HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	Entiat National Fish Hatchery Leavenworth Hatchery Complex
Species or Hatchery Stock:	Spring Chinook Salmon
Agency/Operator:	U. S. Fish and Wildlife Service (USFWS)
Watershed and Region:	Entiat River, tributary to the Columbia River Washington State
Date Submitted:	November 25, 2002
Date Last Updated:	August, 2005

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.
Entiat National Fish Hatchery (ENFH)

1.2) Species and population (or stock) under propagation, and ESA status.
Carson NFH ancestry stock of spring Chinook salmon *(Oncorhynchus tshawytscha)*, unlisted.

1.3) Responsible organization and individuals

Name (and title): Julie Collins (Project Leader)
Agency or Tribe: U.S. Fish and Wildlife Service
Address: 12790 Fish Hatchery Road, Leavenworth, WA
Telephone: (509) 548-7641
Fax: (509) 548-6263
Email: julie_collins@fws.gov

Name (and title): William W. Edwards (Hatchery Manager)
Agency or Tribe: U.S. Fish and Wildlife Service
Address: 6970 Fish Hatchery Road, Entiat, WA. 98822
Telephone: (509) 784-1131
Fax: (509) 784-2964
Email: bill_edwards@fws.gov

Other agencies, Tribes, co-operators, or organizations involved, including contractors, and extent of involvement in the program:
Involved parties include those associated with the Columbia River Fish Management Plan and the *US v. Oregon* court decision.

1.4) Funding source, staffing level, and annual hatchery program operational costs.
Entiat NFH spring Chinook salmon program is funded by the Bureau of Reclamation (BOR) at about $200,000 annually, and is staffed by 3 FTE's. Fish marking, evaluation, and fish health programs are not included in the above operational costs. Other USFWS offices funded by the BOR conduct these programs.

1.5) Location(s) of hatchery and associated facilities.
Entiat NFH is part of the Leavenworth Complex, which also includes the Leavenworth and Winthrop NFH's. Entiat NFH is located west of Entiat, WA on the Entiat River, 6.7 river miles (rm) above its confluence with the Columbia River. Fish returning to Entiat NFH must travel about 491 rm and negotiate passage through eight Columbia River hydroelectric dams.

1.6) Type of program.
Mitigation.

1.7) Purpose (Goal) of program.
Smolt releases are made directly into the Entiat River so adults returning from these releases can potentially provide sport and tribal fishing opportunities while minimizing adverse affects to listed fish. There is no primary intent for returning adults to be used for any purpose other than harvest, brood stock, and stream nutrient enhancement.

1.8) Justification for the program.
The hatchery was originally authorized through the Grand Coulee Fish Maintenance Project in 1937 and again by the Mitchell Act in 1938. Operations began in 1942. Entiat NFH is one of three mid-Columbia hatcheries constructed by the BOR as mitigation for the Grand Coulee Dam-Columbia Basin Project. It is currently used for adult collection, egg incubation, and rearing of spring Chinook salmon.

1.9, 1.10) List of program "Performance Standards and Indicators."
Performance Indicators are designated as "Risk assessment" (R) or "Benefits" (B).

Legal Mandates:
Performance Standard (1): Program contributes to fulfilling tribal trust responsibility mandates and treaty rights, as described in applicable agreements such as under *U.S. v. Oregon.*

Indicator (a): **(B)** Total number of fish given to and/or harvested by Native American organizations.

Performance Standard (2): Program contributes to mitigation requirements as stated in the Columbia River Fish Management Plan and the *U.S. v. Oregon* decision.

Indicator (a): **(B)** Number of fish released by program, returning, harvested and/or surplus, as applicable to given mitigation requirements.

Performance Standard (3): Program addresses ESA responsibilities.

Indicator (a): **(R)** ESA consultations under Section 7 have been completed. A draft Biological Opinion has been issued. Modifications to existing BA's are done in a timely manner.

Harvest:
Performance Standard (4): Fish produced for harvest are reared and released in a manner enabling effective harvest, while avoiding over-harvest of non-target species.

Indicator (a): **(R)** Annual number of fish produced by this program caught in all fisheries, including estimates of fish released and associated mortalities, by fishery.

Indicator (b): **(R)** Annual numbers of each listed, non-target species caught (including fish released) in fisheries targeting this population, when applicable.

Indicator (c): **(B)** Recreational angler days, by fishery, when applicable.

Indicator (d): **(B)** Catch per unit effort, by fishery, when applicable.

Indicator (e): **(R)** Annual escapements of SCS natural populations that are affected by fisheries targeting program fish

Performance Standard (5): Release groups are sufficiently marked in a manner consistent with information needs and protocols to enable determination of impacts to natural and hatchery-origin fish in fisheries.

Indicator (a): **(R)** Marking rate by mark type for each release group.

Indicator (b): **(R)** Sampling rate by mark type for each fishery.

Indicator (c): **(B)** Number of marks of this program observed in fishery samples, and estimated total contribution of this population to fisheries, by fishery.

Conservation of Wild/Naturally Spawning Populations:
Performance Standard (6): Releases are sufficiently marked to allow statistically significant evaluation of program effects on the local natural population.

Indicator (a): **(R)** Marking rates and type of mark.

Indicator (b): **(R)** Number of marks and estimated total proportion of this population in juvenile dispersal and in adults on natural spawning grounds.

Life History Characteristics:
Performance Standard (7): Annual release numbers do not exceed estimated basin-wide and local habitat capacity.

Indicator (a): **(R)** Carrying capacity criteria for basin-wide and local habitat, including method of calculation.

Indicator (b): **(R)** Annual release numbers from all programs in basin and sub-basin, including size and life-stage at release and length of acclimation, by program.

Indicator (c): **(R)** Location of releases and natural rearing areas.

Indicator (d): **(R)** Timing of hatchery releases, compared to natural populations.

Indicator (e): **(R)** Migration behavior of releases from this program.

Genetic Characteristics:
Performance Standard (8): Juveniles are released on-station to maximize homing ability to

intended return location.

Indicator (a): **(R)** Location of juvenile releases

Indicator (b): **(R)** Release type, whether forced, volitional, or direct stream release.

Indicator (c): **(R)** Proportion of adult returns to program's intended return location, compared to returns to unintended upstream dams, fisheries, and artificial or natural production areas.

Performance Standard (9): Juveniles are released at fully smolted stage.

Indicator (a): **(R)** Level of smoltification at release, compared to a regional smoltification index (when developed). Release type, whether forced, volitional, or direct stream release.

Research Activities:
Performance Standard (10): The artificial propagation program uses standard scientific procedures to evaluate various aspects of artificial propagation.

Indicator (a): **(R)** Scientifically based experimental design, with measurable objectives and hypotheses.

Performance Standard (11): The artificial propagation program is monitored and evaluated on an appropriate schedule and scale to address progress toward achieving the experimental objective and evaluate beneficial and adverse effects on natural populations.

Indicator (a): **(R)** Monitoring and evaluation framework including detailed time line.

Indicator (b): **(R)** Annual and final reports.

Operation of Artificial Production Facilities:
Performance Standard (12): The artificial production facility is operated in compliance with all applicable fish health guidelines and facility operation standards and protocols.

Indicator (a): **(R)** Annual reports indicating level of compliance with applicable standards and criteria.

Indicator (b): **(R)** Periodic audits indicating level of compliance with applicable standards and criteria.

Performance Standard (13): Effluent from the artificial production facility will not detrimentally affect natural populations.

Indicator (a): **(R)** Discharge water quality compared to applicable water quality

standards and guidelines, including those relating to temperature, nutrient loading, chemicals, etc.

Performance Standard (14): Water withdrawals and in-stream water diversion structures for facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.

Indicator (a): **(R)** Water withdrawals compared to applicable passage criteria.

Indicator (b): **(R)** Water withdrawal facilities comply with National Marine Fisheries Service (NMFS), USFWS, and Washington Department of Fish and Wildlife (WDFW) juvenile screening criteria.

Indicator (c): **(R)** Proportion of diversion of total stream flow between intake and outfall.

Performance Standard (15): Releases do not introduce pathogens not already existing in the natural populations, and do not significantly increase the levels of existing pathogens.

Indicator (a): **(R)** Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence.

Indicator (b): **(R)** Juvenile rearing densities during artificial rearing/meet standard.

Performance Standard (16): Distribution of carcasses for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines.

Indicator (a): **(B)** Number and locations of carcasses distributed for nutrient enrichment.

Indicator (b): **(R)** Statement of compliance with applicable regulations and guidelines.

Performance Standard (17): Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.

Indicator (a): **(R)** Size at, and time of, release of juvenile fish, compared to size and timing of natural fish present.

1.11) Expected size of program.

1.11.1) Proposed annual brood stock collection level (maximum number of adult fish). Approximately 300 adults are needed for present production of 400K smolts. Additionally, up to 100 adults are secured (when possible) for transfer to Omak Creek in Okanogan County. This upper Columbia River tributary has been void of salmonids for years. This re-introduction effort began through a cooperative agreement between USFWS, NMFS, WDFW, Colville Federated Tribe, and Columbia River Inter-tribal Fish

Commission (CRITFC). Consultation will be conducted by the Colville Tribe.

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

Table 1: Current proposed annual fish releases from the Entiat NFH.

Life Stage	Release Location	Annual Release Level
Eyed Eggs	0	0
Unfed Fry	0	0
Fry	0	0
Fingerling	0	0
Yearling (smolts)	Entiat River	400,000 (goal)
Adults	Omak Creek	Up to 100

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

Table 2: Number of yearling spring Chinook released, adult returns by brood year and corresponding smolt to adult survival (%) from Entiat NFH, 1980 to 1994 (USFWS 2002).

Brood year	Smolts Released	Adult returns (BY)	Smolt to Adult Survival (%)
1983	894,631	1,155	0.129
1984	835,090	216	0.026
1985	925,000	929	0.100
1986	838,940	449	0.054
1987	791,263	490	0.062
1988	585,800	742	0.127
1989	818,707	450	0.055
1990	343,150	30	0.009
1991	376,462	127	0.032
1992	378,729	182	0.048
1993	391,211	244	0.062
1994	335,593	240	0.072

1.13) Date program started (years in operation), or is expected to start.
Releases of spring Chinook salmon were re-established in 1976.

1.14) Expected duration of program.
Ongoing.

1.15) Watersheds targeted by program.
Entiat River Basin (WRIA 46). Returning adults of ENFH origin are expected to return to the Entiat River only, although some adults are harvested in lower Columbia and ocean fisheries.

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

1.16.1 Brief Overview of Key Issues

A portion of the issues stated below were presented by entities other than the USFWS, and therefore are not necessarily the opinion of the management entity.

NOAA Fisheries asked for the elimination of the sub-yearling program (400k annually) and this has been accomplished. Currently, there is a hatchery/wild fish genetic study underway and tissue samples are being taken from both populations. This is a big issue and the results may have a great impact on the future of the Entiat program. ENFH also lacks a quality water source for the production program. Another key issue in the Entiat Basin is whether to keep this river as a "reference" stream. This is potentially the only basin available in the upper-Columbia River ESU where the effects of supplementation can be measured against areas without hatchery influence.

1.16.2 Potential Alternatives to the Current Program

The potential alternatives presented are in draft form and are not necessarily endorsed by the management entity, as mitigation responsibilities may override the desire to implement the alternative.

Alternative 1: Change release location of some or all of the spring Chinook reared at ENFH to the Okanogan River basin or a mainstem Columbia River location to allow a tribal and non-tribal fishery opportunity. An important objective of this mitigation hatchery is to provide fish for harvest. Because the Entiat Basin has an ESA listed spring Chinook stock present, no fishery is allowed. By moving the juveniles to areas not constrained by listed stocks, the returning adults could be harvested (some would need to retained for brood) to aid in fulfilling the mitigation objective.

Alternative 2: Shift production at ENFH to a species other than spring Chinook or steelhead. Formally establish the Entiat River populations of spring Chinook and steelhead as reference populations for supplemented populations throughout the upper Columbia ESU. A greater than normal number of hatchery spring Chinook have been recovered on the spawning grounds during recent years of high adult returns. A segregated program should minimize the potential of hatchery fish straying into the natural spawning areas. If straying cannot be controlled, the program should be changed. Historically, other species have been successfully reared at ENFH (e.g. summer Chinook).

Alternative 3: If data indicates that the hatchery and natural spawning populations are genetically similar.

Background – The Biological Assessment and Management Plan (BAMP, April, 1998), the consensus document that is the basis for the Mid-Columbia HCPs, states that for the Entiat River basin "continue the current program until the genetic and demographic assessment of hatchery and natural fish is completed. If the two components appear reproductively integrated, develop and maintain a locally adapted Entiat population. In addition to the ongoing program, initiate a

supplementation program for the upper Entiat River. Additional production (if feasible) capability will be 200,000 yearling smolts. Emphasis will be placed on natural rearing. If the natural population appears to be reproductively isolated from those reared at Entiat NFH, develop a strategy to monitor that population as a non-intervention "reference" group."

Status – The USFWS has been collecting genetic samples from naturally spawning and hatchery populations for 2 or 3 years. NOAA Fisheries has published a preliminary report on their initial findings; **Population genetics of Entiat River spring Chinook salmon: a preliminary analysis** (Ford, 2002). Though this report is very preliminary in the overall analysis, it states "the similarity of the Entiat River wild samples and the Entiat NFH samples suggests that Entiat NFH salmon have successfully spawned and introgressed into or replaced the natural Entiat River population."

Proposed Action – If, in fact, the two Entiat spring Chinook populations are genetically similar, than as described in the BAMP, implement a supplementation program using the Entiat NFH as a central facility and develop low cost, natural acclimation sites in the upper Entiat basin funded by either Chelan or Grant PUD. The "Entiat stock" should be used for the supplementation effort. The "reference" concept becomes moot if the populations are similar given the genetic "cleansing" of the Methow basin spring Chinook populations that NOAA, USFWS and WDFW have implemented over the last several years.

Benefits – Would meet the spring Chinook recovery goals of the Tribal Recovery Plan, and utilize available habitat in the Entiat watershed.

Risks – A spring Chinook supplementation program in the Entiat Basin will have to consider potential ecological risks to listed fish, i.e. steelhead and bull trout. Interaction studies in the Wenatchee have shown that juvenile steelhead and spring Chinook occupy different niches within the available habitat which is consistent with the scientific literature. Bull trout interactions should be also minimal since natural production for juveniles probably occurs well upstream of where supplementation fish would be residing. Juvenile bull trout tend to rear in the headwaters of streams in the Wenatchee basin upstream of both coho and spring Chinook salmon supplementation fish.

Alternative 4: <u>If data indicates that the hatchery and natural spawning populations are **not** genetically similar.</u>

Background – The Biological Assessment and Management Plan (April, 1998), the consensus document that is the basis for the Mid-Columbia HCPs, states that for the Entiat River basin, "continue the current program until the genetic and demographic assessment of hatchery and natural fish is completed……". If the natural population appears to be reproductively isolated from those reared at Entiat NFH, develop a strategy to monitor that population as a non-intervention "reference" group."

Status – The USFWS has been collecting genetic samples from naturally spawning and hatchery populations for 2 or 3 years. NOAA Fisheries has published a preliminary report on their initial findings; **Population genetics of Entiat River spring Chinook salmon: a preliminary**

analysis (Ford, 2002). Though this report is very preliminary in the overall analysis, it states "the similarity of the Entiat River wild samples and the Entiat NFH samples suggests that Entiat NFH salmon have successfully spawned and introgressed into or replaced the natural Entiat River population."

Proposed Action – If, in fact, the two Entiat spring Chinook populations are genetically different, then implement a program that has a strong monitoring evaluation component so that the Entiat basin can truly be scientifically designated as a "reference/control" basin for spring Chinook. Under this scenario, use the Entiat NFH to rear up to 400,000 coho pre-smolts for restoration/supplementation purposes in the Entiat basin and potentially the Wenatchee and Methow basins depending on coho program objectives.

Benefits – Would meet the coho recovery goals of the Tribal Recovery Plan, and make the Entiat basin a "true" spring Chinook reference basin with coho naturally co-habitating with spring Chinook as in the Wenatchee and Methow basins. This would utilize available habitat in the Entiat watershed.

Risks – A coho supplementation program in the Entiat Basin will have to consider potential ecological risks to listed fish, i.e. spring Chinook, steelhead and bull trout. Interaction studies in the Wenatchee have shown that juvenile steelhead and spring Chinook occupy different niches from coho within the available habitat which is consistent with the scientific literature. Bull trout interactions should be also minimal since natural production for bull trout juveniles probably occurs well upstream of where coho supplementation fish would be residing. Juvenile bull trout tend to rear in the headwaters of streams in the Wenatchee basin upstream of both coho and spring Chinook supplementation fish.

1.16.3 Potential Reforms and Investments

The potential reforms and investments stated below are in draft form, presented for further discussion, and do not represent final decisions by the management entities.

Reform/Investment 1: Obtain additional good quality water for the facility. This action would allow additional production (different stock or species) and/or a reduction in raceway densities, which promotes improved fish health. Because this basin is already over-appropriated and the current wells are considered to be in continuity with the river, this reform/investment has not recently been pursued. Monetary costs for this project are not known at this time.

Reform/Investment 2: Develop a comprehensive monitoring and evaluation plan for the spring Chinook and steelhead populations consistent with those operating in the Wenatchee and Methow Basins, as reference population's comparable data should be collected. $$$

Reform/Investment 3 (pertaining to Alt. 3):

1. Build low cost acclimation facilities (2 to 3) using existing ponds and side-channels in the watershed, up to river mile 29. $$
2. Set up a monitoring/evaluation program to evaluate adult and juvenile survival, adult

replacement, spawning success, and potential impacts to listed fish. $$$
3. Construct an adult trap, using a Canadian design (LGL in Sidney, B.C.) to collect broodstock and monitor hatchery versus natural origin returns. $$

Reform/Investment 4 (pertaining to Alt. 4):

1. Build low cost acclimation facilities (2 to 3) using existing ponds and side-channels in the watershed, up to river mile 29. $$
2. Set up a monitoring/evaluation program to evaluate adult and juvenile survival, adult replacement, spawning success, and potential impacts to listed fish. $$$
3. Construct an adult trap, using a Canadian design (LGL in Sidney, B.C.) to collect broodstock and monitor hatchery versus natural origin returns. $$

For reference:

$	<$50,000
$$	$50,000 - <$100,000
$$$	$100,000 - <$500,000
$$$$	$500,000 - <$1,000,000
$$$$$	$1,000,000 - <$5,000,000
$$$$$$	Over $5,000,000

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

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

1. FWS # 1-9-99-I-112 (bull trout).
2. NMFS Draft BiOp, dated 9/7/01, for UCR steelhead and spring Chinook salmon.
3. Section 7 Biological Assessments for steelhead (11/97) and spring Chinook salmon (3/99) have been submitted and accepted.
4. NMFS 1999 Biological Opinion on Artificial Production in the Columbia River Basin.
5. Permit #1119 (research), NMFS.

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.

Spring Chinook salmon (SCS)

Adult spring Chinook destined for the upper-Columbia Basin enter the Columbia River beginning in March and reach peak abundance (in lower river) in April and early May (Chapman et al. 1995). Spring Chinook enter the main stem portions of tributaries from late-April to July. Spawning occurs from late-July through September, usually peaking in mid to late August (Chapman et al. 1995). From 1991 to 2000, the average date for peak spawning occurs during the last week in August; the first week in September. Equal

to spawning periods at the hatchery. Data from post-spawn adults collected and sampled in mid-Columbia tributaries, 1986 to 1993, shows that on average, 5% of males return at age 3, 58% at age 4, and 37% at age 5. Female averages are 58% at age 4, and 42% return at age 5 (Chapman et al. 1995).

On the spawning grounds, Chapman et al. 1995, indicated that females may dominate the males in numbers, but state that the ratio may be closer to 1:1. This is because there is a greater likelihood of recovering females on the spawning grounds than males (Chapman et al. 1994).

Wild juvenile spring Chinook salmon originating in the upper-Columbia Basin emigrate towards the ocean during their second year. Average size at emigration (April and May) ranges from about 91.8 mm to 100.5 mm (averages from three emigration studies) (Chapman et al. 1995).

Summer Steelhead (SST)

Steelhead destined for the upper-Columbia region enter the Columbia River between May and September (WDF et al. 1990). They pass Rock Island Dam from July through the following May. All steelhead spawn in the spring, regardless of when they enter the Columbia River.

Spawning grounds are not surveyed for steelhead because the adults generally spawn over a 4 to 5 month period coinciding with the spring run-off when water visibility is low and discharge high (Chapman et al. 1994). Spawning is believed to take place between March and June, but has been observed as late as July (Chapman et al. 1994).

Females make up about 65% of adults sampled at Wells Dam; of smolts sampled at Rock Island Dam in 1988, 63% were female (Chapman et al. 1994).

Howell et al. (1985) reported age estimates from creel surveys in the Wenatchee River from the late 1970s to the early 1980s. Scale samples from these surveys were used for age determination. In the Wenatchee River, they report naturally produced steelhead of five different age classes (2.1, 2.2, 2.3, 3.1, and 3.2), with the largest percentage in the 2.1 class. The "European Method" was used for age determination where the first digit represents the number of winters spent in freshwater, and the second digit indicates the number of winters in saltwater. This data should also be applicable to the Entiat River.

Migrating steelhead smolts captured at Rock Island Dam average 163 to 188 mm. Adults returning after one year average 59 to 64 cm, whereas those spending two years at sea average 67 to 76 cm when returning to freshwater. Between 1986 and 1993, wild adults of both sexes combined, averaged 66.5 cm (Chapman et al. 1994).

- Identify the ESA-listed population(s) that will be directly affected by the program.
The listed SCS stock in the Entiat River spawns in an area about 10 miles upstream

(rms 16 – 27) of the hatchery (rm 6.7). Although uncommon, adults of Entiat NFH origin are found on the spawning grounds.

Little is known about the status of the steelhead stock in the Entiat River Basin. The main spawning area for steelhead is in the Mad River, which is about 4 miles above the hatchery.

- Identify the ESA-listed population(s) that may be <u>incidentally</u> affected by the program.
UCR steelhead and Entiat Basin (UCR) spring Chinook salmon.

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

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

NMFS determined that the annual rate of population change for the UCR spring Chinook and summer Steelhead ESU is less than 0.9, and decreasing in abundance at a rate of at least 10% per year. These populations are at dire risk, with only small fractions of their already depressed populations expected to persist through the next 24 years under current conditions (NMFS 2001). Therefore, UCR spring Chinook and summer Steelhead are considered at a "critical population threshold."

- 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.
Unknown for SCS or SST, please see below.

- 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.

Table 3. Number of SCS redds found in the Entiat River Basin, 1990 to 2001 (Hamstreet and Carie 2002).

Year	# of Redds	Year	# of Redds
1990	83	1996	20
1991	32	1997	37
1992	42	1998	24
1993	100	1999	27
1994	34	2000	73
1995	13	2001	202

Note: 1990 – 1993, only single "index" counts were conducted. 1994 – 2001 is expanded survey.

- 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.

Table 4. Estimates of the number of natural-origin SCS returning to the Entiat River, 1990 – 2001 (Hamstreet and Carie 2002).

Year	Total Adults	# of Natural Origin Adults	Year	Total Adults	# of Natural Origin Adults
1990	290	Unknown	1996	48	38
1991	112	Unknown	1997	89	Unknown
1992	147	Unknown	1998	58	58
1993	350	Unknown	1999	65	65
1994	82	82	2000	175	55
1995	31	31	2001	485	339

Note: Estimates of natural-origin SCS adults were derived from carcass recoveries. This is a rough estimate as few carcasses were recovered. If no hatchery adults were among those found, then number is same.

Table 5: Percentage of wild proportion of SST passing Priest Rapids Dam (destined for the upper Columbia) (NMFS 2001).

Year	Wild % of Total	Year	Wild % of Total
1987	28.4	1993	16.3
1988	26.2	1994	12.7
1989	25.2	1995	22.7
1990	20.2	1996	10.1
1991	20.0	1997	8.8
1992	11.4	1998	15.9

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

- Describe hatchery activities that may lead to the take of listed salmonid populations in the target area, including how, where, and when the takes may occur, the risk potential for their occurrence, and the likely effects of the take.
Brood stock collection is directed at unlisted adults returning to Entiat NFH and has a low potential to "take" listed spring Chinook salmon. Since 1994, only three verified listed spring Chinook have been used for propagation. Returning listed salmonid populations have unobstructed access to the water above Entiat NFH. Listed fish may voluntarily enter the spring Chinook adult trap during the hatchery run. Identifiable salmonids (bull trout and steelhead) are returned to the Entiat River as quickly as possible.

- Provide information regarding past takes associated with the hatchery program, (if known) including numbers taken, and observed injury or mortality levels for listed fish.
Since 1994, only three verified listed or naturally produced SCS have been used for production.

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

- 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.
Beginning with brood year 1999, 100% of all spring Chinook hatchery releases have been ad-clipped. Our contingency plan beginning with return year 2004 will be that all ad-present adults found in adult holding ponds will be returned to the Entiat River during any operation that involves adequate hands on inspection of the returning adults. Listed non-spring Chinook salmonids will also be returned to the Entiat River immediately.

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 Columbia River Fish Management Plan *(US v Oregon)* directs the operation/production of this facility.

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

Original Authorities

- Grand Coulee Dam Project, 49 Stat. 1028, 08/30/1935
- Grand Coulee Fish Maintenance Project, 04/03/1937
- Mitchell Act, 52 Stat. 345, 05/11/1938
- Columbia Basin Project Act, 57 Stat. 14, 03/10/1943
- Mitchell Act (amended), 60 Stat. 923, 08/14/1946
- Fish and Wildlife Coordination Act, 60 Stat. 1080, 08/14/1946

Description of Roles/Responsibilities/Authorities Beyond Those Initially Authorized

- Treaty with the Walla Walla, Cayuse, Umatilla Tribes, 06/09/1855
- Treaty with the Yakama, 06/09/1855
- Treaty with the Nez Perce, 06/11/1855
- Treaty with the Tribes of Middle Oregon, 06/25/1855
- Executive Order (Treaty with Bands of Colville), 04/08/1872
- U.S. v. Oregon (Sohappy v. Smith, "Belloni decision", Case 899), 07/08/1969
- Endangered Species Act of 1973, 87 Stat.884, 12/28/1973
- Salmon and Steelhead Conservation and Enhancement Act, 94 Stat. 3299, 12/22/1980

- Pacific Salmon Treaty Act of 1985 (U.S./Canada Pacific Salmon Treaty), Public Law 99-5, 16 U.S.C. 3631, 03/15/1985

3.3) Relationship to harvest objectives.

The average adult return to Entiat NFH for the past 25 years has been just over 600 adults which prohibits any significant harvest. When returns can be become more predictable and with 100% marking of hatchery stock, a limited sport harvest combined with an on station tribal surplus may occur. Production numbers are derived from the *U.S. v. Oregon* court decision.

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

Fisheries that benefit from the program:

- Marine sport and commercial
- Columbia River gill net and freshwater net
- Columbia River and freshwater (tributary) sport
- Treaty ceremonial and tribal harvest

Table 6: Number of ENFH SCS adults harvest, 1988 to 1999.

Year	1988	1989	1990	1991	1992	1993
Entiat Basin Harvest	0	0	0	0	0	0
Outside Basin Harvest	64	8	0	9	13	52

Year	1994	1995	1996	1997	1998	1999
Entiat Basin Harvest	0	0	0	0	0	0
Outside Basin Harvest	8	12	7	0	16	25

3.4) Relationship to habitat protection and recovery strategies.

As previously mentioned, ENFH is a mitigation facility constructed to compensate for the loss of spawning and rearing habitat due to the construction of Grand Coulee Dam.

Anadromous salmonid populations in the Entiat sub-basin are influenced by the following out-of-sub-basin impacts; degraded estuarine habitat, fish harvest, unfavorable ocean conditions, and the effects of eight Columbia River reservoirs and hydroelectric dams on smolt and adult migration.

The ability of the Entiat watershed to fully sustain salmon populations is most limited by a lack of over-wintering juvenile habitat. Losses in floodplain and riparian zone connectivity and function have dramatically altered natural hydrological and geomorphic processes essential to juvenile survival (CBFWA 2002).

Other factors have also contributed to the simplification of fish habitat. Historically, moderate to heavy sheep grazing in the uplands modified the under story grassy communities, and the

removal of beaver diminished water storage capacity and altered flow regimes. Timber harvest, fire suppression, and the conversion of floodplains to crops, pasture, roads, and urban uses has contributed to losses of important salmonid rearing habitat through compacted soils, simplification and destruction of vegetative communities, accelerated sediment and water delivery to stream channels, and increases in the frequency, intensity and duration of flood and mass wasting events. These conditions can hinder salmon productivity and/or lead to mortality of eggs, juveniles and adults (Andonaegui 1999).

3.5) Ecological interactions.

Table 7. Expected fish species present in Entiat River

Salmonid Species	Scientific Name	Non-salmonid Species	Scientific Name
Spring Chinook salmon	*Oncorhynchus tshawytscha*	Longnose dace	*Rhinichthys cataractae*
Summer Chinook salmon	*O. tshawytscha*	Mottled sculpin	*Cottus bairdi*
Sockeye salmon	*O. nerka*	Largescale sucker	*Catostomus macrocheilus*
Coho salmon	*O. kisutch*	Bridgelip sucker	*C. columbianus*
Summer steelhead	*O. mykiss*	Pacific lamprey	*Entosphenus tridentatus*
Westslope cutthroat trout	*O. clarki lewisi*	Northern pikeminnow	*Ptychocheilus oregonensis*
Redband trout	*O. mykiss gairdneri*	Redside shiner	*Richardsonius balteatus*
Bull trout	*Salvelinus confluentus*		
Brook trout	*S. fontinalis*		
Mountain whitefish	*Prosopium williamsoni*		

Ecological effects/interactions of ENFH fish on natural populations is broken-down into two categories; 1) effects associated with juvenile releases, and 2) effects associated with returning adults. Potential effects to listed stocks are described below.

Juvenile Releases

Competition:

When hatchery-origin Chinook are released into the Entiat River the potential exists for intra- and inter-specific competition with natural-origin juvenile salmonids, including listed spring Chinook salmon and Steelhead (NMFS 2001). Listed wild spring Chinook and Steelhead are present year-round in Upper Columbia River region tributary and mainstem areas. Spring Chinook fry emerge from the gravel in late winter or early spring at an average size of approximately 30 mm fl, with most fry immediately moving downstream to mainstem tributary areas for rearing (NMFS 2001). Upper Columbia River spring Chinook salmon migrating seaward as yearling fish between April and June, average 87 to 127 mm fl (NMFS 2001). Steelhead fry egress from late spring through August at a size of 30 to 33 mm fl (NMFS 2001). The fry disperse to downstream areas in late summer and fall. Upper Columbia River steelhead emigrate seaward as age 2+ (43.2%) or 3+ (46.4%) smolts (Peven, 1990) during April and May at an average size of 163 to 188 mm (Chapman et al. 1994).

For the species viewed as posing competition risks by the Species Interaction Work Group (SIWG (1984)), spring Chinook, summer Chinook, and Coho salmon yearling smolts released from the hatcheries by the action agencies (which includes ENFH) in April and May likely encounter newly emerged, listed spring Chinook salmon fry adjacent to the hatchery release sites

(since 1994, only one SCS redd has been documented in the lower 16 miles of the Entiat River). These release groups may also encounter spring Chinook fry and juvenile steelhead in river reaches downstream of the release sites. Emigrating spring Chinook and steelhead smolts in the action area may also be encountered during the hatchery fish emigration period. The SIWG (1984) identified a high risk that competition by hatchery-origin Chinook and Coho salmon juveniles will have a significant negative impact on productivity of wild Chinook salmon and Steelhead juveniles in freshwater.

The release of migration-ready smolts limits the duration of interaction between the hatchery fish and listed wild spring Chinook and Steelhead rearing in areas adjacent to, and downstream of, the hatchery fish release locations. This release practice therefore likely decreases resource competition and behavioral dominance risks posed by the larger hatchery fish. The larger size of the hatchery fish relative to the wild fry and fingerlings present at the time of releases also decreases the likelihood for competition for the same food resources by the hatchery and wild fish. The larger, seaward migrating hatchery smolts will also tend to use different habitat than rearing steelhead and spring Chinook fry and fingerlings that may be encountered (NMFS 2001).

Predation:

By virtue of their large size compared to wild juvenile fish that they may encounter after release, and considering the areas where hatchery fish are released, hatchery spring Chinook yearlings have the potential to prey upon listed fish in the Entiat River and mainstem Columbia River (NMFS 2001). The SIWG (1984) identified that the release of hatchery Chinook and Coho salmon would adversely affect the productivity of wild Chinook and Steelhead populations through predation, but to what extent is unknown.

Spring Chinook yearling smolts released from ENFH in April have the potential to encounter newly emerged, listed spring Chinook fry in the lower Entiat River that have emigrated downstream from natural spawning areas above the hatchery. The hatchery smolts may also encounter rearing spring Chinook fry and fingerlings, and yearling steelhead fingerlings, downstream of the release site in the mainstem Columbia River. The later emergence time for steelhead fry in the Entiat River Basin likely separates the fry temporally from the hatchery salmon releases, making predation unlikely (NMFS 2001). Applying the "1/3 size rule" (USFWS 1994), and considering hatchery release timing relative to the presence and life history stage of listed fish that may be encountered, ENFH yearling spring Chinook salmon may pose an elevated risk of predation to newly emerged wild spring Chinook fry (NMFS 2001).

Hatchery spring Chinook released at ENFH in April may encounter emigrating spring Chinook and Steelhead smolts in the action area during the hatchery fish release and downstream migration period. Predation by hatchery fish on listed spring Chinook and Steelhead smolts commingling with hatchery fish during seaward emigration is unlikely, given the similar size of hatchery salmon and wild spring Chinook, and the generally larger size of emigrating wild steelhead smolts (NMFS 2001). The hatchery releases may pose indirect predation risks to the wild fish in Basin reaches where hatchery fish are densely distributed and commingled with wild fish, however, by attracting avian or fish predators (NMFS 2001).

Residualism:
Spring Chinook, summer Chinook, Sockeye, and Coho salmon released from hatcheries as yearling smolts do not have the same potential to residualize as steelhead (NMFS 2001). Standardization of the life history of these salmon species by producing yearling smolts differs from the variability in growth and advent of smoltification evident in wild fish populations. The hatchery production strategies designed to release uniform sized smolt groups limit the likelihood for residualization of the salmon released (NMFS 2001).

Residualization by ENFH yearling spring Chinook salmon, leading to the occurrence of precocious male spring Chinook, may be a risk factor for listed wild adult spring Chinook in the Entiat River Basin (NMFS 2001). The existence of non-migrating, precocious males is common and characteristic of hatchery and wild spring Chinook stocks in the region at low proportions (1% to 3% of yearling populations) (USFWS 1999). These precocious fish may contribute to reproduction in natural spring Chinook spawning areas, but the extent of any contribution is unknown. The risk of adverse effects may be reduced by an apparent higher mortality rate for these precocious fish relative to non-maturing juvenile fish, and a low stray rate to areas outside of the hatchery release location (NMFS 2001).

Transmission of Disease or Parasites:
The potential for ENFH fish to transmit diseases and parasites to listed salmonids is unknown, but thought to be low. Service fish health biologists routinely assess the health of spring Chinook propagated at ENFH. At least once per month, biologists sub-sample ponds to determine Bacterial Kidney Disease (BKD) levels, overall fish health, parasites, and the possible occurrence of other viral or bacterial infections. Under Service fish health policy, fish at ENFH must be destroyed and their remains buried if they are diagnosed with viral diseases not endemic to the country or that threaten the continued existence of fish populations. Parasites are not prevalent among ENFH fish. Female adults are tested for levels of *Renebacterium salmoninarum* at spawning time, and eggs from females with high levels of BKD are discarded.

Migration Corridor:
Unlisted hatchery salmon smolts released from the Upper Columbia River hatcheries may encounter listed Columbia and Snake river basin salmon and steelhead juveniles during migration in the mainstem Columbia River and the estuary (NMFS 2001). Spatial and temporal interaction between hatchery-released smolts and listed salmon and steelhead juveniles may lead to several types of adverse affects on the listed natural populations: predation, competition, behavioral alteration, and disease transmittal.

There is likely a low risk of predation by Upper Columbia River hatchery Chinook smolts on listed Chinook salmon, Sockeye, and Steelhead juveniles due to low spatial and temporal overlap with fish of a susceptible size in the migration corridor. Listed Lower Columbia River Chum salmon may be susceptible to predation by yearling Chinook salmon in the lower Columbia River and estuary (NMFS 2001). SIWG (1984) indicated a high risk that predation by this species (and others) would have negative effects on the productivity of Chum salmon. Chum are thought to emigrate predominately in March, which may separate them from Upper Columbia region hatchery Chinook, which are released in April. The duration of time that Chum salmon

inhabit the Columbia River estuary is unknown, as is the risk of predation on the commingled wild fish (NMFS 2001).

Potential impacts of competition on listed fish in the migration corridor likely diminish as hatchery smolts disperse from the hatchery release locations and become less concentrated. Food resource competition may continue to occur at an unknown, but likely lower level as smolts move downstream through the migration corridor (NMFS 2001). NMFS (1996) previously determined that no adverse competition effects on co-occurring listed salmon in the migration corridor would result from the release of hatchery smolts that begin migration immediately seaward after release. The release of migration-ready smolts limits the duration of interaction with wild salmonids in the migration corridor. Competition between Upper Columbia River hatchery-origin unlisted salmon and wild salmon and steelhead in the mainstem corridor should not significantly affect listed salmonids (NMFS 2001).

Release of only smolts from ENFH will minimize temporal overlap between unlisted hatchery-released salmon and listed fish in the Columbia River mainstem. Releases of hatchery salmon smolts coincident with managed releases of water from dams (water budget releases) will help accelerate migration of hatchery-released salmon, further reducing spatial and temporal overlaps with wild fish (NMFS 2001).

Additional compliance with fish disease control and minimization policies and guidelines (IHOT 1995), significantly decreases the likelihood for transfer of disease from hatchery salmon to listed wild salmonids during the seaward emigration period in the mainstem river (NMFS 2001).

Returning Adults

The possibility is thought to be low that adult spring Chinook salmon returning to ENFH will adversely impact listed salmonids. Potential for effect could occur in the ocean and in-river migration corridor or during broodstock collection, harvest, or straying of ENFH adults into the natural spawning areas.

Ocean Effects:

Little is known about individual stocks of Chinook salmon and Steelhead trout between the time they leave the estuary as smolts and return as adults to spawn. Available information is inferred from CWT data taken from fish harvested at sea. These data, however, do not give us insight into fish behavior nor inter-specific interactions among stocks in the ocean. Since Spring Chinook are harvested at an extremely low rate, ENFH fish are not an important factor in determining ocean harvest regulations and quotas that could effect listed species.

In-river Effects:

Adults returning to ENFH are trapped as volunteers to the hatchery from late May to mid-June. There is potential that listed natural-origin spring Chinook originating from other portions of the Columbia River Basin may also be trapped at the hatchery as volunteers. However, the number of listed spring Chinook adults that are likely to return to ENFH is low. Scale and CWT analysis of spring Chinook adults collected at ENFH indicates that very few wild spring Chinook stray

into the hatchery

Harvest:
Adult returns to the Entiat NFH have not consistently produced sustainable numbers for any harvest. Any harvest in the Entiat Basin exposes listed spring Chinook salmon to take. Listed SCS in the Entiat River have restricted (prohibited) any local harvest of returning spring Chinook adults.

Straying and Spawning:
No stray data is available up to 1993. In 1994, USFWS expanded the WDFW redd surveys to include an additional seven miles of the upper Entiat River. In 1995, USFWS took-over all anadromous salmonid surveys in the Entiat Basin. At that time, extensive carcass recovery efforts also began (Table 4).

Current data suggests that during years of low adult returns, few SCS of Entiat NFH or other hatchery origin stray into the upper Entiat Basin (<4%). In years of high abundance (2000 and 2001), this estimate increases substantially (~40%). Although the majority of the unmarked strays are probably of Entiat NFH origin, adults from other basins are also found (Wenatchee, Methow, and Snake rivers).

Wells Dam is located on the Columbia River approximately eight miles below the Methow River confluence. In years of very low adult SCS returns (<600 adults above Wells Dam), all SCS negotiating the dam are trapped and hauled to the two Methow Basin salmonid hatcheries. Since 1996, this protocol has been applied twice (1996, 1998). When all ascending SCS adults are trapped at Wells Dam, many ENFH adults are present. When no trapping occurs at the dam, very few ENFH adults are found in the broodstock or on the spawning grounds. This suggests that even though ENFH adults may stray upriver to Wells Dam, if given the opportunity, most of these will turn back down the Columbia River and enter the Entiat Basin.

Sockeye Salmon:
A small number of Sockeye salmon spawn in the Entiat River and its tributaries. These fish are probably strays from the Lake Wenatchee or Lake Osoyoos stocks. Effects on these from our smolt releases are unknown, but thought to be minimal.

Coho Salmon:
Coho salmon have been extirpated from the Entiat River Basin, no viable population exists at this time.

SECTION 4. WATER SOURCE

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

On July 18, 1994, the U.S. Fish and Wildlife Service filed an application for a change in Entiat

NFH's Surface Water Certificate No. 3058. The service requested to change the point of diversion authorization under Certificate No. 3058, to six wells in continuity with the Entiat River. The Entiat NFH requested that all six production wells and the diversion of water from the Entiat River be within the scope of Certificate No. 3058 provided suitable measuring devices be installed and monitored on all diversionary sources. On February 21, 1996, the above request was approved by the State of Washington, Dept. of Ecology. The quantity of water under this change is for 22.5 cfs from six wells and the Entiat River for the purpose of fish propagation.

Table 8: The following table represents current water use rights for the Entiat National Fish Hatchery.

Certificate Number	Source	Priority Date	Amount
Surface & Ground Water 3058	Entiat River and/or Wells #1-#6	June 4, 1943 Amended Feb.21, 1996	22.5 CFS 10098 GPM
3059	Limekiln (Packwood Spring)	June 4, 1943	7.0 CFS 3142 GPM

The intake is located at river mile 7.2, approximately .33 miles upstream of the hatchery. Water is conveyed to the hatchery through a buried 36-inch pipe system. This water enters a pre-settling basin via inclined 3/32" screens. Screened debris and downstream migrants are diverted via a 18" line back to the Entiat River. The water intake structure consists of a diversion dam, intake well, and bar trash racks (3 inch spacing).

Non-hatchery fish and other aquatic organisms that enter the system can return to the river via an 18" water line that diverts screened debris and water from the stations surface water screen chamber building. Screen chamber meets the standards for screening criteria described in the *1994 Policies and Procedures for Columbia Basin Anadromous Salmonid Hatcheries* developed by NMFS.

Surface water is used on a limited basis. Currently surface water is used to supply adequate amounts of water to operate the station's fish ladder during spring Chinook adults returns. Surface water is also used in case of long-term loss of ground water supplies (emergency). It has been determined that Entiat River water contains high organic loads and detrimental parasites (*Myxobolus sp*.) which have been shown to have a negative impact on hatchery fish production. Since 1990, hatchery production has relied primarily on ground and spring water for fish production. The availability of said ground water determines fish production at Entiat NFH. An average of 2000 gpm is available for production. Water quality data for the Entiat River is in Attachment 1.

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.

Screens are cleaned at least twice per day. Deflectors are installed in the screen chamber to divert sufficient amounts of water through and over 3/32 inch holed screens when water demand from the river is low. These deflectors simply shunt water over the screens so that downstream migrants and debris washes off the screens. Effluent discharge is monitored, reported, and currently complies with applicable standards.

SECTION 5. FACILITIES

5.1) Brood stock collection facilities (or methods).
All brood stock used for production are volunteers to the facility. Adults swim up the collection ladder and into one of two holding ponds. The holding ponds measure 16 x 120 feet, and are supplied with a mixture of surface and ground water for attraction and operation of the ladder. After the spring Chinook adults are spawned, the ponds are cleaned, disinfected, and a portion of the juveniles from the previous years brood are moved from the upper raceways into the large adult ponds. The juveniles remain there until their release the following April.

5.2) Fish transportation equipment (description of pen, tank truck, or container used).
To date, no adults have been transported to/or from Entiat NFH since the spring Chinook program began. In the future, if adult SCS are delivered to Omak Creek a distribution truck will be obtained.

5.3) Brood stock holding and spawning facilities.
As stated in section 5.1, all adults are held in two 16 x 120 foot concrete ponds. The spawning building sits next to the holding ponds. This area has access to pathogen-free well water which is used in the spawning process. After the gametes are mixed, the enumerated egg buckets are taken inside the hatchery building.

5.4) Incubation facilities.
From fertilization to the eyed stage, eggs are incubated in trays receiving 4 gallons per minute. Eggs from individual females are kept separate until fish health tests are completed. Eyed eggs are mixed by egg take after they are "picked". Developing eggs are treated every other day with 750 ppm of formalin for fungus control until they reach 600 temperature units. The current SCS production is incubated on 100% ground water at 47-51^{0}F until "eyed". The eggs are shocked, picked, and inventoried by egg take. Eggs are returned to incubation trays and incubated on 100% ground water at 39-41^{0}F. Emergence is delayed until late February, early March. Previous broods, 2000 and older, were incubated on 100% ground water at 48-51^{0}F until emergence, which occurred in mid-December every year.

5.5) Rearing facilities.
Rearing facilities include the aforementioned adult holding ponds, 30– 8 x 80 raceways, 32 starter tanks, and as stated above in 5.4, emergence occurs in late February to early March. Fry are moved from trays directly to outside raceways. Fry are reared on first pass ground water. Ponds are loaded pending scheduled tagging. At this point fry are counted and "split" into raceways for summer and fall rearing. Once spawning in complete, fry from raceways are moved to the large adult ponds for four months until release (April).

5.6) Acclimation/release facilities.
Yearlings (smolts) are force released directly from the raceways. Dam boards are removed, and the smolts travel through an underground pipe system, which empties at the base of the collection ladder into the Entiat River. The juveniles holding in the adult ponds are forced out down the hatchery ladder into the Entiat River.

5.7) Describe operational difficulties or disasters that led to significant fish mortality.
To date, the only significant loss of fish occurred in 1992 (Brood year 1990) when an estimated 18,000 fish were lost in one of the holding ponds. A combination of human error and advanced smoltification were attributed to this loss. Since this event, an earlier release date has been set to reduce possible losses due to smolt stress.

5.8) Indicate available back-up systems, and risk aversion measures that will be applied, that minimize the likelihood for the take of listed natural fish that may result from equipment failure, water loss, flooding, disease transmission, or other events that could lead to injury or mortality.
The hatchery is staffed full-time eight hours per day. One person is living in residential quarters on the hatchery grounds. The station has a centrally located alarm, which is connected to an automatic dialer. If this system fails, the station is still supplied with between 350 and 450 gpm of gravity fed spring water. This is the failsafe. This water will keep production alive, albeit a relatively short time, until corrective measures can be made. With regards to the "take" of listed fish, the only event that would have some effect would be an emergency release on non-smolting fish. As stated above, the water and alarm systems currently in place reduce the possibility of an emergency release to zero. If power is lost to the facility, there is an emergency back-up system that automatically engages to restore power.

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1) Source.

Table 9: History of Egg Source for the Entiat NFH

Egg Source	Brood	Stock Origin
Rock Island Dam	1942 and 1944	Commingled Upriver Stocks
McKenzie River, OR	1941	McKenzie River
Cowlitz River Hatchery	1974	Cowlitz River
Carson NFH	1975-1981	Carson (Bonneville)
Little White Salmon NFH	1976,1978,1979,1981	Little White Salmon River
Leavenworth NFH	1979-81,1994	Commingled Hatchery Stock
Winthrop NFH	1988	Commingled Hatchery Stock
Entiat NFH	1980, 1983-present	ENFH rack returns

6.2) Supporting information.

6.2.1) History.
The original brood stock used to start the program was commingled, and destined for the upper Columbia Basin. These adults were trapped at Rock Island Dam and brought to the Entiat NFH facility. No spring Chinook releases were made from the facility from 1945 to 1975. Spring Chinook production resumed in 1974, with releases in 1976. Since 1974, eggs sources and subsequent yearling releases have been from several lower river sources as well as from Leavenworth and Winthrop NFHs. The history of their egg

source has been incorporated into the yearling fish production at ENFH. The Little White Salmon (LWS) stock started in 1967, when fish of unknown origin returned to the LWS River. These adults were probably descendants of several different stocks.

6.2.2) Annual size.
See section 2.2.3.

6.2.3) Past and proposed level of natural fish in brood stock.
Adults used for brood stock are assumed to be hatchery fish. Currently, all adults retained for brood are spawned. Staff collects snouts from all ad-clipped adults, and scales from a portion of ad-present fish. Origin (natural or hatchery) of these adults can be determined by scale analysis and de-coding of the CWT. Also see section 2.2.3.

6.2.4) Genetic or ecological differences.
Homing permits local adaptation in salmonids. If hatchery fish, such as Entiat fish with extensive Carson Hatchery background, strayed extensively into tributaries used by wild SCS, one might expect hybridization to occur with detectable consequences. No direct evidence exists that such hybridization has occurred in Entiat River.

Starting in 2001, FWS started collecting genetic (tissue) samples from carcasses obtained on the spawning grounds and from brood taken at the hatchery. These samples, and subsequent samples, are sent to NMFS's genetic lab for analysis. From these data, potential genetic differences between the hatchery and wild stocks may be determined.

6.2.5) Reasons for choosing.
Availability was probably the main factor when brood stock was selected. At that time, little was known about the potential effects of propagating a non-endemic 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 brood stock selection practices.
Currently, no measures are in place as no listed fish are targeted for broodstock and it is a rare occurrence that one enters the facility. Also see section 2.2.3.

SECTION 7. BROODSTOCK COLLECTION

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

7.2) Collection or sampling design.
Brood stock is obtained entirely from adults volunteering to the hatchery's collection ladder. The ladder operates from mid-May to mid-July, which covers the full spectrum of the run. Excess adults are periodically donated to various tribes and non-profit groups. This occurs when large numbers of adults enter the ladder in a short period of time. All adults enter one holding pond, and those retained for brood are moved to a separate unit.

7.3) Identity.
Since only an unlisted spring Chinook stock is propagated at this facility, it is a rare occurrence (less than 1%) that a listed adult is captured at the hatchery. Continued marking and clipping will facilitate immediate identification of non-hatchery fish beginning with return year 2003.

7.4) Proposed number to be collected:

7.4.1) Program goal (assuming 1:1 sex ratio for adults):
Approximately 300 adults are needed to secure production needs. An additional 100 adults may be held for the Omak Creek re-introduction effort.

7.4.2) Table 10. Brood stock collection levels for the last twelve years (e.g. 1988-99), or for most recent years available:

Brood Year	Females	Males	Jacks	Egg Take(e)	Smolts Released
1988	132	68	0	612,188	585,800
1989	240	174	0	878,245	818,707
1990	197	183	0	804,660	721,096[1]
1991	216	180	2	896,000	738,052[1]
1992	233	152	8	885,400	710,907[1]
1993	299	299	0	1,196,000	791,440[1]
1994	42	27	4	168,000	335,593
1995	58	55	3	232,000	200,486
1996	102	62	7	387,600	350,784
1997	139	102	2	500,400	519,237[1]
1998	126	69	14	441,000	359,667
1999	281	144	34	1,067,800	818,981[1]
2000	210	168	24	756,000	533,720
2001	135	98	11	635,250	400,000[2]

(e) estimated; [1]Includes Sub-yearling releases; [2]Program release

7.5) Disposition of hatchery-origin fish collected in surplus of brood stock needs.
Under an agreement with Bureau of Indian Affairs, adults collected in excess of brood stock needs are donated to various tribes for ceremonial and subsistence purposes. A small portion may also go to non-profit groups. Also, up to 100 adults may be transferred to Omak Creek in Okanogan County.

7.6) Fish transportation and holding methods.
All adults used for brood stock are volunteers to the hatchery. No adults are transported to the facility. Adults swim into two 16' X 120' adult holding ponds. Adults may be held up to three months before spawning. A flow-through formalin treatment is administered every other day to help control parasites and fungus. Treatment procedures are consistent with the protocols outlined in INAD permit #9013.

7.7) Describe fish health maintenance and sanitation procedures applied.
Fish health services are provided by staff from the USFWS Olympia Fish Health Center (OFHC)

which is a full service aquatic health facility capable of monitoring, diagnostic, and certification procedures that meet or exceed all national, international, IHOT or co-manager requirements.

Pathogen and disease monitoring starts with adult testing of captured populations for all reportable aquatic viruses and bacteria at the minimum assumed pathogen prevalence level of 5% (i.e. 60 individuals). In addition, all females spawned are specifically and individually tested for *Renibacterium salmoninarum*, the causative agent of BKD. This is essential to determine the pathogen levels and eliminate or segregate the resulting eggs from different risk levels. This process greatly reduces the impact of transmitting the disease from infected females to progeny. All eggs and accompanying containers are disinfected with iodine solution during the water hardening process following fertilization.

Juveniles are routinely monitored throughout the rearing period by monthly visits by fish health biologists. More frequent diagnostics are performed if hatchery staff notices undue mortality or morbidity. Disease outbreaks are prevented or treated by legal application of appropriate chemicals or by modification of rearing parameters. During the rearing period, fish culture equipment is rinsed in disinfectant following use in each pond. Bird exclusion devices are used on all rearing units to minimize the spread of disease through bird predation. At the end of the rearing period, all production lots are again tested for reportable pathogens at the minimum assumed prevalence level of 5% prior to release.

7.8) Disposition of carcasses.

Since all females are injected with Erythromycin prior to spawning, they cannot be placed into basin tributaries for nutrient enhancement. These adults are buried on-site in an earthen pit. All post-spawn adult male carcasses are scatter planted in several basin tributaries for nutrient replacement under permits obtained from WDFW and FWS.

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 brood stock collection program.

As previously mentioned, no listed fish are targeted for brood stock. Since 1994, only three verified listed SCS have been used for production.

SECTION 8. MATING

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

8.1) Selection method.

The fish ladder operates and adult trapping is conducted throughout the entire run. If run size is large, excess fish are periodically removed and brood stock moved to a separate holding pond in proportion to the run size. This enables us to retain adults from the entire run spectrum. All ripe females are spawned weekly. No other selection occurs.

8.2) Males.
Milt from the primary male is used first for fertilization. A secondary male (backup), which was the primary male in the prior mating, is used again about one minute after the primary male. Precocious males (3-year-old jacks) are used randomly throughout spawning at a rate relative to the total return.

8.3) Fertilization.
A 1:1 female to male spawning ratio is the objective. Due to the continuous number of fish removed, and separate male and female staging areas, there is no selectivity in mating. The abdomen of a female is opened, egg's flow freely into a colander where the ovarian fluid is decanted. Eggs are transferred to a bucket where fertilization takes place. After milt from the primary and secondary male is added to the eggs, pathogen-free well water is added. Eggs are destroyed if the female displays gross BKD lesions. Each female is given a number, which corresponds to an individual incubator and a fish health tissue sample. The ELISA (Enzyme-Linked Immunosorbent Assay) method is used to detect BKD, which takes about 30 days to process. Eggs are not combined until fish health reports are complete. Egg lots are categorized via the ELISA method, ranging from very high to no detection. Egg lots, depending on their numeric value, are segregated from others. Eyed eggs are physically shocked before egg picking begins. The undeveloped or infertile eggs remain tender and will rupture when shocked. Within a few hours, these eggs turn white and are easily identified. Due to the large number of fish returning, cryopreserved gametes and pooled and factorial mating is felt to be unnecessary.

8.4) Cryopreserved gametes.
Not used (see 8.3).

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.
No measures are applied as no adverse effects are foreseen. During years of low broodstock collection (less than 60 females), green eggs from each female are divided and fertilized by different males.

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.
The goals that pertain to the Entiat facility are 95% survival for both green egg-to-fry and fry-to-smolt (IHOT 1995).

9.1) Incubation:

9.1.1) Table 11: Number of eggs taken and survival rates to eye-up.

Year	# Eggs	Survived to Eyed	Percent(%)
1988	612,188	548,520	89.6
1989	878,245	828,185	94.3
1990	804,660	768,450	95.5
1991	896,000	876,976	98.1
1992	885,400	861,494	97.3
1993	1,196,000	1,169,688	97.8
1994	168,000	162,120	96.5
1995	232,000	222,488	95.9
1996	387,600	378,685	97.7
1997	500,400	483,887	96.7
1998	441,000	423,801	96.1
1999	1,067,800	1,029,359	96.4
2000	756,000	706,104	93.4

9.1.2) Cause for, and disposition of surplus egg takes.
Surplus eggs are taken to allow for the culling of moderate to high risk BKD infected eggs. It is common practice to cull (destroy) eggs that have a very high ELISA rating. We use historical data to determine egg collection levels. The culled eggs are disposed of in an earthen pit on station property. Typically, an additional 10% of females are taken to account for culled eggs due to moderate to high ELISA ratings.

9.1.3) Loading densities applied during incubation.
The dry-weight method is used to enumerate eggs. Only one female per tray is incubated until the eggs reach the "eyed" stage. Following shocking and picking, each female's eggs are sampled for weight. A combined average is used for groups of 10 females. Eyed eggs are returned to incubation trays, loaded at 4000 eggs per tray. Incubation continues on chilled spring/ground water. Water flow is set at a minimum of 4 gallons per minute.

From fertilization to the eyed stage, eggs are in individual tray-type incubators receiving 4 gallon per minute of ground water. Eggs are treated every other day with 750 ppm of formalin for fungus control until approximately 600 Temperature Units (TUs) are achieved.

9.1.4) Incubation conditions.
Eggs are incubated in low pathogen (spring/well) water. Water temperature is continuously monitored every thirty minutes and logged by a remote temperature sensor. Water temperatures are converted to temperature units for each spawning day. For the Entiat SCS stock, it takes about 600 temperature units to reach the eyed stage and 1750 temperature units to the button-up stage or initial feeding.

Well water passes through an aeration chamber prior to entering the nursery. Water oxygen levels are always at saturation. When cleaning the nursery, the effluent passes through a pollution abatement facility prior to entering the Entiat River via a pump back system. Non-cleaning effluent flows directly into the Entiat River.

9.1.5) Ponding

Fry are removed from incubators when they are 99% buttoned-up. After a few days of acclimation and when all fish are on or near the surface, feeding commences. Fry are "ponded" directly from incubation trays to outside raceways. To date, this method has not shown any ill effects.

9.1.6) Fish health maintenance and monitoring

Disease monitoring is accomplished through daily observations by hatchery staff and monthly monitoring by fish health biologists/pathologists from the OFHC.
Any abnormal situations observed by hatchery personnel are called to the attention of the OFHC, which performs diagnostic and confirmatory clinical tests before recommending appropriate treatments. Treatment procedures may include environmental manipulation to control stresses and enhance the fish's ability to recover from infectious agents and/or appropriate chemicals or antibiotics. Antibiotics and chemicals that are registered for fish disease treatments are applied as per labeled instructions. Other therapeutic drugs and chemicals may be applied through appropriate INAD permits or by allowable extra-label prescription by staff Veterinary Medical Officer or local veterinarian.

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.

No listed stocks are propagated at this station; therefore no adverse effects are anticipated.

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.

Table 12: Percent survival estimates for juvenile SCS, ENFH.

Brood year	Fry to Fingerling (%)	Fingerling to Smolt (%)
1989	99.8	99.8
1990	99.6	95.4
1991	97.8	96.4
1992	89.9	96.5
1993	97.3	95.8
1994	99.8	81.9
1995	99.0	84.5
1996	98.2	98.3
1997	98.8	97.1
1998	99.0	96.8

1999	98.8	98.1
2000	96.3	95.8

9.2.2) Density and loading criteria (goals and actual levels).
See 9.2.3 below

9.2.3) Fish rearing conditions
Table 13 describes monthly monitoring variables collected during the rearing of a single brood year of spring Chinook. Values are collected monthly from a random sample of separate rearing units unless otherwise indicated. The table presents approximate values that are indicative of a "normal" production year. The monitoring values of dissolved oxygen, carbon dioxide and total gas pressure are not indicated, however, reference to the exclusion of these variables is footnoted below in Table 13.

Density and flow indices are the criteria by which standard pond management procedures adhere. These criteria include efforts to remain below a density index of 0.17 and below a flow index of 0.75 while maintaining production goals.

Table 13: Monthly production density and flow indexes for yearling brood years from 1990 to present.

Month	Development Stage	Temp[1] Avg. ^{0}F	Water Source[2]		Flow (GPM)	Flow Index[3] Lbs./L(in)GPM	Density Index[3,4] Lbs./L(in)cuft
			% River	% Ground			
August	EGG	48.5	0	100	40	4000/tray	Na
September.	EGG	48.8	0	100	40	4000/tray	Na
October	EGG	50.5	0	100	40	4000/tray	Na
November	EGG/Alevin	50.5	0	100	40	4000/tray	Na
December	Alevin/Fry	50.0	0	100	1800	0.23	0.05
January	Fry	48.0	0	100	1800	0.37	0.08
February	Fry	47.0	0	100	1800	0.52	0.11
March	Fry	47.0	0	100	1800	0.56	0.14
April	Fingerling	47.0	0	100	5400[5]	0.53	0.11
May	Fingerling	46.7	0	100	5400	0.32	0.06
June	Fingerling	46.7	0	100	5400	0.40	0.08
July	Fingerling	47.6	0	100	5400	0.49	0.10
August	Fingerling	48.5	0	100	5400	0.58	0.12
September	Fingerling	48.8	0	100	5400	0.60	0.09
October	Fingerling	50.5	0	100	5400	0.66	0.09
November	Fingerling	50.5	0	100	5400	0.70	0.10
December	Year;ing	50.0	0	100	5400	0.74	0.11
January	Yearling	49.0	0	100	5400	0.77	0.11
February	Yearling	48.5	0	100	5400	0.72.	0.11
March	Yearling	47.5	10	90	5940	0.70	0.12
April	Yearling/Smolt	47.0	20	80	6480	0.72	0.12

Unless otherwise indicated all values are for end of the month totals or values obtained for the last ten days of the month.
Dissolved oxygen is measured during critical periods of disease, elevated temperatures, restricted flows, or fouled water. Minimum $d0_2$ standards for salmonids are 5 mg/L (Piper et al 1982)*. [1]Temperature data is electronically measured every .5 hours and averaged for the month.
[2]Data indicates approximate water source usage. Actual usage depends on a variety of factors including disease and maintaining water temperatures (through well /river mixing) to minimize the formation of slush ice in winter and not to exceed 68^{0}F in summer.
[3]Estimated GPM used by brood including re-use. Calculated by dividing total weight (lbs.) by the average length (in.) X FI.
[4]Index averaged from Entiat NFH lot history records from brood years 1997 and 1998.
*Piper, R.G., I.B. McElwain, L.E. Orme, J.P. McCraren, L.G. Fowler, & J.R. Leonard. 1982. Fish Hatchery Management. US Department of Interior. Pp. 503. Washington DC. [5] Serial Re-use; water is re-used twice; 1st pass, 2nd pass and 3rd pass rearing.

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

rearing if available.

Table 14: Entiat NFH number, size, growth and condition values. These are average values for broods reared since 1990. Fish began feeding the end of the second week in December.

MONTH	Inventory (#fish)	Weight (lbs.)	Size (#/lb)	Size (gms)	Length (mm)	Length (in)	Condition Factors K= g/mm^3	Growth Rate (mm/mth)	Growth Rate (gms/mth)
Start	**410,000**	**342**	**1200**	**0.38**	**33.9**	**1.33**			
Dec	396,681	537	738.5	0.62	39.9	1.57	0.922	12.2	0.46
Jan	393,586	1,126	349.5	1.30	51.0	2.01	0.949	11.1	0.69
Feb	390,266	1,861	209.7	2.16	60.7	2.39	0.966	9.7	0.86
Mar	382,818	2,796	136.9	3.33	70.1	2.76	0.967	9.4	1.17
Apr	379,062	3,969	95.5	4.78	78.9	3.11	0.970	8.9	1.45
May	376,810	5,683	66.3	6.82	88.9	3.50	0.971	9.9	2.04
Jun	379,829	8,081	47.0	9.70	99.8	3.93	0.941	10.9	2.80
Jul	379,579	10,814	35.1	12.9	109.9	4.33	1.010	10.2	3.20
Aug	379,119	13,786	27.5	16.5	119.4	4.70	1.013	9.4	3.6
Sept	377,685	16,140	23.4	19.4	125.9	4.96	1.060	6.6	2.9
Oct	376,945	18,661	20.2	22.6	132.6	5.22	1.020	6.6	3.2
Nov	374,664	20,252	18.5	24.5	136.1	5.36	1.002	3.5	1.9
Dec	372,534	21,914	17.0	26.7	140.2	5.52	0.988	4.1	2.2
Jan	368,733	23,789	15.5	29.2	144.5	5.69	0.988	4.3	2.5
Feb	365,130	25,009	14.6	31.1	147.6	5.81	0.991	3.1	1.9
Mar	361,306	27,372	13.2	34.4	152.4	6.00	0.955	4.8	3.3
Apr	Fish released 1st week in April								

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

Figure 1, (below) describes periods of growth at Entiat NFH. As indicated, predominant growth occurs the first spring and summer, from May through September. Minimal growth occurs during the fall and winter followed by a secondary period of increased growth just prior to release in April. Additional measures of fish performance are described in Table 14 (above) and Table 15 (below).

Energy reserve data through routine monitoring of body fat content is not conducted on a routine basis. On a quarterly basis fish health profiles are conducted through the collection of a Goede Index that ascribes qualitative values to external and internal observations of fish health. Data is available through ENFH.

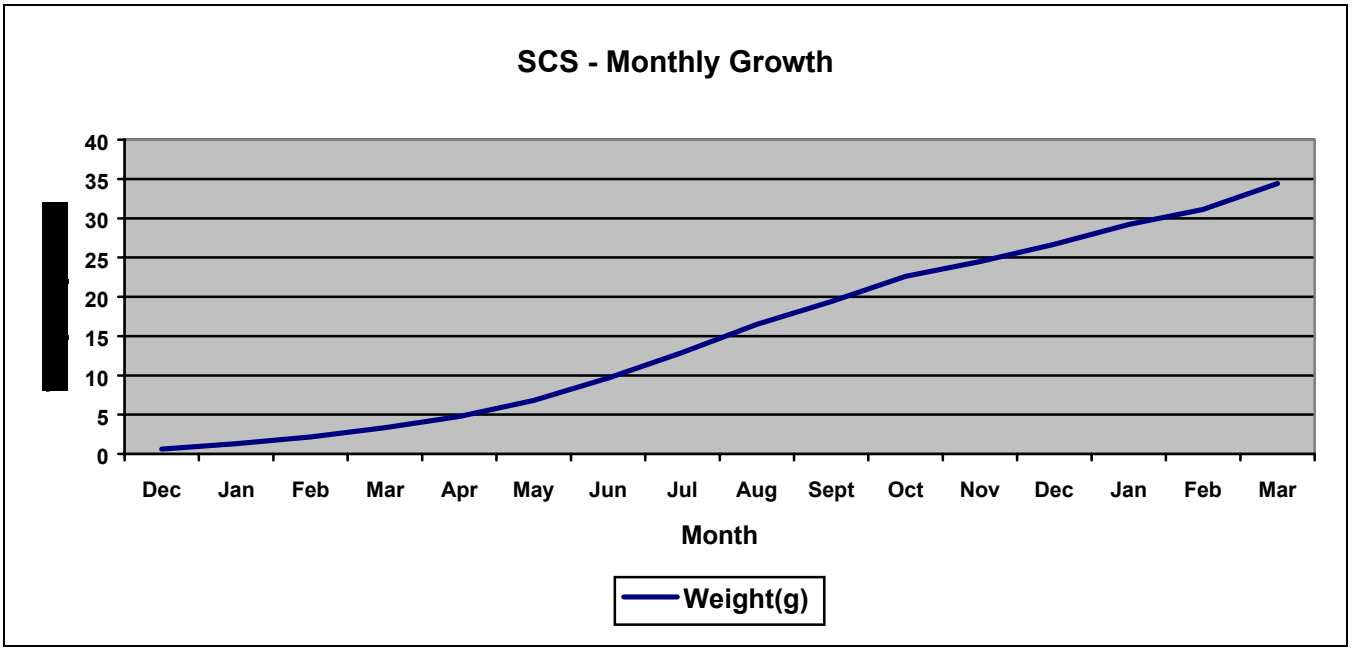

Figure 1. Average monthly growth for spring Chinook salmon, Entiat NFH.

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).

Table 15. Entiat NFH feed type, application rates, and food/length conversion rates for an average production year.

MONTH	Feed Type	Feed Fed Per Day (lbs.)	Total Feed (lbs./mo)	Feeding Rate % BW/day1	Food Conversion (lbs. Fed/lbs. Gain)	Conversion Temp. Units Per in. growth2
December	BioMoist Starter #2	14	209	2.6	1.07	35
January	BioMoist Starter #3	21	534	1.9	0.91	37
February	BioMoist Grower 1.0mm	28	710	1.5	0.97	42
March	BioMoist Grower 1.3mm	49	1078	1.8	1.15	41
April	BioMoist Grower 1.5mm	70	1408	1.8	1.20	42
May	BioMoist Grower 1.5mm	87	1738	1.5	1.01	37
June	BioMoist Grower 2.0mm	100	2000	1.2	0.83	35
July	BioMoist Grower 2.0mm	163	2612	1.5	0.96	41
August	BioMoist Feed 2.5mm	190	3035	1.4	1.02	47
September	BioMoist Feed 2.5mm	197	3149	1.2	1.34	70
October	BioMoist Feed 2.5mm	181	2892	1.0	1.15	68
November	BioMoist Feed 2.5mm	204	2647	1.0	1.66	113
December	BioMoist Feed 3.0mm	201	2610	0.9	1.57	96
January	BioMoist Feed 3.0mm	168	2187	0.7	1.17	82
February	BioMoist Feed 3.0mm	149	2382	0.6	1.95	111
March	BioMoist Feed 3.0mm	155	3411	0.6	1.44	73

1- Factor utilized to determine feed application rates calculated as the % of body weight (BW) in total mass divided by total pounds fed.
2- temperature units per inch of growth are calculated by subtracting 32^0F from the average monthly temperature and length gain.

9.2.7) Fish health monitoring, disease treatment, and sanitation procedures.
The OFHC provides fish health monitoring. Examinations are once per month or more, if necessary. Normally, treatments for BKD and both internal and external parasites are customary for a brood year of fish. The frequency of a treatment is determined by the severity and persistency of the problem.

9.2.8) Smolt development indices (e.g. gill ATPase activity), if applicable.
Currently not conducted.

9.2.9) Indicate the use of "natural" rearing methods as applied in the program.
FWS is currently conducting a "natural" rearing study at Winthrop NFH. Data obtained from this effort may be applicable to other Complex hatcheries.

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.
No listed fish are reared at this station.

SECTION 10. RELEASE

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

10.1) Table 16: Proposed fish release levels.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs				
Unfed Fry				
Fry				
Fingerling				
Yearling	400,000	18 – 20	April 1-15	Entiat River
Adults	100	NA	June - July	Omak Creek

10.2) Specific location(s) of proposed release(s).
Stream, river, or watercourse: Entiat River
Release point: rm 7
Major watershed: Entiat River (WRIA 46)
Basin or Region: Upper Columbia

Specific location(s) of proposed release(s).
Stream, river, or watercourse: Omak Creek
Release point: **Major watershed:** Okanogan River (WRIA 49)
Basin or Region: Upper Columbia

10.3) Table 17. Numbers and size of fish released through the program. (data source: hatchery records).

Release year	Eggs/ Unfed Fry	Avg size	Fry/Fingerling	Avg size (fpp)	Sub-yearling	Avg size (fpp)	Yearling	Avg size (fpp)
1988			263,018 24,942 10,800	541.0 320.0 101			838,940 56,493	21.026.0
1989							2,109,923 129,754	20.6 18.5
1990							2,251,503 52,734	18.1 17.9
1991					377,946	79.4	819,764	20.2
1992					361,590	52.6	347,500	15.0
1993					332,178	42.0	376,462	14.4
1994					399,429	38.7	378,729	13.5
1995					186,817	50.8	392,011	13.5
1996							332,593	13.3
1997							200,486	9.7
1998					164,999	41.3	350,784	10.8
1999							354,238	11.3
2000					421,126	43.8	397,855	12.7
Average			22981	504				

10.4) Actual dates of release and description of release protocols.
From 1990 to 2001, release dates ranged from April 1 to April 19. All juveniles were yearlings and were forced out of the ponds. Historically, smolts from ENFH have shown early signs of smolt stress. April 1st, is the earliest date at which fish can be released. River conditions and by-pass operations at Rocky Reach and Rock Island Dams are also considered prior to release. The sub-yearling program was terminated after 2000.

10.5) Fish transportation procedures, if applicable.
Adults for the Omak Creek program are selected prior to antibiotic injections. We make an attempt to bring the sex ratio of the transferred adults as close to 50:50 as possible. No juveniles are taken off station, and to-date, no adults have been transferred off station.

10.6) Acclimation procedures.
Fish are reared for about 18 months in the hatchery, and released directly from the facility.

10.7) Marks applied, and proportions of the total hatchery population marked, to identify hatchery adults.
Current production is marked at 50% CWT and ad-clip combination with the remainder having an ad-clip only (total is 100%). This marking scenario is covered under the 2001 Draft Biological Opinion (BiOp) issued by NMFS covering unlisted hatchery production in the upper Columbia Basin.

10.8) Disposition plans for fish identified at the time of release as surplus to programmed or approved levels.
Production goal numbers are adjusted by number of adults spawned. If too many eggs are taken, numbers are adjusted prior to hatching.

10.9) Fish health certification procedures applied pre-release.
Pre-release certification procedures are selective grab samples of moribund fish in the population followed by non-selective grab samples to make up a minimum of 60 fish (to statistically satisfy the assumed pathogen prevalence level of 5%) of each production group of fish. Kidney and spleen samples are tested for the presence of reportable viruses and bacteria.

10.10) Emergency release procedures in response to flooding or water system failure.
Only under the most severe circumstance would fish be released early. If the problem causing the emergency cannot be remedied and catastrophic loses are eminent, part or all of production would be forced out into the river. It would be an unlikely event to release all production fish, but a partial or "thinning" release may occur. If an emergency release occurred, the appropriate contacts would be notified as per instructions in the BiOp.

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.
Rearing and release strategies are designed to limit the amount of ecological interactions occurring between hatchery and naturally produced fish. Fish are reared to sufficient size that smoltification occurs within nearly the entire population, which reduces retention time in the streams after release. Listed stocks in this basin are well above ENFH. Smolts released from

ENFH may mix with these stocks in the lower Entiat and Columbia Rivers, but specific impacts are unknown.

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.

Legal Mandates

Performance Indicators 1a and 1b:

- Estimate tribal and sport harvest in Entiat River, when applicable; and maximize distribution of surplus adults to the tribes.

Performance Indicator 2a:

- Ensure, when possible, that production numbers meet those negotiated through *U.S. v. Oregon.*
- Estimate ENFH's contribution to harvest through CWT recoveries.

Performance Indicator 3a:

- ESA consultations under section 7 and 10 have been submitted and accepted. Modifications to existing BA's are completed to cover any program changes.

Harvest

Performance Indicators 4a – 4e:

- Estimate number of fish released and associated harvest through CWT recoveries.
- Estimate number of non-target listed fish taken in the harvest through CWT recoveries, analysis of scales taken, and creel surveys.
- Estimate angler hours/days through creel surveys.

Performance Indicators 5a – 5c:

- Mark production sufficiently to obtain statistically valid evaluation data. Current marking of production is 50% CWT + ad-clip and the remainder (50%) with an ad-clip only. Listed stocks do not carry an ad-clip; therefore the unlisted stock is easily identified within the Entiat River Basin.

Conservation of Wild/Naturally Spawning Populations

Performance Indicators 6a and 6b:

- See 5 above.

Life History Characteristics

Performance Indicators 7a – 7e:

- Release numbers do not exceed mitigated requirement, or level as stated in the Hatchery BiOp.
- No juvenile releases occur outside Entiat River.
- Ensure release dates coincide with wild fish migration timing.
- Smolts are released during or just prior to smoltification, which promotes a rapid migration.
- Estimate travel time and survival through the Columbia corridor using data obtained from PIT tag recoveries at mainstem hydroelectric dams.

Genetic Characteristics

Performance Indicators 8a – 8c:

- Juveniles are released directly from the hatchery to promote homing back to the facility.
- Mark juveniles sufficiently to obtain valid stray-rate estimates.
- Stray rates are calculated through CWT recoveries on the natural spawning grounds.

Performance Indicator 9a:

- Estimate optimal release time using historical emigration data and hatchery records.

Research Activities

Performance Indicators 10a, 11a and 11b:

- Promote and conduct experiments as stated in the 2001, NMFS Hatchery BiOp, when feasible. Study designs are peer reviewed when applicable.
- Annual reports are prepared covering bio-sampling of hatchery adults (brood stock), return estimates by brood year, harvest, and straying rates.

Operation of Artificial Production Facilities

Performance Indicators 12a, 12b, 13a, 14a-c, 15a, 15b, 16a, 16b, and 17a:

- Produce annual reports indicating level of compliance with applicable standards and criteria.
- Effluent is monitored weekly to ensure compliance with NPDES guidelines.
- Conduct monthly fish health monitoring and a pre-release examination. Adherence to regional fish health protocols is strictly maintained.
- Ensure rearing densities are within designed ranges.
- All male carcasses are deployed in basin tributaries. Permits for this activity were secured through WDFW and FWS. Annual reports are submitted to appropriate agencies.
- Release juveniles at size range as stated in IHOT, 1995.
- In the future, conduct size-at-release study to determine range most beneficial to both hatchery and wild populations.

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

Current funding fully supports the evaluation program as is. The BOR has been

supportive of funding as necessary.

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.

None, as no listed stocks are in the areas where research takes place.

SECTION 12. RESEARCH

USFWS conducts SCS redd surveys in the Entiat River Basin. Please reference NMFS Permit # 1119.

12.1) Objective or purpose.

See BA for and Permit # 1119.

12.2) Cooperating and funding agencies.

See BA for and Permit # 1119.

12.3) Principle investigator or project supervisor and staff.

See BA for and Permit # 1119.

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

See BA for and Permit # 1119.

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

See BA for and Permit # 1119.

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

See BA for and Permit # 1119.

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

See BA for and Permit # 1119.

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

See BA for and Permit # 1119.

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). None

12.10) Alternative methods to achieve project objectives.

None

12.11) List species similar or related to the threatened species; provide number and causes of mortality related to this research project.
None

12.12) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse ecological effects, injury, or mortality to listed fish as a result of the proposed research activities.
See BA for and Permit # 1119.

SECTION 13. ATTACHMENTS AND CITATIONS

Andonaegui, C. 1999. Salmon and Steelhead habitat limiting factors report for the Entiat Watershed Water Resource Inventory Area (WRIA) 46, Version 3. Washington State Conservation Commission. Olympia, WA. 51pp.

CBFWA 2002. Columbia Basin Fish and Wildlife Authority. Draft Entiat Sub-basin Summary. From www.CBFWF.org, August, 2002.

Chapman, D., C. Peven, T. Hillman, A. Giorgi, and F. Utter. 1994. Status of Summer Steelhead in the Mid-Columbia River. Don Chapman Consultants Inc. Boise, ID.

Chapman, D., C. Peven, T. Hillman, A. Giorgi, and F. Utter. 1995. Status of Spring Chinook Salmon in the Mid-Columbia Region. Don Chapman Consultants Inc. Boise, ID.

Hamstreet, C. O., and D. G. Carie. 2002. Spring and Summer Chinook Salmon Spawning Ground Surveys on the Entiat River, 2001. U.S. Fish and Wildlife Service, Mid-Columbia River Fishery Resource Office, Leavenworth, WA.

Howell, P., K. Jones, L. LaVoy, W. Kendra, and D. Ortmann. 1985. Stock assessment of Columbia River Anadromous salmonids. Volume II: Steelhead stock summaries, stock transfer guidelines-information needs. Report to Bonneville Power Adminitration, Proj. No. DE-A179-84BP12737.

IHOT (Integrated Hatchery Operations Team). 1995. Operation Plans for Anadromous Fish Production Facilities in the Columbia River Basin. Volume III, Washington. Report to U.S. Department of Energy. Proj. No. 92-043. BPA, Portland, OR.

NMFS (National Marine Fisheries Service). 1996. Informal consultation on proposed Cle Elum Hatchery. NOAA/NMFS, April 1, 1996.

NMFS (National Marine Fisheries Service). 2001. Biological Opinion on Artificial Propagation in the Upper Columbia River Basin. NMFS, Northwest Region.

Peven, C.M. 1990. The life history of naturally produced steelhead trout from the mid-Columbia River Basin. M.S. thesis. University of Washington, Seattle.

SIWG (Species Interaction Work Group). 1984. Evaluation of potential interaction effects in the planning and selection of salmonid enhancement projects. J. Rensel, chairman and K. Fresh editor. Report prepared for the Enhancement Planning Team for the implementation of the Salmon and Steelhead Conservation and Enhancement Act of 1980. Washington Department of Fish and Wildlife. Olympia, WA.

USFWS. 1994. U.S. Fish and Wildlife Service. Biological assessments for the operation of USFWS operated or funded hatcheries in the Columbia River Basin in 1995-1998. Submitted to National Marine Fisheries Service, August 2, 1994.

USFWS. 1999. Section 7 biological assessment, U.S. Fish and Wildlife Service, Entiat, Leavenworth, and Winthrop National Fish Hatcheries 1999-2003. Department of Interior. Mid-Columbia River Fishery Resource Office. Leavenworth, WA.

USFWS. 2002. Adult Salmonid Returns to Leavenworth, Entiat, and Winthrop National Fish Hatcheries in 2000. U.S. Fish and Wildlife service, Mid-Columbia River Fishery Resource Office, Leavenworth, WA.

WDF (Washington Department of Fisheries), Confederated Tribes and Bands of the Yakama Nation, Confederated Tribes of the Colville Reservation, and Washington Department of Wildlife. 1990. Columbia Basin system planning salmon and steelhead production, Wenatchee River Subbasin. Northwest Power Planning Council, Portland, OR. 122pp.

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.

Name, Title, and Signature of Applicant:

Certified by_____ Date:_____

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

Listed Species Affected: Spring Chinook	**ESU/Population:** Upper Columbia Spring Chinook			
Location of hatchery activity: Entiat NFH	**Dates of activity:** May – July **Hatchery Program Operator:** USFWS			
Type of Take	**Annual Take of Listed Fish by Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass[1]			0	
Collect for transport[2]			0	
Capture, handle, and release[3]			<5	
Capture, handle, tag/mark/tissue sample, and release[4]			0	
Removal (e.g. broodstock)[5]			<5	
Intentional lethal take[6]			0	
Unintentional lethal take[7]			<5	
Other Take (specify)[8]			0	

[1] Contact with listed fish through stream surveys, carcass and mark recovery projects, or migrational delay at weirs.
[2] Take associated with weir or trapping operations where listed fish are captured and transported for release.
[3] Take associated with weir or trapping operations where listed fish are captured, handled and released up or downstream.
[4] 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.
[5] Listed fish removed from the wild and collected for use as broodstock.
[6] Intentional mortality of listed fish, usually as a result of spawning as broodstock.
[7] 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.
[8] Other takes not identified above as a category.

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

Listed Species Affected: Summer Steelhead	**ESU/Population:** Upper Columbia Summer Steelhead			
Location of hatchery activity: Entiat NFH	**Dates of activity:** May-July **Hatchery Program Operator:** USFWS			
Type of Take	**Annual Take of Listed Fish by Life Stage *(Number of Fish)***			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass[1]			0	
Collect for transport[1]				
Capture, handle, and release[1]			All that enter ladder	
Capture, handle, tag/mark/tissue sample, and release[1]			0	
Removal (e.g. broodstock)[1]			0	
Intentional lethal take[1]			0	
Unintentional lethal take[1]			0	
Other Take (specify)[1]				