed planted (e.g. "Elwha River").)

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling	220,000	150-80 per pound	May 1st through May 30th.	Whitehorse Hatchery
Yearling				

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

Stream, river, or watercourse: *(include name and watershed code (e.g. WRIA) number)*
Release point: Whitehorse Hatchery (WRIA 05.0254A) at river mile 28 of the
Major watershed: North Fork Stillaguamish (WRIA 05.0135)
Basin or Region: Puget Sound

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

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Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Release Date	Release Type
1988					137,243	90/lb	5/18	Forced
1989					41,115	85/lb	5/17	Forced
1990					46,837	86/lb	5/16	Forced
1991					69,100	69/lb	5/17-5/20	Vol/Forc
1992					176,756	85/lb	5/15-5/19	Vol/Forc
1993					100,121	80/lb	5/24-5/29	Vol/Forc
1994					216,000	80/lb	5/13-5/26	Vol/Forc
1995					211,200	70/lb	5/24-5/29	Vol/Forc
1996					35,500	50/lb	5/23-5/28	Vol/Forc
1997					218,092	90/lb	5/17	Forced
1998					47,639	56/lb	5/14-5/23	Vol/Forc
1999					190,654	84/lb	5/22-5/28	Vol/Forc
2000					172,350	78/lb	5/19-5/25	Vol/Forc

Data source: (Link to appended Excel spreadsheet using this structure. Include hyperlink to main database)

Source of data: Kip Killebrew, Stillaguamish Tribe; Northwest Indian Fish Commission CRAS Data Base

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

During the 1988-90 period, chinook fingerlings were reared in net pens at the Fortson Mill Pond. The net pen rearing required a forced release. Beginning in 1991, final acclimation occurred at the Washington State Department of Fish and Wildlife Whitehorse Hatchery. The large gravel pond that the fish were reared in allowed for an initial volitional release beginning when the fish started congregating near the outflow screen and continuing until most of the fish had left the pond. Hatchery staff would then lower the pond to force the remaining few fish out. The initial time period for release also reflects the peak outmigrant timing for natural chinook based on several years of outmigrant trapping by the WDF (Seiler, 1984) and Stillaguamish and Tulalip Tribes.

Please see the above **table (10.3)** for detailed release information

10.5) Fish transportation procedures, if applicable.

Chinook fry are transported to the Whitehorse Hatchery during the first part of March each year for final acclimation, tagging and release. Fish transportation occurs in a fiberglass insulated fish-hauling tank. Loading densities are 300lbs of fry per 680 gallons of well water. Salt is added as therapeutic treatment and water temperatures are within 5 degrees Farenheit of the receiving water. Compressed oxygen is fed into the transport tank using a standard welding type regulator set at 10-14 psi. Oxygen levels can be monitored from inside the cab of the transport truck. Transit time is typically 1 hour.

10.6) Acclimation procedures (*methods applied and length of time*).

Chinook fry are transported via tank truck to the WDF&W Whitehorse Hatchery for final acclimation during the first week to 10 days of March. Fish are held until May when they begin to crowd the outflow screens at which time they are volitionally released.

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

Fish are tagged during the first part of April as part of the US/Canada Indicator Stock Study. Typically fish are between 150 to 100 fish per pound and are tagged with coded wire tag. Beginning in release year 1999, fish were no longer adipose clipped in conjunction with tagging. The co-managers made this decision based on integrated recovery status of the program and that returning fish were going to the spawning grounds and not a hatchery.

The Chinook Technical Committee of the Pacific Marine Fisheries Council has raised concerns about the loss of critical harvest and migration information on Stillaguamish Summer chinook and the associated North Puget Sound wild chinook stocks that it is suppose to represent as a result of the stock not being both adipose clipped and coded wire tagged.

Because the originial intent of the chinook program was as a US/Canada indicator stock and because of stable and slightly increasing escapment numbers for wild North Fork chinook, the co-managers have agreed to return to both adipose clipping and coded wire tagging program fish beginning in 2004. This decision would be reviewed annually to incorporate changes in either escapement numbers or additional harvest impacts.

See attached CRAS reports (Appendix I): Release Summary Report indicates CWT status. CWT Summary Report provides proportion of tagged, shed tag, untagged fish per CWT release.

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

In the past, all eggs were reared to fingerling stage, tagged and released.
Because these hatchery fish and their progeny are part of the listed species, we are unable to destroy any surplus eggs or fry. The proposal would be to continue tagging and releasing any surplus production contingent upon working closely with National Marine Fisheries Service to determine the best strategy for those surpluses.

10.9) Fish health certification procedures applied pre-release.

Fish are checked monthly during the fry to fingerling growth period and then are checked typically within one week prior to release. A representative sample of healthy fish are examined along with any sick or dead fish. See section 9.2.7 for further fish health information.

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

If adequate time is available, it is technically feasible to transport fish to other hatcheries within the watershed to save them and avoid early releasing.

In the event of a natural catastrophe, dam boards and screens are pulled and the fish are released irrespective of their tagging status or size.

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.

To minimize competition concerns with fry and fingerlings in the river, fish are reared to a size that approximates the size at smoltification based on the outmigrant studies. Then the fish are allowed to leave volitionally. The volitional release reduces the swamping and predator concentration problems associated with a delayed release/ force release strategy.

SECTION 11. MONITORING AND EVALUATION OF PERFORMANCE INDICATORS

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

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

See Table in Section 1.10

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

Some funding and staff time have been allocated to begin implementing the monitoring and evaluation program outlined. The components of the plan will be prioritized and implemented to the extent that funding and staff continue be provided for carrying out the plan.

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

Hatchery operations will be carried out following the recommendations of the Co-managers Salmonid Disease Control Policy. Fish health staff from the Northwest Indian Fish Commission will routinely review all aspects of fish handling and rearing.

Spawning ground surveys for naturally spawning returning hatchery fish will be carried out to minimize harassment of adult fish and damage to redds by field staff traveling in the margins of the stream channel.

Field staff will utilize an outmigrant smolt trap to evaluate differences between chinook hatchery and wild outmigrants. The smolt trap will be operated to minimize stress and mortalities to chinook and other species. The trap will be checked frequently, large predators will be removed first and then chinook will be anesthetized for handling and replaced in recovery tanks prior to release.

The continued operation of the smolt trap is contingent upon receiving the necessary funding to hire the additional staff required to operate it.

SECTION 12. RESEARCH

12.1) Objective or purpose.

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There is no direct hatchery related research currently being conducted at these facilities at this time. The US/Canada Indicator Stock Study is a fisheries management project.

12.2) Cooperating and funding agencies.

12.3) Principle investigator or project supervisor and staff.

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

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

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

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

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

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

12.10) Alternative methods to achieve project objectives.

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

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

SECTION 13. ATTACHMENTS AND CITATIONS

Include all references cited in the HGMP. In particular, indicate hatchery databases used to provide data for each section. Include electronic links to the hatchery databases used (if feasible), or to the staff person responsible for maintaining the hatchery database referenced (indicate email address). Attach or cite (where commonly available) relevant reports that describe the hatchery operation and impacts on the listed species or its critical habitat. Include any EISs, EAs, Biological Assessments, benefit/risk assessments, or other analysis or plans that provide pertinent background information to facilitate evaluation of the HGMP.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

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

Name, Title, and Signature of Applicant:

Certified by_____________________________ Date:_____________

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

Listed species affected: **Stillaguamish NF Chinook** **ESU/Population: Puget Sound Chinook** **Activity: Natural Stock Restoration Program**			
Location of hatchery activity: Harvey Ck and Whitehorse Dates of activity:Aug through September Hatchery program operator: Stillaguamish Tribe			
Type of Take	**Annual Take of Listed Fish By Life Stage *(Number***		
	Egg/Fry	Juvenile/Smolt	Adult
Observe or harass a):snorkel surveys/foot surveys/spawner surveys		1500-5000	500-3000
Collect for transport b):			
Capture, handle, and release c)future adult mark/recapture			200-3000
Capture, handle, tag/mark/tissue sample, and release d): Outmigrant smolt trap calibration; carcass surveys; fish wheel	220,000 fry cwt tagging	50,000 smolt trap calibration fish	100-600
Removal (e.g. broodstock) e)			80-150
Intentional lethal take f):fish health sampling;spawning for egg take	60-200 fish health	60-200 fish health	80-150 egg take
Unintentional lethal take g):hatchery operation mortalities Includes mortalities that may occur with planned placement of vibert egg boxes utilizing eyed hatchery eggs for a survival study in the NF Stillaguamish.	10,000-75,000	10,000-75,000	4-50
Other Take (specify) h)			

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

Instructions:

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