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John A. Kitzhaber, MD, Governor

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May 2, 2011

Mr. Rob Jones
NOAA Fisheries Service
Salmon Recovery Division
1201 NE Lloyd Blvd., Suite 1100
Portland, Oregon 97323

Dear Mr. Jones:

Attached is the Hatchery and Genetic Management Plan (HGMP) for the Imnaha Spring/Summer Chinook hatchery program operated by Oregon Department of Fish and Wildlife. This HGMP was completed in consultation with program co-managers and is consistent with provisions of U.S. v. Oregon and associated co-manager agreements. We are submitting this HGMP as an application for federal Endangered Species Act Section 10 permit.

Should you have questions regarding this HGMP please contact Ms. Colleen Fagan at 541-962-1835 or myself at 541-962-1825.

Sincerely,

Bruce Eddy
Grande Ronde District Manager
Oregon Department of Fish and Wildlife

Enclosure

c: Joe Krakker – LSRCP
Mark Chilcote – NMFS
Jonathan McCloud – BPA
Ron Costello – BPA
Jeff Gislason – BPA
Nancy Weintraub – BPA
Scott Patterson – ODFW
Rich Carmichael – ODFW
Colleen Fagan – ODFW
Becky Johnson – NPT
Gary James – CTUIR

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program:	**Lower Snake River Compensation Plan (LSRCP) Imnaha Spring/Summer Chinook Program**
Species or Hatchery Stock:	**Spring/summer Chinook (Stock # 029)**
Agency/Operator:	**Oregon Department of Fish and Wildlife**
Watershed and Region:	**Imnaha / Snake River / Columbia Basin / Oregon**
Date Submitted:	**December 2002**
Date Last Updated:	**May 2011**

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Lower Snake River Compensation Plan (LSRCP), Imnaha Spring/Summer Chinook Hatchery Program.

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

Snake River ESU/Imnaha Spring-Summer Chinook, *Oncorhynchus tshawytscha,* (stock 029). ESA status: threatened.

1.3) Responsible organization and individuals

ODFW Salem Headquarters Staff:

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ODFW NE Regional Staff:

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ODFW Hatchery Manager:
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ODFW Fish Research:
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Co-Management Organizations:

1. U. S. Fish and Wildlife Service – Lower Snake River Compensation Plan - Program (LSRCP) funding/oversight
2. Confederated Tribes of the Umatilla Indian Reservation – Co-manager
3. Nez Perce Tribe – Co-manager

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

The program is part of the federally-mandated Lower Snake River Compensation Plan (LSRCP) mitigation program funded through the US Fish and Wildlife Service and designed to mitigate for fish losses at the Lower Snake River dams. The LSRCP spring/summer Chinook program in Northeast Oregon includes Lookingglass Hatchery, integrated with Grande Ronde Basin Chinook program, Imnaha Basin program, and Captive Broodstock program. Lookingglass Hatchery staff includes: Hatchery Manager, Supervising Fish and Wildlife (F&W) Technician, four F&W Technicians, and two 4-month seasonal laborer, and Facilities Operation Specialist. Annual operation and maintenance costs for the Imnaha portion of the FY2009 program are estimated at $350,000.

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

Adult holding, spawning, egg incubation, and rearing:

Lookingglass Hatchery is located 19 miles north of the town of Elgin, Oregon on the east bank of Lookingglass Creek (ODFW watershed code 080440000, Figure 1). The hatchery is located near the Jarboe Creek confluence which is approximately 2.2 miles above the Lookingglass Creek confluence with the Grande Ronde River, River Mile 86. Elevation at the hatchery is 2,550 feet above sea level. Adult facilities consist of one adult trap, two adult concrete raceways (4,560 ft^3), each partitioned into two ponds, three adult circular holding tanks 942 $ft.^3$ (20'x3'), and three small circular tanks (6' x 3'). Incubation is in 504 vertical incubator trays with a capacity of 2.52 million eggs (5,000 eggs/tray) to hatching. There are 28 Deep Canadian troughs for early rearing with a capacity of 50,000 fish or 250 pounds. Early rearing density indices (lbs/ft^3/inch) range from 0.4 to 0.75. Final rearing is in 18 concrete raceways (4,000 ft^3) with 3,000 cubic feet of rearing space. Final rearing density indices range from 0.17 to 0.24.

In addition to existing rearing facilities, Imnaha spring Chinook adult holding, spawning, incubation, and rearing is planned to occur at the proposed Lostine River Hatchery designed to be constructed on the Lostine River at approximately river mile 10, near the town of Lostine, in Wallowa County, Oregon (Sec. 3, T2S/R43E, Figure 1). An extensive design description and the associated production plan details are documented in the Wallowa/Lostine Spring Chinook Hatchery and Genetic Management Plan. Further, any specifics related to projected Imnaha spring Chinook production at the new facility that vary from the existing program's description are concurrently identified in the appropriate sections this document. Unless otherwise noted, all other management plan explanation contained in this text would apply to anticipated Imnaha spring Chinook production activity at the Lostine River Hatchery.

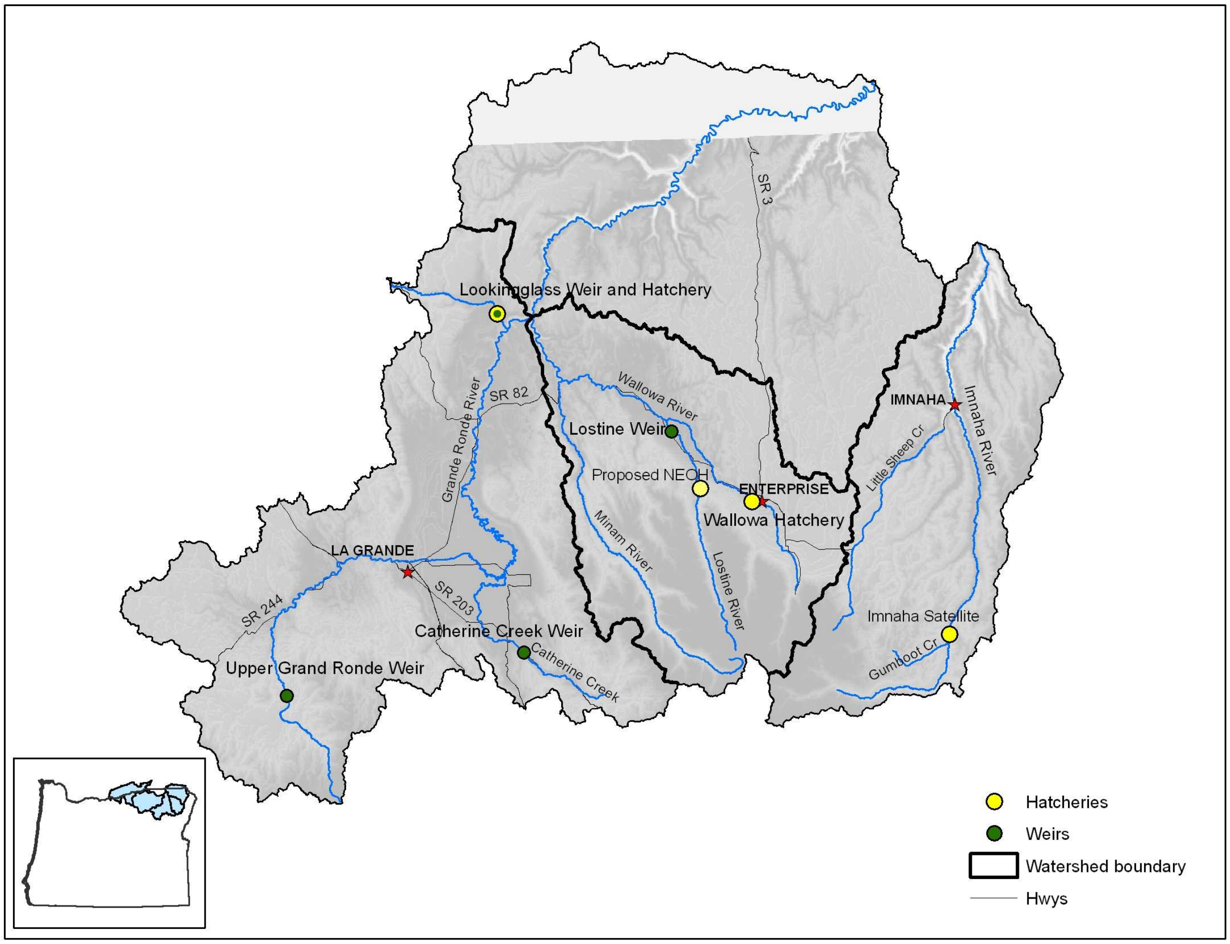

Figure 1. Locations of spawning, rearing, and release facilities for the Imnaha Chinook hatchery program. Map also shows locations of weir sites within the Grande Ronde and Imnaha basin.

Adult collection, acclimation and release:

Imnaha adult collection and smolt acclimation facility is located two to three hours driving time from Lookingglass Hatchery and about an hour from the proposed Lostine River Hatchery, approximately 30 miles south from the town of Imnaha, Oregon, (ODFW watershed code 0800200000) at River Mile 45.5 (Figure 1). Elevation at the Imnaha facility is 3,760 feet above sea level. Facilities consist of a picket weir, an adult trap, spawning area and one pond (13,000 ft3). The pond is used for juvenile acclimation and release in the spring. Capacity for juveniles is 18,000 pounds (360,000 fish at 20 fpp DI=.25.) Current acclimation strategy is to rear smolts for 2 to 3 weeks. After 2 to 3 weeks, the pond screens are removed and smolts are allowed to volitionally leave for an additional two week period. At the end of four to five weeks on Imnaha River water, fish remaining in the pond are forced out.

Other organizations:

The U.S. Fish and Wildlife Service (USFWS), through the Lower Snake River Compensation Plan (LSRCP), funds operation and maintenance expenditures at Lookingglass and Imnaha satellite facility. The Nez Perce Tribe (NPT), Oregon Department of Fish and Wildlife (ODFW), and Confederated Tribes of the Umatilla Indian Reservation (CTUIR) are co-managers of the Imnaha River Chinook salmon program.

1.6) Type of program.

Integrated Recovery: The Imnaha River spring/summer Chinook salmon (ODFW stock ID 029) fish propagation program is funded through LSRCP mitigation and managed to recover and sustain the population and in years of abundant returns provide harvest opportunities.

1.7) Purpose (Goal) of program.

This hatchery program is part of the Lower Snake River Compensation Plan (LSRCP). The purpose of the LSRCP is to replace adult salmon, steelhead and rainbow trout lost by construction and operation of four hydroelectric dams on the Lower Snake River in Washington. Specifically, the stated purpose of the plan is:

"…[to]….. provide the number of salmon and steelhead trout needed in the Snake River system to help maintain commercial and sport fisheries for anadromous species on a sustaining basis in the Columbia River system and Pacific Ocean" (NMFS & FWS 1972 pg 14)

Specific mitigation goals for the LSRCP were established in a three step process. First the adult escapement that occurred prior to construction of the four dams was estimated. Second an estimate was made of the reduction in adult escapement (loss) caused by construction and operation of the dams (e.g. direct mortality of smolt). Last, a catch to escapement ratio was used to estimate the future production that was forgone in commercial and recreational fisheries as result of the reduced spawning escapement and habitat loss. Assuming that the fisheries below the project area would continue to be prosecuted into the future as they had in the past, LSRCP adult return goals were expressed in terms of the adult escapement back to, or above the project area. Other than recognizing that the escapements back to the project area would be used for hatchery broodstock , no other specific priorities or goals were established in the enabling legislation or supporting documents regarding how these fish might used.

For spring Chinook salmon the escapement above Lower Granite Dam prior to construction of these dams was estimated at 122,200 adults. Based on a 15% mortality rate for smolts transiting each of the four dams (48% total mortality) the expected reduction in adults subsequently returning to the area above Lower Granite Dam was 58,700. This number established the LSRCP escapement mitigation goal. This reduction in natural spawning escapement was estimated to result in a reduction in the coast wide commercial/tribal harvest of 176,100 adults, and a reduction in the recreational fishery harvest of 58,700 adults below the project area. In summary the expected total number of adults that would be produced as part of the LSRCP mitigation program was 293,500.

Component	Number of Adults
Escapement above Lower Granite Dam	58,700
Commercial Harvest	176,100
Recreational Harvest	58,700
Total	**293,500**

Since 1976, when the LSRCP was authorized, many of the parameters and assumptions used to size the hatchery program and estimate the magnitude and flow of benefits have changed.

- The survival rate required to deliver a 4:1 catch to escapement ratio has been less than expected and this has resulted in fewer adults being produced.
- The listing of Spring Chinook under the Endangered Species Act has resulted in significant curtailment of commercial, recreational and tribal fisheries throughout the mainstem Columbia River. This has resulted in a higher percentage of the annual run returning to the project area than was expected.
- The *U.S. vs. Oregon* court stipulated Fishery Management Plan has established specific hatchery production agreements between the states, tribes and federal government. This agreement has substantially diversified the spring Chinook hatchery program by adding new off station releases sites and stocks designed to meet short term conservation objectives.

The LSRCP hatchery program for Imnaha spring Chinook was designed to escape 3,210 adults back to the project area after a harvest of 12,840. While recognizing the overarching purpose and goals established for the LSRCP, and realities' regarding changes since the program was authorized, the following objectives for the beneficial uses of adult returns have been established for the period through 2017:

1. To contribute to the recreational, commercial and/or tribal fisheries in the mainstem Columbia River consistent with agreed abundance based harvest rate schedules established in the 2008–2017 U.S. vs. Oregon Management Agreement.

2. To establish an annual supply of brood fish that can provide an egg source capable of meeting mitigation goals. Based upon the adult return goal and an estimated 0.65% smolt-to-adult survival rate the target for smolt production was set at 490,000 fish. Due to facility limitations the current production goal is only 420,000 smolts, which proportionally would result in 2,730 adults returning to the project area[1].

3. To restore and maintain a viable natural spawning population.

4. To reestablish sport and tribal fisheries.

5. Minimize the impacts of the program on other indigenous fish species.

6. To maximize the beneficial uses of fish that return to the project area that are not used for broodstock, harvest or natural spawning, for such uses as tribal subsistence, food bank donations, and nutrient enhancement.

1.75) Recovery Plan Goals

Background

The program goal to restore a viable natural population of spring Chinook in the Imnaha River will be guided in part by the recovery plan currently under development for the Snake River ESU of spring/summer Chinook. The primary units of the recovery plan are Major Population Groups (MPGs). The spring/summer Chinook that exist in the Imnaha and Grande Ronde basins represent one of these MPGs. For the ESU to achieve recovery, all MPGs must be viable. A determination of whether or not a MPG is viable is dependent on the status of the constitute populations. However, as per guidance from the Interior Columbia Technical Recovery Team (ICTRT), not all populations in a MPG must achieve low risk status before the MPG can be classified as viable. In the case of the Grande Ronde/Imnaha MPG, only five of the eight populations are associated with recovery plan actions that are expected to lead to low risk status. The Imnaha population is one of the five MPG populations that are intended to achieve low risk status. This population is believed to have been historically distributed throughout the Imnaha basin, with the exception of the Big Sheep watershed. Spring Chinook originating from the Big Sheep watershed are considered a separate population by the ICTRT. However, the ICTRT also concluded that the Big Sheep population has become functionally extirpated (i.e., no longer exists; ICTRT 2010a).

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[1] Current capacity at Lookingglass Hatchery does not allow production of 490,000 yearlings. The Parties have agreed in interim to produce 360,000 yearlings (currently 420,000 as of 2011). If capacity becomes available or following the construction of NEOH on the Lostine River, production would increase.

In general, hatchery production is a management tool used to prevent extirpation of the Grande Ronde/Imnaha spring/summer Chinook MPG while maintaining societal benefits. Currently, all but two populations in the MPG, the Wenaha and Minam, are supplemented by hatchery production. The recovery strategy includes the implementation of conservation hatchery programs with the intent to balance the adverse short-term impacts on diversity versus the long-term risk of population extirpation.

1.8) Justification for the program.

The Lower Snake River Compensation Plan is a congressionally-mandated program pursuant to PL 94-587. The Imnaha River hatchery program provides adult Chinook for hatchery broodstock and limited recreational and tribal harvest within the Lower Snake River Compensation Plan mitigation area (Snake River and tributaries above Ice Harbor Dam). The program also provides fish for harvest in Columbia River fisheries. The program utilizes an endemic Chinook hatchery stock to the Imnaha River. Natural adults from the Imnaha River are incorporated into the broodstock annually and hatchery origin adults are allowed to spawn naturally in the Imnaha River each year. As per comanager agreements, up to 300 adults excess to the needs of the hatchery program, are released into the Big Sheep Creek watershed (AOP 2011).

1.9) List of program "Performance Standards".

Performance standards are organized in terms of 1) legal mandates, 2) harvest, 3) hatchery performance, 4) conservation objectives, 5) ecological impacts, and 6) monitoring and evaluation. Plans and methods for monitoring and evaluation of these indicators are cross-referenced in section 11.1.1.

Legal Mandates - Provide adult spring/ summer Chinook within the LSRCP mitigation area while minimizing adverse impacts to listed fish.

Performance Standard (1): Imnaha Basin Chinook production contributes to fulfilling tribal trust legal mandates and treaty rights.

Indicator 1(a): Estimated number of program Chinook harvested in tribal fisheries by run year.
Indicator 1(b): Estimated number of Imnaha Basin wild Chinook harvested in tribal fisheries by run year.

Performance Standard (2): Program contributes to annual mitigation requirements.

Indicator 2(a): *Estimated number of recreational angler days in the Imnaha Basin Chinook fishery by run year.*
Indicator 2(b): *Estimated annual harvest in LSRCP mitigation areas and annual escapement to the hatchery facility.*
Indicator 2(c): *Estimates total return to compensation area.*

<u>**Harvest**</u>

Performance Standard (3): Fish are produced in a manner enabling effective harvest while avoiding over-harvest of non-target fish.

Indicator 3(a): Estimated run year harvest and harvest related mortality for hatchery and wild fish, by fishery.
Indicator 3(b): Estimated number of recreational angler days in the Imnaha Basin Chinook fishery by run year.

Performance Standard (4): Release groups are marked to enable determination of impacts and benefits in fisheries.

Indicator 4(a): Number of recovered marked fish reported in each fishery produces accurate estimates of harvest.
Indicator 4(b): Verify that mark rate, at release, is 95% to 100% for all smolt release groups.

Performance Standard (5): Non-monetary societal benefits for which the program is designed are achieved.

Indicator 5(a): Number of recreational fishery angler days.

<u>**Hatchery Performance**</u>

Performance Standard (6): The hatchery program produces smolts at a higher efficiency than would be achieved in nature.

Indicator 6(a): Survival of hatchery Chinook, by life stage.

Performance Standard (7): Artificial production program uses standard scientific procedures to evaluate various aspects of artificial propagation.

***Indicator 7(a)*:** Scientifically based experimental design, with measurable objectives and hypotheses.

Performance Standard (8): Facility operation complies with applicable fish health and facility operation standards and protocols.

Indicator 8(a): Results of monthly fish health examinations.
Indicator 8(b): Annual reports indicating level of compliance with applicable standards and criteria.

Performance Standard (9): Releases do not introduce new pathogens into local populations, and do not increase the levels of existing pathogens.

Indicator 9(a): Results of monthly fish health examinations.
Indicator 9(b): Certification of juvenile fish health immediately prior to release.
Indicator 9(c): Juvenile rearing density by hatchery design is 0.25 lbs/inch/ft^3 However co-managers have agreed to rear stocks at lower densities.

Performance Standard (10): Any distribution of carcasses or other products for nutrient enhancement meets appropriate disease control regulations and interagency agreements.

Indicator 10(a): Number and location of carcasses distributed for nutrient enrichment.
Indicator 10(b): Disease examination of all carcasses to be used for nutrient enrichment.
Indicator 10(c): Statement of compliance with applicable regulations and guidelines (MOU with DEQ).

Performance Standard (11): Effluent from artificial production facilities will not detrimentally affect populations.

***Indicator 11(a*)**: Verify that hatchery effluent is in compliance with existing NPDES permit conditions and water quality standards.

Performance Standard (12): Juvenile production costs are similar to or less than other regional programs designed with similar objectives.

Indicator 12(a): Total cost of program operation.
Indicator 12(b): Average cost of similar operations.

Performance Standard (13): Hatchery program is sustainable.

Indicator 13(a): Number of broodstock collected is sufficient to maintain the hatchery brood.
Indicator 13(b): Number of smolts released achieves smolt production goals.

Conservation Objectives - Conserve genetic and life history diversity of Chinook within the Imnaha River consistent with recovery plan strategies and proposed actions.

Performance Standard (14): Broodstock collection does not reduce potential juvenile production in natural rearing areas.

> ***Indicator 14(a)*****:** Number of wild spring/summer Chinook retained for broodstock collection does not exceed 50% of the annual natural-origin escapement population.
> ***Indicator 14(b):*** Percentage of natural-origin fish returning to the facility taken for broodstock comprises at least 20% of the brood population and 100% during years of high wild fish escapement.

Performance Standard (15): Weir/trap operations do not result in significant stress, injury or mortality in natural populations.

> ***Indicator 15(a):*** Adult trapping mortality rate for natural-origin fish does not exceed 5%.
> ***Indicator 15(b):*** Adult trap is checked daily when in operation.

Performance Standard (16): Juveniles are released after sufficient acclimation at the Imnaha facility to maximize homing to target sub-basins.

> ***Indicator 16(a):*** Smolts are acclimated for 2-3 weeks prior to release.
> ***Indicator 16(b):*** The proportion of marked spring/summer Chinook returning to the Imnaha facility is equal to or greater than 95% of reported escapement.

Performance Standard (17): Patterns of genetic variation within and among natural-origin spring/summer Chinook populations do not diverge as a result of artificial production programs.

> ***Indicator 17(a):*** Compare genetic profiles and divergence of naturally produced juveniles from indicator areas within the Imnaha Basin over time.

Performance Standard (18): Hatchery produced adults do not exceed a maximum of 70% of natural spawners in the Imnaha River above the facility.

> ***Indicator 18(a):*** Proportion of hatchery and natural-origin fish in key natural spawning areas.

Performance Standard (19): Broodstock selection strategies effectively maintain genetic and life history characteristics in the hatchery population.

> ***Indicator 19(a):*** Natural-origin fish comprise at least 40% of the hatchery

broodstock.
Indicator 19(b): Timing of hatchery adult returns to the Imnaha facility mimics natural-origin Chinook returns.
Indicator 19(c): Genetic profile of natural-origin and hatchery fish in Imnaha River does not significantly diverge.
Indicator 19(d): Size and age composition of returning adults is consistent with natural-origin run over time.

Performance Standard (20): Broodstock collection does not significantly alter spatial and temporal distribution of naturally spawning spring/summer Chinook populations.

Indicator 20(a): Number of adult fish aggregating or spawning immediately below the adult weir does not exceed historical distributions and spawning activity.
Indicator 20(b): Natural-origin spring/summer Chinook are captured and sorted, and either retained, transported, or released according to annual run timing and run size.

Performance Standard (21): Hatchery supplementation benefits natural population abundance and productivity.

Indicator 21(a): Natural adult returns increase.
Indicator 21(b): Natural productivity (recruits-per-spawner) does not decrease.

Performance Standard (22): Spawning characteristics of hatchery salmon spawning in nature is similar to that of natural salmon. Spawning characteristics of natural salmon are not changed by introgression with hatchery salmon.

Indicator 22(a): Run and spawn timing of hatchery salmon is similar to that of natural salmon.
Indicator 22(b): Run and spawn timing of natural salmon do not change over time.
Indicator 22(c): Spawning distribution of hatchery salmon is similar to that of natural salmon.

Ecological Impacts

Performance Standard (23): Release numbers do not exceed an assumed habitat capacity for spawning, rearing, migration corridor, and estuarine and near-shore rearing.

Indicator 23(a): Smolts are released in March through April and are released into targeted locations to promote smolt emigration.
Indicator 23(b)**:** Proportion of residual hatchery smolts in key natural rearing areas does not exceed 10%.

Indicator 23(c): Emigration behavior of hatchery smolts matches that of their wild counterparts.

Performance Standard (24): Water withdrawal and diversion structures used in operation of artificial production facilities will not prevent access to natural spawning areas, affect spawning behavior of listed natural populations, or impact juvenile rearing.

Indicator 24(a): Water withdrawals compared to applicable passage criteria.
Indicator 24(b): Water withdrawal compared to NOAA juvenile screening criteria.
Indicator 24(c): Proportion of diversion of total stream flow between hatchery facility intake and out-fall.
Indicator 24(d): Length of stream impacted by water withdrawal.

Performance Standard (25): Predation by artificially produced fish on natural produced fish does not significantly reduce numbers of natural fish.

Indicator 25(a): Size at, and time of juvenile release compared to size and timing of natural fish present.

Monitoring and Evaluation

Performance Standard (26): Monitoring and evaluation occurs on an appropriate schedule and scale to assess progress toward achieving program objectives and evaluating the beneficial and adverse effects on natural populations.

Indicator 26(a): Monitoring and evaluation framework including detailed timeline.
Indicator 26(b): Annual and final reports.

Performance Standard (27): Release groups are marked to allow evaluation of effects on local natural populations.

Indicator 27(a): Visible mark (Ad-clip) in hatchery-origin release groups.
Indicator 27 (b): Represented coded wire tag in hatchery-origin release groups to monitor downstream harvest contribution.
Indicator 27 (c): Represented coded wire tag in hatchery-origin release groups to monitor stray rates.

In addition, Appendix Table 1 represents the union of performance standards described by the Northwest Power and Conservation Council, regional questions for monitoring and evaluation for harvest and supplementation programs, and performance standards and testable assumptions as described by the Ad Hoc Supplementation Work Group (Beasley et. al. 2008). Appendix Table 2 describes a common set of standardized performance measures (Appendix Table 1) as established by the Collaborative

Systemwide Monitoring and Evaluation Project (CSMEP). The suite of performance measures developed by the CSMEP represents a crosswalk mechanism that is needed to quantitatively monitor and evaluate the standards and indicators listed in Appendix Table 2. The CSMEP measures have been adopted by the AHSWG (Beasley et. al. 2008), and are consistent with those presented in the Northeast Oregon Hatchery Monitoring and Evaluation Plan (NEOH M&E Plan; Hesse et al. 2006). The adoption of this regionally-applied means of assessment will facilitate coordinated analysis of findings from basin-wide M&E efforts and will provide the scientifically-based foundation to address the management questions and critical uncertainties associated with supplementation and ESA listed stock status/recovery.

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

“Performance Indicators” determine the degree that program standards have been achieved, and indicate the specific parameters to be monitored and evaluated. Adequate monitoring and evaluation must exist to detect and evaluate the success of the hatchery program and any risks to or impairment of recovery of affected, listed fish populations.

The Northwest Power Planning Council (NPPC) presents a list of draft “Performance Indicators” that, when linked with the appropriate performance standard, stand as examples of indicators that could be applied for the hatchery program. Essential ‘Performance Indicators” that should be included are monitoring and evaluation of overall fishery contribution and survival rates, stray rates, and divergence of hatchery fish morphological and behavioral characteristics from natural populations.

The list of “Performance Indicators” should be separated into two categories: "benefits" that the hatchery program will provide to the listed species, or in meeting harvest objectives while protecting listed species; and "risks" to listed fish that may be posed by the hatchery program, including indicators that respond to uncertainties regarding program effects associated with a lack of data.

Performance indicators that we use to evaluate the performance standards listed in section 1.9 are presented in Appendix Table 2. These performance measures are taken from Beasley et al. (2008) and are consistent with NEOH M&E Plan (Hesse et al. 2006). The performance indicators are broken into the categories of abundance, survival-productivity, distribution, genetic, life history, habitat, and in-hatchery groups. Within each of these groups are the specific indicator(s) and brief description of the definition/method(s).

1.10.1) “Performance Indicators” addressing benefits.

Evaluation of the Imnaha program utilizes the performance standards and associated performance indicators in sections 1.9 and Appendix Table 1. In addition to yearly evaluations, every five years the Imnaha program performs a comprehensive review of the program to include adaptive management recommendations addressing the benefits and risks of the program. The recommendations will incorporate the findings from studies conducted on the Imnaha and other hatchery programs that may lead to greater program benefits to the natural Imnaha population and attainment of mitigation level adult returns.

1.10.2) "Performance Indicators" addressing risks.

Evaluation of the Imnaha program utilizes the performance standards and associated performance indicators in sections 1.9 and Appendix Table 1. In addition to yearly evaluations, every five years the Imnaha program performs a comprehensive review of the program to in include adaptive management recommendations addressing the benefits and risks of the program. These recommendations will incorporate the findings from studies conducted on the Imnaha and other hatchery programs that may lead to a further reduction in program risks to the Imnaha population.

1.11) Expected size of program.

Mitigation hatchery production goal for Imnaha spring/summer Chinook salmon is 490,000 smolts. Due to facility limitations the current production goal is only 420,000 smolts (AOP 2011), which proportionally would result in 2,340 adults returning to the project area[1].

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

Collection is not expected to exceed 342 adults to produce 490,000 smolts; however, only of 228 adults are required to produce 420,000 smolts, based on the expected hatchery survival rates, average fecundity, disease screening, and a 1:1 sex ratio.

For the Imnaha program, there are specific guidelines for the collection of broodstock and level of supplementation of the natural population. The proportion of natural fish included in the hatchery broodstock will be higher in years when the expected return of natural origin fish is higher. In addition, when the spawning escapement of natural origin fish is expected to be high, supplementation levels using adult hatchery fish will be reduced. The details of this abundance contingent management scheme have been developed and agreed to by the co-managers in what is referred to here as the "sliding scale" (Table 1).

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[1] Current capacity at Lookingglass Hatchery does not allow production of 490,000 yearlings. The U.S. vs. Oregon Parties have agreed in interim to produce 360,000 yearlings (420,000 as of 2011). If capacity becomes available or following the construction of NEOH on the Lostine River, production would increase.

As noted in Section 1.75, the implementation of the sliding scale (Table 1) relies on the operation of a weir that can sample the entire return. The current weir is inoperable during periods of high flow. As a consequence, only the latter half of the return can be intercepted and managed according to the sliding scale protocol. Because of this deficiency the objectives of the sliding scale cannot be met until a new weir is installed that that can operate under all flow conditions. The Northeast Oregon Hatchery master plan (Ashe et al. 2002) also calls for the construction and operation of such a new weir.

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

The Imnaha River will be the primary location for release smolts produced by this program (Table 2). However, after the Lostine Hatchery becomes functional the number of smolts released will increase from the present level of 420,000 to the mitigation goal of 490.000.

Table 1. Sliding scale management tool for Imnaha Chinook hatchery program utilized for managing disposition of Chinook salmon adults for broodstock and escapement to natural spawning areas.

Estimated natural run of ADULTS to river mouth as a proportion of minimum interior TRT minimum abundance threshold (MAT)	Number of ADULT natural fish to river mouth	Expected handle rate at weir of ADULT natural fish (50%)	Max % natural ADULTS for broodstock	Number of ADULT natural fish retained for broodstock	Max proportion of ADULT hatchery fish released above weir
> .05 of Critical	> 15	> 8	0	0	NA
.05 - .5 of Critical	15 - 149	8 - 74	50%	04 - 37	NA
.5 - Critical	150 -299	75 -149	40%	30 - 60	70%
Critical - .5 of MAT	300 - 499	150 -249	40%	60 - 100	60%
.5 Viable - MAT	500 - 999	250 - 499	30%	75 - 150	50%
			40%[1]		
Viable - 1.5 MAT	1000 - 1499	500 - 749	30%	150 - 225	40%
			40%[1]		30%
1.5 - 2 x MAT	1500 - 1999	750 - 999	25%	188 - 250	25%
> 2 x MAT	> 2000	> 1000	25%	> 250	<10%

[1] Percentage highlighted will be implemented in the third year after two consecutive years of escapement at that level or higher and preseason projection at that level of higher.

Table 2. Proposed annual fish release levels (maximum number) by life stage and location.

Life Stage	Release Location	Annual Release Level
Yearling	Imnaha River RM 45.5[a]	490,000
Adult	Big Sheep Creek Basin	Up to 300

[a] The acclimation facility is not big enough to acclimate the entire 490,000 production at one time. If production reaches 490,000 co-managers may direct stream release a portion of the production at the acclimation facility or in another section of the Imnaha River or acclimate fish in two groups.

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

The numbers of Imnaha Chinook salmon collected at the weir since 1990 are presented in Table 3. Estimated total adults produced from juvenile Imnaha spring/summer Chinook salmon released for this program is reported in Table 4.

Table 3**.** Summary of Imnaha Chinook salmon trapped at the Imnaha Facility and their disposition since 1990 (adults and jacks combined). Released = released alive above and below the weir. Broodstock = transferred to Lookingglass Hatchery with the intent of using for brood stock. Food banks/other = fish sent to food banks, kept for tribal/ceremonial purposes, and outplants to other Powder River. (ODFW Annual Report Series, Evaluation of Lower Snake River Compensation Plan Facilities in Oregon). Only a portion of the total annual return of spring Chinook returning to the Imnaha basin are trapped at the Imnaha Weir.

	Natural Origin			Hatchery Origin				
Return Year	Trapped	Released	Broodstock	Trapped	Released	Broodstock	Outplanted to Big Sheep Basin	Hatchery Origin Fish to Food banks/ other
1990	183	102	81	227	68	159	0	0
1991	131	80	51	374	112	262	0	0
1992	162	108	54	682	351	331	0	0
1993	352	294	58	892	498	345	49	0
1994	72	52	20	91	60	31	0	0
1995	38	0	38	30	0	30	0	0
1996	145	73	72	84	23	61	0	0
1997	84	61	23	394	59	147	188	0
1998	149	73	76	234	98	97	39	0
1999	67	46	21	323	73	250	0	0

2000	278	232	46	829	224	309	296	0
2001	1,390	1,283	107	2,116	1,353	246	517	0
2002	249	206	43	955	472	278	205	0
2003	360	294	65	945	266	308	372	0
2004	210	147	62	1,039	188/25	259	336	232
2005	236	176	60	987	226	236	292	233
2006	128	72	56	663	131/6	213	302	11
2007	151	102	49	1,180	318	205	288	369
2008	145	81	64	1,925	127/99	227	379	1,093
2009	259	184	75	3,273	127	249	1,042	1,855
2010	314	229	85	1,817	195/109	208	293	1,012

Note: In 1990 and 1991 not all the Imnaha Chinook salmon juveniles released were marked. Estimates of unmarked hatchery fish included in the above numbers are: 1991 = 92; 1992 = 253; and 1993 = 302.

Table 4**.** Estimated total return to the Imnaha River, by brood year, of hatchery spring Chinook salmon (age 3-5) produced from juveniles released into the Imnaha River (ODFW Annual Report Series, "Evaluation of Lower Snake River Compensation Plan Facilities in Oregon.").

Brood Year (release year -2)	Number of Smolts Released	Age 3	Age 4	Age 5	Total	Smolt to Adult Return (percent)
1990	262,500	32	59	12	103	0.039
1991	157,659	6	76	8	90	0.057
1992	438,617	102	87	9	198	0.073
1993	590,118	64	446	225	735	0.125
1994	91,240	9	66	15	90	0.099
1995	50,911	79	424	16	519	1.019
1996	93,127	259	453	145	857	0.920
1997	194,893	810	2,420	247	3,477	1.783
1998	179,987	823	2,615	971	4,409	2.452
1999	123,014	224	868	74	1,166	0.948
2000	303,737	715	1,342	107	2,164	0.712
2001	268,426	969	986	45	2,000	0.745
2002	398,185	241	941	105	1,287	0.323
2003	435,186	97	935	288	1,320	0.303
2004	441,680	586	2,525	228	3,339	0.756
2005	432,530	1,497	1,725	186	3,408	0.788
2006*	348,910	3,780	2,932	N.A.*	6,712	1.924*
2007*	293,802	1,065	N.A.*	N.A.*	1,065	0.362*

* = incomplete brood year

The hatchery mitigation goal was 490,000 smolts, 3,200 adults and an SAR of 0.65%; however, with target production of 420,000 smolts an expected return would only be 2,730 adults.

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

Lookingglass Hatchery was completed in 1982. The Imnaha Acclimation Satellite modifications were completed in 1989. The first program releases of Imnaha Chinook salmon occurred at the Imnaha Facility in March 1984 (1982 brood).

1.14) Expected duration of program.

The Imnaha spring/summer Chinook salmon (stock 029) program is an ongoing project.

1.15) Watersheds targeted by program.

The Imnaha watershed (0800200000) is the target area.

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

Given the ESA-listed status of Snake River spring/summer Chinook, maintaining a hatchery program is currently the only method to supplement the natural population and provide harvest opportunity on hatchery produced fish in the LSRCP mitigation area.

Northeast Oregon Hatchery

The Northeast Oregon Hatchery (NEOH) Project Final Design package identifies facility improvements for the Imnaha and Grande Ronde spring Chinook programs. This package was prepared jointly by the Nez Perce Tribe (NPT), the Confederated Tribes of the Umatilla Indian Reservation (CTUIR), the Oregon Department of Fish and Wildlife (ODFW) and U.S. Fish and Wildlife Service (USFWS) and submitted to the Northwest Power and Conservation Council in March 2006. The package of proposed new facilities successfully completed the Council's Three-Step Review process and was recommended to proceed to construction in May 2006. A decision to proceed with construction by Bonneville Power Administration has been pending for 3.5 years.

RPA Hatchery Strategy 2, Action # 42 of 2008 Federal Columbia River Power System Biological Opinion specifically calls for implementation of the Lostine and Imnaha river spring Chinook program;

"For the Lostine and Imnaha rivers, contingent on a NOAA approved HGMP, fund these hatchery programs, including capital construction, operation and monitoring and evaluation costs to implement supplementation programs using local broodstock and following a sliding scale for managing the composition of natural spawners comprised of hatchery origin fish.

The facilities proposed for construction through NEOH include:

1) A new incubation and rearing facility on the Lostine River consisting of:
- a hatchery building including incubation and early rearing facilities,
- eight rearing raceways,
- a quarantine raceway,
- a utility building and storage area,
- a clarifier,
- six adult holding ponds with associated fishway, trap, crowding, sorting, and spawning facilities
- three residences

Production at the Lostine River Hatchery would be 250,000 Lostine River spring Chinook smolts and 245,000 Imnaha River spring Chinook smolts (half of the 490,000 Imnaha production). The Lostine River Hatchery would work in conjunction with Lookingglass Hatchery to produce the 490,000 smolts for the Imnaha spring Chinook mitigation program. The associated Wallowa/Lostine Spring Chinook HGMP (section1.16) identifies proposed program modifications that support attainment of the Imnaha spring Chinook hatchery production goals noted previously in section 1.11 of this document. The facility design and planned fish production objectives would provide the required additional low density rearing opportunity necessary to achieve the mitigated smolt production and subsequent release goals.

Scientific Reviews

In 2009 two independent scientific review groups, the Hatchery Scientific Review Group (HSRG) and Hatchery Review Team (HRT) assessed the Imnaha program extensively. Their findings are summarized. The primary recommendations of the HSRG and HRT reviews were considered; however, with the exception of facility improvements and disease management, the operators of this program do not propose several key elements be implemented.

The rationale for this decision has four key elements. First, a co-manager agreed to protocol for managing hatchery broodstock and escapement needs (sliding scale, Table 1) has been developed for this program. The co-managers, having long standing differences with respect to the use of hatchery fish, were able to achieve consensus and develop these protocol. Radically changing this agreement, as the HSRG and HRT recommendations propose, would necessitate the negation of this hard won achievement and likely create new disagreements that could hamper efforts to recover spring Chinook in NE Oregon.

Second, there is a need to gather information on what has been learned to date on the effectiveness of this hatchery program and evaluate whether changes might be appropriate to improve the program. However, this evaluation should include the participation of the co-managers. Therefore, this is a long-term process and one that probably best fits within the structure of the 5-year reviews described in Sections 1.10.1 and 1.10,2.

Third, the HSRG and HRT recommendations focus on a long-term perspective of what might be one approach for management of the hatchery program. However, the more immediate task for the Imnaha is to ensure the population is stabilized and to maintain a hatchery broodstock that can be used as a backup should an extreme period of poor ocean conditions, similar to those experienced in the 1990s, occur in the future. We also believe there is considerable uncertainty as to the benefits that will accrue in terms of the production of more natural origin fish as result of the changes suggested by the HSRG. While the genetic model that underpins the analysis done by HSRG may be sound, the translation of this relation to productivity in naturally reproducing salmon populations is tenuous and has not been demonstrated empirically. Therefore, we believe that the short and long-term approach outlined by the draft recovery plan and provided here in Section 1.75 provides a more realistic strategy for the future operation of this hatchery program.

Finally, the HSRG acknowledges that their recommendations are not the only correct path for the future operation of a particular hatchery program as following HSRG policy statement indicates.

"The Hatchery Scientific Review Group (HSRG) effort was directed to answer the questions of whether and in what manner hatcheries can be used to assist the managers in meeting their conservation and harvest goals for salmon and steelhead in the Columbia River Basin. The HSRG's recommendations are not the only possible alternatives for managing hatchery programs to meet conservation and harvest goals. As such, the managers may develop other solutions which better meet their program principles and goals. Success over time will be defined by the managers' ability to take actions in the future to adjust hatchery programs based on good science to meet their conservation and harvest goals"

Hatchery Scientific Review Group (HSRG)

Hatchery Scientific Review Group (HSRG) developed guidelines for minimal conditions that must be met for three types of programs based on a function of the biological significance of the natural populations they affect. The three strategies are Primary, Contributing, and Stabilizing. Imnaha spring/summer Chinook population was classified as an integrated Primary population; therefore, the guidelines for a primary population include proportion of natural origin (pNOB) adults in the broodstock should exceed proportion of Hatchery Origin Spawners (pHOS) by at least of factor of two, corresponding to a PNI (proportion natural influence) of 0.68 (PNI=0.68; pNOB = 65%; pHOS – 35%).

The HSRG recommended to modify or replace the Imnaha River adult weir (to remove a minimum of 70% of the unharvested returning hatchery adults) to improve broodstock and escapement management. Co-managers agree that this recommendation be implemented to meet objectives of the sliding scale management tool (Table 1) and as described in sections 1.75, 1.11.1, 5.1, 6.1, and 7.9. A new picket weir with a pneumatically-controlled weir for safer and more efficient broodstock collection over the entire run is proposed as part of the NEOH (Northeast Oregon Hatchery) project. In addition, improvements to adult holding, handling and juvenile acclimation and release at the Imnaha satellite facility are designed and proposed for the Imnaha satellite facility including: 1) relocation of the intake rock sluiceway to a settling basin east of the existing storage building, 2) redesign of the new acclimation and holding ponds to the east side of the existing holding ponds, 3) extension of the existing storage building and addition of vehicle parking area, 4) relocation of the vehicle access ramp, 5) addition of adult holding area extension, 6) additional portable generator and skid-mounted air compressor for pneumatically-controlled weir and intake screen cleaning, and 7) replacement of the existing intake structure with a larger structure capable of delivering more surface water to the facility. In May of 2006 the Northwest Power and Conservation Council recommended proceeding with construction of NEOH (including these modifications) however, initiation of construction is pending a decision from Bonneville Power Administration.

A new picket weir would also allow for improved management of hatchery fish that would be necessary to implement the HSRG's second recommendation: a two-stage conservation and harvest program consistent with the HSRG-defined standards for a primary population. The program would consist of an integrated conservation component producing approximately 113,000 smolts (PNI – 0.68; pNOB = 65%; pHOS = 35%). This component initially would be produced by collecting 100% of its broodstock from natural-origin returns. Subsequent generations would be maintained by collecting 65% of the broodstock from natural-origin and 35% from hatchery origin returns for this conservation production component. Excess hatchery-origin returns from the conservation component would provide all broodstock to maintain an additional second stage harvest component of approximately 246,000 smolts. Unharvested hatchery returns from the harvest component would not be used for broodstock. This requires differential marking of the juveniles from the two programs. For example, the juveniles from the conservation program would be coded wire tagged only, while the harvest program fish would be adipose-marked and coded wire tagged.

For reasons mentioned above, the co-managers do not recommend implementing this HSRG recommendation to implement a two-stage broodstock program at the present time. ODFW and NPT are implementing the Imnaha spring Chinook program that was developed as a result of dispute resolution within the *U.S. vs. Oregon* forum. Sliding scales are used to manage potential genetic risks associated with hatchery broodstock and natural spawner escapement in combination with a sliding scale to manage terminal tribal and non-tribal fisheries. This program and the associated sliding scales were developed in consultation with NOAA Fisheries.

Finally, the HSRG recommended that co-managers continue to implement their successful broodstock bacterial kidney disease (BKD) management strategy. The co-managers agree on this recommendation.

Hatchery Review Team (HRT)

The Hatchery Review Team (HRT) considered many benefits and risks while reviewing Imnaha program and associated facilities: Lookingglass hatchery and Imnaha satellite (USFWS 2009). HRT recommendations are summarized in Table 5, the entire review is located at: *http://www.fws.gov/Pacific/fisheries/Hatcheryreview/reports.html.*

The HRT recommends reduction in the program goal from 360,000 to 325,000 smolts annually to address facility constraints at Lookingglass FH and to meet the Team's recommended alternative to increase production of Lookingglass FH spring Chinook (see issues LC-SC7, 8, and 11 and the recommended alternative in the Lookingglass FH spring Chinook section). This includes implementing the Teams current program recommendations and constructing a new, more efficient weir that can be installed at the beginning of the Imnaha spring/summer Chinook run so that the program can be managed as intended. However, as mentioned above, this recommendation amongst others conflicts with the 2008-2017 *U.S. vs. Oregon* production agreement and are not recommended by co-managers for implementation at this time.

Table 5. Summary of HRT recommendation, priorities, approximate costs, and comments.

Imnaha	Brief Description of Recommendations	Priority	Additional Costs	Comments
Alter.	Reduce production to 325,000	Low	$0	*U.S. vs. Oregon* issue
SC1	Restate Goals	Low	$0	HGMP
SC2	Discontinue release of adults in Big Sheep	Low	$0	*U.S. vs. Oregon* issue
SC3	Adjust adult sliding scale	Low	$0	*U.S. vs. Oregon* issue, needs resolution
SC4	Establish harvest goals	Low	$0	Ongoing, FMEP submitted in 2010, Tribal Resource Management Plan also submitted
SC5	Report proportion of jacks used to fertilize eggs	Low	$0	Ongoing
SC6	Reduce early rearing density	High	$60,000	Ongoing in O&M 2010 budget

SC7	Design and construct new ladder and weir	High	$1,000,000	Highest priority
SC8	Cover ladder	Medium	$10,000	Ongoing in O&M 2010 budget
SC9	Intake screen meet NOAA criteria	High	$100,000	Under discussion with LSRCP
SC10	Consult and design de-icing screen or delay acclimation	Low	$0 - $100,000	Under discussion with LSRCP
SC11	Modify trap to meet adult holding	High	$10,000	2010 O&M budget
SC12	Construct RV pad	Low	$20,000	O&M budget
SC13	Monitor Big Sheep releases or discontinue	Low	<$100,000	*U.S. vs. Oregon* issue to discontinue
SC14a	Continue population monitoring	High	$0	Ongoing
SC14b	Pedigree study	Medium	$50,000	Discuss with LSRCP after new weir is constructed
SC15	Continue applied M&E	High	$20,000	Acclimation study
SC16	Enhance I&E efforts	Low	$25,000	Ongoing in O&M
SC17	Establish volunteer program	Low	$5,000	Under advisement
SS13	Review tagging composition	Low	0	Ongoing

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

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

ESA Section 10 permit #1128 (expired; HGMP submittal 2002).

Lower Snake River Compensation Plan program
NPDES 0300J permit (site number 64492)
Erythromycin INAD 090RLOSCS1.

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

The Imnaha River population is at **High Risk** based on current abundance and productivity. The point estimate resides below the 25% risk curve (Figure 2, ICTRT 2010a).

The Interior Columbia Technical Recovery Team (ICTRT) evaluated the viability status of the Imnaha River Chinook population using return data to 2005 (ICTRT 2010a, Table 6). For this analysis, abundance of natural-origin spawners in the Imnaha River spring/summer Chinook salmon population had trended downwards at a rate of approximately 2% per year since 1980 (Table 7). After peaking during 2001-2003, return levels in 2004 and 2005 have been just below the levels observed in the early 1980s. A substantial proportion of the estimated number of spawners in the Imnaha River spring/summer Chinook salmon population originates from the hatchery supplementation program. Assuming that hatchery and natural-origin spawners contribute to production at the same rate, the estimated intrinsic population growth rate over the most recent twenty year period has been well below replacement (0.85, 7% probability of exceeding 1.0). The estimate of population growth rate is sensitive to the assumption regarding relative hatchery effectiveness at the average level of hatchery-origin spawner proportion observed for the Imnaha River spring/summer Chinook salmon population. Setting the relative hatchery effectiveness value to 0.0 to reflect the opposite extreme assumption, results in an estimated average population growth rate of 1.0.

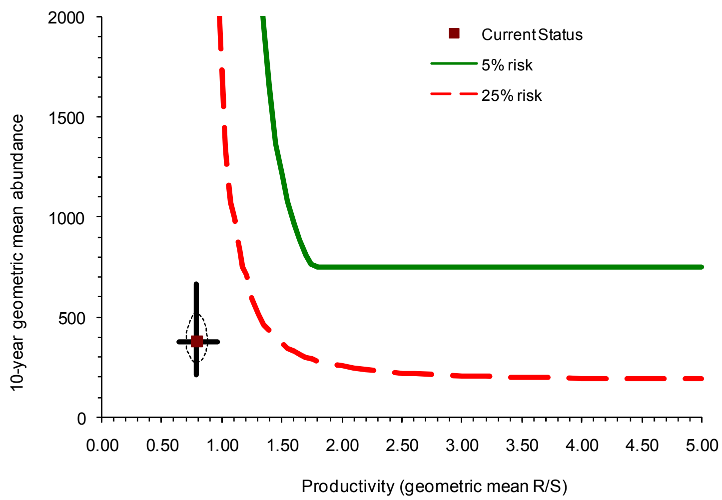

Figure 2. Imnaha River spring/summer Chinook salmon current abundance and productivity compared to the ESU viability curve. Ellipse = 1 SE. Error bars = 90% CI for productivity.

Overall Viability Rating

The Imnaha River spring/summer Chinook salmon population does not meet viability criteria and the overall viability rating is considered **HIGH RISK** (Figure 2, ICTRT 2010a). Overall abundance and productivity is rated at **High Risk.** At the time of the viability analysis, the 10-year geometric mean abundance of natural-origin spawners was 380, which is only 51% of the minimum abundance threshold of 750. The 20-year geometric mean productivity (0.79 R/S; Table 3.2.6–6) is well below the viability target of 1.76 R/S and is in the high risk zone. The overall spatial structure and diversity rating is at **Moderate Risk** due to phenotypic, genetics and hatchery influence on spawner composition and selectivity metrics (ICTRT 2010a).

		Spatial Structure/Diversity Risk			
		Very Low	**Low**	**Moderate**	**High**
Abundance/ Productivity Risk	**Very Low** (<1%)	**HV**	**HV**	**V**	**M**
	Low (1-5%)	**V**	**V**	**V**	**M**
	Moderate (6 – 25%)	**M**	**M**	**M**	**HR**
	High (>25%)	**HR**	**HR**	**HR Imnaha River**	**HR**

Figure 3. Imnaha River spring/summer Chinook salmon population risk ratings integrated across the four viable salmonid population (VSP) metrics. *Viability Key: HV – Highly Viable; V – Viable; M – Maintained; HR – High Risk; Shaded cells - not meeting viability criteria (darkest cells are at greatest risk).*

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

The Interior Columbia Technical Recovery Team (ICTRT) established biological viability criteria to monitor recovery efforts in the ESUs for salmon and steelhead listed under the Endangered Species Act. The viability criteria were based on guidelines in NOAA Technical Memorandum *Viable Salmonid Populations and the Recovery of Evolutionary Significant Units* (McElhany et al. 2000). These guidelines were used to describe the Imnaha spring/summer Chinook population.

The Imnaha Spring/Summer Chinook population is part of the Snake River Spring/Summer Chinook ESU that is classified as threatened under the Endangered Species Act. This ESU has five major population groupings (MPGs), including: Lower Snake River, Grande Ronde/Imnaha, South Fork Salmon River, Middle Fork Salmon River, and the Upper Salmon River group. The ESU contains both spring and summer run Chinook. The ICTRT categorized the Imnaha population in the Imnaha/Grande Ronde Major Population Group (MPG).

The Imnaha population (whose range does not include the Big Sheep Creek watershed) is a spring/summer run, and is considered an "intermediate" sized population by the ICTRT. An "intermediate" population is one that requires a minimum abundance of 750 natural origin spawners and an intrinsic productivity of 1.8 recruits per spawner (R/S) to be viable at the 5% extinction risk threshold. A second population, Big Sheep Creek, a tributary of the Imnaha, is considered by the ICTRT to be a "Basic" spring run population, requiring a minimum abundance of 500 natural origin spawners. However; the Big Sheep population was considered to be functionally extirpated. Big Sheep includes both Little Sheep and Lick Creek.

Historically, it is estimated that the Imnaha River supported one of the largest spring Chinook runs in Wallowa County. Prior to the construction of the four lower Snake River dams, maximum run size to the basin was estimated at 6,700 fish (NPPC 2004).

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

ESA listed naturally produced spring/summer Chinook returning to Imnaha River are collected and utilized in the hatchery broodstock. Notably, progeny from hatchery and wild fish spawned are listed as well (NMFS 2005).

Imnaha Spring/summer Chinook

Spawning Range - Adults spawn primarily in the headwaters of the Imnaha River beginning near the South Fork Imnaha extending to Freezeout Creek, with the majority of spawning in the 17.7 miles from the "Blue Hole" to Crazyman Creek. The population has one major and one minor spawning areas defined by the ICTRT. Many areas of the basin including reaches below spawning areas and tributaries that maintain suitable habitat conditions that are utilized by rearing juveniles. The combined natural and hatchery returns to the basin have ranged from several hundred in the late 1980s and 1990s to several thousands in the early 2000s. A collective (naturally-produced plus hatchery-origin fish) escapement of 3,105 adult (age-4 and 5) was projected in 2010.

Adult Age Class Structure - Imnaha Basin adults typically return as four-year-olds in both hatchery (65%) and natural (58%) fish. However, age composition of returning adults differs with 20% to 40% of the hatchery males maturing at age-three (jacks) compared to <10% of natural origin males maturing at age three. In contrast, the frequency of age five spawners is higher in the natural origin return than it is in the hatchery origin return (Carmichael et al 1998). Returning adults range in size from 45 to 110 cm and 1.4 to 11.5 kg.

Life History Migration Timing - Adult spring Chinook enter the Columbia River from March through May. Spring Chinook move into summer holding areas in preparation to spawn from May through July. Spawning occurs from early August through late September and generally peaks in late August. Fry emergence begins in February and extends into May. Fry expand their spatial distribution after emergence in the spring; the extent depending on annual environmental conditions. A substantial portion of the basin population will move into lower river reaches in the fall, over-winter, and migrate in late March through early June (Figure 3). Generally, juveniles will rear for one year in freshwater.

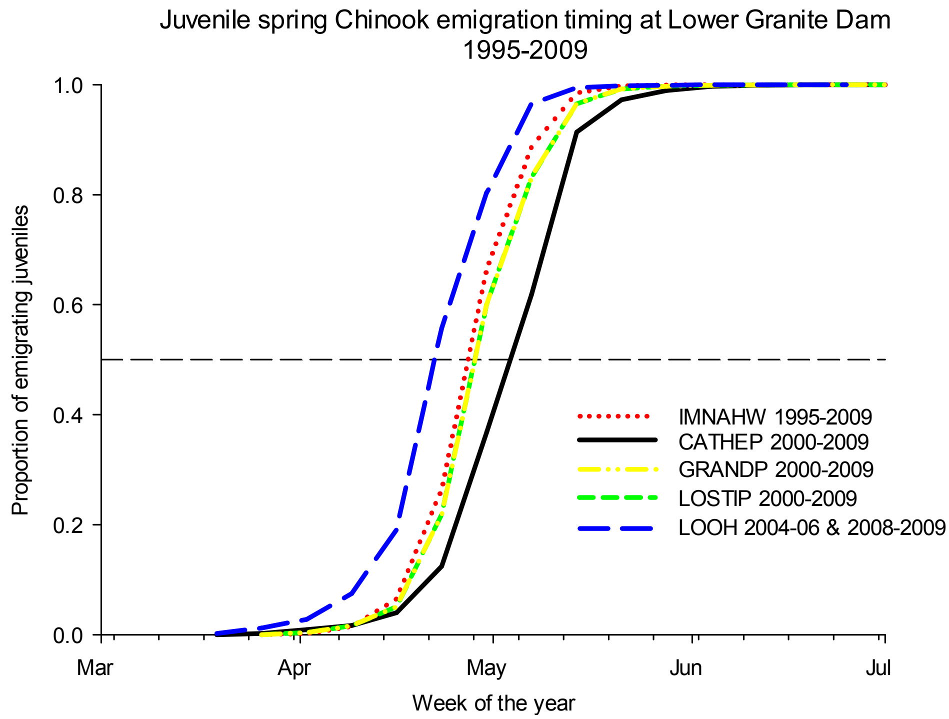

Figure 4. Average arrival time at Lower Granite Dam of PIT tagged juvenile spring/summer Chinook (*O. tshawytscha*) released from acclimation ponds on the Imnaha River (IMNAHW), Catherine creek (CAHTEP), the Grande Ronde River (GRANDP), the Lostine River (LOSTIP), and Lookingglass Fish Hatchery (LOOH) between the 1995 and 2009 migration years.

Outside of the Imnaha River, there have been a total of 283 estimated coded wire recoveries (adjusted for tag rate) from brood years 1982 to 2006. Strays into other Columbia River tributaries below McNary dam accounts for 80% (223), and tributaries above McNary dam accounts for 7% (20) of the 283 estimated recoveries. Within the Snake River basin, 3% (8) of the estimated tag recoveries occurred in tributaries below Lower Granite Dam, and 8% (24) of the 283 estimated recoveries occurred in tributaries above Lower Granite Dam. Strays outside of the Columbia basin accounted for 1% (4) of the estimated tag recoveries. Straying of Imnaha River Chinook into the adjacent Grande Ronde Basin is believed to be negligible.

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

The hatchery production program may incidentally affect listed Snake River summer steelhead populations. In addition, listed Snake River spring Chinook populations, Snake River fall Chinook and Columbia Basin bull trout may be affected to a lesser degree. Bull trout are most affected during Chinook trapping activities.

Summer steelhead - Imnaha Basin summer steelhead are typical of A-run steelhead from the mid-Columbia and Snake basins. Most adults (60-70 %) return to the basin after one year of ocean rearing. Most of the remainder returns as two-salt adults with an occasional three-salt fish observed. Returning adults range in size from 45 to 91 cm and 1.4 to 6.8 kg. Adults enter the Columbia River from May through August subsequently entering the Imnaha from September through May. Adults utilize accessible spawning habitat throughout the Imnaha Basin.

Imnaha summer steelhead begin spawning in March in lower elevation and spring-fed tributaries and continues into early June in higher elevation snowmelt systems. Juveniles utilize a wide range of habitats throughout the basin including areas adjacent to smolt release locations. Most (75-80%) naturally produced smolts migrate after rearing for two years in freshwater tributaries. A much lower percentage (20-2 %) migrates after one or three years. Smolt out-migration from the Imnaha Basin extends from late winter until late spring; however, peak smolt movement is associated with increased flow events, generally between mid-April and mid-May. A few adult summer steelhead have been encountered at the Imnaha weir.

Fall Chinook – Fall Chinook in the lower reaches of the Imnaha are considered segments of the Snake River population and exhibit similar life histories. Spawning is generally limited to a few redds located in the lower five miles of the river. Adult Snake River fall Chinook enter the Columbia River in July and migrate into the Snake River from mid-August through October. Spawning occurs from late October through early December, with fry emergence during March and April. Smolt emigration occurs within several months following emergence with peak migration past Lower Granite Dam in late June.

Bull Trout – Both fluvial and resident life history forms of bull trout inhabit the Imnaha River and a number of tributaries. Bull trout utilize suitable habitat within the Imnaha River basin including; mainstem Imnaha River, it's north and south forks and the lower reaches of several smaller tributaries to the upper Imnaha system, Big Sheep Creek and tributaries, Lick Creek, and Little Sheep Creek and several of its small tributaries. Fluvial adults migrate into headwater areas during spring and summer after over-wintering in mainstem tributaries and the Snake River. Spawning for both resident and fluvial adults occurs in September and October. Fry emerge during the spring. Juvenile rearing is restricted to headwater areas where water remains cooler above approximately rkm 67 on the Imnaha and rkm 40 on Big Sheep and Little Sheep creeks.

In 1992, two-pass electro-fishing density estimates in Big Sheep, Lick, Salt and Little Sheep creeks were conducted. That work suggested moderate to high densities of rearing bull trout in streams except Little Sheep Creek. No bull trout were collected from sample reaches of Little Sheep Creek. Densities ranged from 5.6 to 15.8 (1+ and older) fish per $100m^2$ within sample sections containing bull trout in the other Imnaha tributaries, in addition to varying densities of 0-age bull trout (Smith and Knox, 1992). More recent research suggests the resident bull trout population in Big Sheep Creek is less than 2,000 individuals, above and below the WVIC and including all tributaries (USFS 2001). The resident bull trout population in Little Sheep Creek is fewer than 500 (USFS 2003). The resident population of McCully Creek, which formerly flowed into Little Sheep Creek, is estimated at approximately 2,500 individuals (Smith and Knox as referenced in Buchanan et al. 1997). The WVIC is a water diversion in northeastern Oregon that has impacted bull trout and their habitat. The canal was constructed in the 1880s and diverts water from several Imnaha River basin streams between Big Sheep Creek and McCully Creek to Prairie Creek in the Wallowa River Basin.

More recent work summarized by Sausen (2010) suggests the Imnaha bull trout population is one of the strongholds within the Imnaha basin as it has multiple age classes, contains fluvial fish, has an anadromous prey base, connectivity with the Snake River, and bull trout are distributed throughout the habitat. Primary spawning activity on the Imnaha River has been documented to occur in the headwaters which lie within wilderness (G. Sausen, USFWS, and B. Knox, ODFW, pers. comm. 2005). Both fluvial and resident life history forms are present. Habitat conditions vary widely across the basin and affect bull trout productivity in some areas. The Imnaha River is rated at low risk of extinction, Little Sheep is rated at high risk of extinction, and Big Sheep is rated "of special concern" (Buchanan, et al 1997). Collectively, the local bull trout populations in the Imnaha and Big Sheep and Lick Creek appear to be relatively stable for the survey period (1999-2008); although, a minimum of 15 years is needed to determine population trends.

Bull trout spawning ground surveys on the Imnaha have been conducted since 2001 and in Big Sheep and Lick Creek since 2000 (Sausen 2010). Between 2001 and 2010, the number of redds counted on surveys on the Imnaha has ranged from 101-262 (Figure 5). In 2006 and 2007, there was a significant shift in documented spawning distribution from past years. In 2006 through 2008, the majority of the spawning bull trout were located from the Imnaha falls to Indian Crossing, whereas, in past years the distribution had higher numbers above the Blue Hole (two miles upstream of Indian Crossing), as well as in the upper tributary streams (S.F. and N.F. Imnaha).

On Big Sheep and Lick Creek, the number of redds counted has ranged between 8 and 34 redds (Figure 5). Redd surveys for bull trout in the Big Sheep system have been limited in miles of survey (8.4 to 14.1 miles from 2000 to 2010) and in frequency, (2000-2001 surveys were conducted once late season, and in 2002, 2003, 2005-2010 surveys were conducted twice, mid and late season). In 2004, the survey was conducted once late season for Big Sheep and twice, mid and late season for Lick Creek.

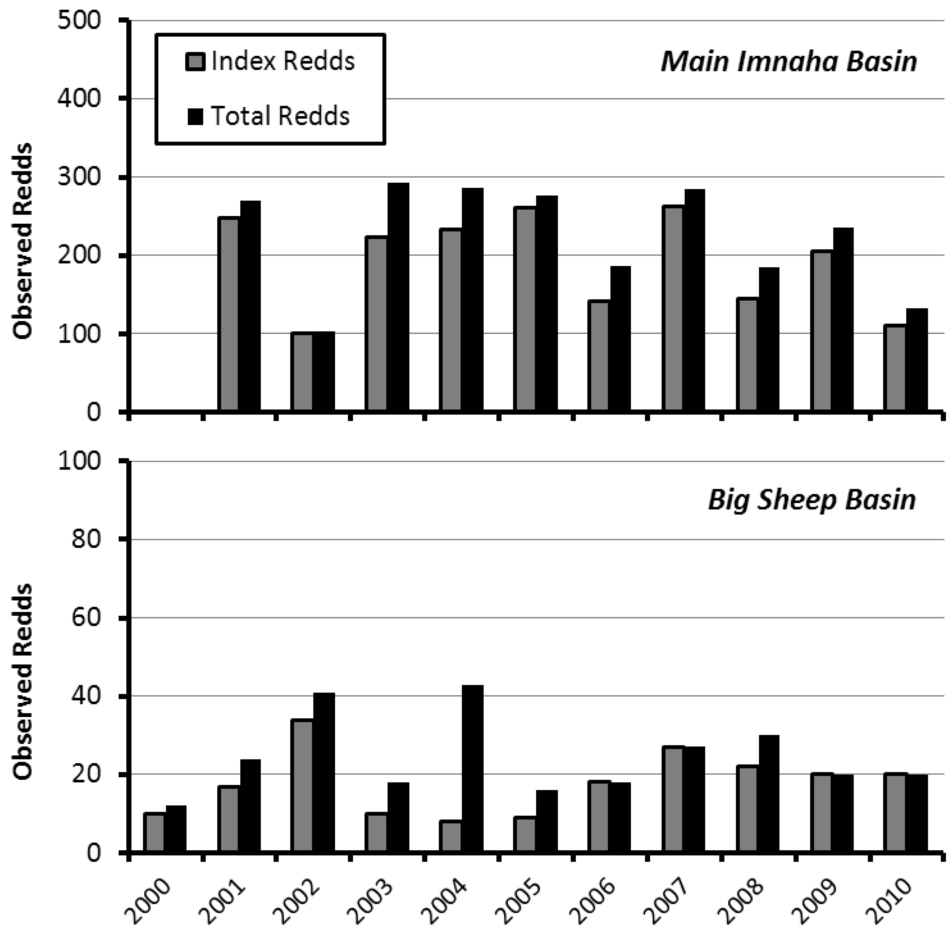

Figure 5. Comparison of bull trout redds in index reaches and total surveys in the main Imnaha basin (top panel) and Big Sheep Creek basin (bottom panel) from 2000 to 2010 (Sausen 2010). Note difference in y-axis between panels.

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**

<u>Spring Chinook</u> – The draft Interior Columbia Technical Recovery Team (ICTRT) guidelines for critical and viable population thresholds for Imnaha River spring Chinook and steelhead are listed in Table 8. The population abundance and productivity data used in the ICTRT viability analysis for the Imnaha population is listed in Table 6 and 7.

From 1957 to 1984, estimated run size of natural-origin fish to the mainstem Imnaha River exceeded the TRT draft guideline of 750 natural-origin spawners in all but four years (ICTRT 2010a). Since the initiation of the hatchery program in 1984 hatchery origin fish have made up 60 to 75 percent of spring Chinook returning to the Imnaha basin (Figure 6). Natural origin returns have met the critical threshold in 13 of the last 20 years but the viable threshold in only 4 of the last 20 years (Figure 6). Similar declines have occurred in other populations in NE Oregon that were not heavily supplemented with hatchery fish during the same period. It is likely that the primary cause of the observed declines was the combined effects of construction of four dams on the lower Snake River that increased mortality rates on migrating juveniles and a coinciding major shift in ocean conditions that resulted in substantially lower marine survival rates. Natural origin spawners in Big Sheep Creek have remained at extremely low numbers in recent years (Table 9 and 11). Big Sheep Creek spawning surveys accounted for relatively greater numbers of redds in some recent years. However, higher counts occurred only during years when surplus Imnaha River hatchery origin fish were outplanted to that system.

Table 6. Imnaha River spring/summer Chinook salmon population abundance and productivity data used for the ICTRT viability analysis (ICTRT 2010a).

Abundance/Productivity Statistics	Estimate	(Range)	SE
Abundance: natural-origin spawners (10-year geometric mean, range)	380	(124-2217)	
Proportion: natural-origin spawners (10-year geometric mean, range)	0.31	(0.20-0.66)	
	Estimate	**(90% CI)[b]**	**SE**
Intrinsic productivity (20-year R/S, SAR adjusted & delimited) [a]	0.79	(0.65-0.96)	
Productivity (20-year Beverton-Holt fit, SAR adjusted)	1.45		0.49
Trend Statistics (1980-2005)	**Estimate**	**(95% CI)**	**P>1.0**
ln(natural-origin spawner abundance)	0.98	(0.94-1.02)	
Population growth rate (λ): Hatchery effectiveness = **1.0**	0.85	(0.67-1.09)	0.07
Population growth rate (λ): Hatchery effectiveness = **0.0**	1.00	(0.74-1.36)	0.50

a. Delimited productivity excludes any recruit/spawner pair where the spawner number exceeds the median parent escapement for the data series. This approach attempts to remove density dependence effects that may influence the productivity estimate.

b. Lower end of the 90% CI on productivity is used in evaluating the impact of parameter uncertainty on risk.

Table 7. Imnaha River spring/summer Chinook salmon population abundance and productivity data used for curve fits and R/S analysis (ICTRT 2010a). Bolded values were used in estimating the current productivity.

Brood Year	Adult Spnr	%Wild	Nat. Adults	Nat. Rtns	R/S	SAR Adj. Factor	Adj. Rtns	Adj. R/S
1981	735	1.000	735	1263	1.72	0.63	794	1.08
1982	958	1.000	958	627	0.65	0.51	320	0.33
1983	706	1.000	706	818	1.16	0.58	471	0.67
1984	839	1.000	839	219	0.26	1.65	361	0.43
1985	1239	0.917	1239	197	0.16	1.57	310	0.25
1986	757	0.938	723	208	0.27	1.41	294	0.39
1987	**488**	**0.898**	**472**	**178**	**0.36**	**1.83**	**324**	**0.66**
1988	**634**	**0.846**	**576**	**427**	**0.67**	**0.75**	**319**	**0.50**
1989	**294**	**0.733**	**253**	**178**	**0.60**	**1.79**	**319**	**1.08**
1990	**352**	**0.514**	**188**	**61**	**0.17**	**4.65**	**286**	**0.81**
1991	**379**	**0.307**	**183**	**108**	**0.28**	**3.01**	**324**	**0.86**
1992	884	0.212	191	261	0.30	1.65	432	0.49
1993	1259	0.338	426	190	0.15	1.61	306	0.24
1994	**251**	**0.454**	**116**	**100**	**0.40**	**1.04**	**105**	**0.42**
1995	**160**	**0.560**	**86**	**187**	**1.17**	**0.60**	**112**	**0.70**
1996	**339**	**0.662**	**255**	**573**	**1.69**	**0.54**	**311**	**0.92**
1997	**551**	**0.231**	**124**	**2242**	**4.07**	**0.30**	**663**	**1.20**
1998	**330**	**0.403**	**156**	**1316**	**3.98**	**0.30**	**391**	**1.18**
1999	706	0.196	188	813	1.15	0.65	527	0.75
2000	850	0.325	324	294	0.35	1.00	294	0.35
2001	4485	0.443	2217					
2002	4005	0.222	923					
2003	3427	0.320	1461					
2004	1050	0.233	300					
2005	700	0.319	233					

Table 8. List of the natural fish populations, "Viable Salmonid Population" thresholds, and associated hatchery stocks included in this FMEP.

Natural Populations (or Management Units	**Critical Thresholds (BRWG)**	**Minimum Abundance Thresholds (TRT)**	**Associated hatchery stock(s)**	**Hatchery stock essential for recovery?(Y or N)**
Imnaha River Spring Chinook[a]	Abundance: 300 naturally produced adults/year Productivity: replacement rate = 0.7	Abundance: 750 naturally produced adults/yr Productivity: long term avg. replacement rate = 1	Imnaha spring Chinook hatchery stock	Y
Big Sheep Creek Spring Chinook[a]	Abundance: 150 naturally produced adults/year Productivity: replacement rate = 0.7	Abundance: 500 naturally produced adults/yr Productivity: long term avg. replacement rate = 1	Imnaha spring Chinook hatchery stock	N

Natural Populations (or Management Units	Critical Thresholds (BRWG)	Minimum Abundance Thresholds (TRT)	Associated hatchery stock(s)	Hatchery stock essential for recovery?(Y or N)
Imnaha Steelhead	Abundance: 300 naturally produced adults/year Productivity: replacement rate = 0.7	Abundance: 1000 naturally produced adults/yr Productivity: long term avg. replacement rate = 1	Little Sheep Creek steelhead hatchery stock	N

[a] The Big Sheep Creek Chinook population is considered functionally extirpated by the ICTRT. Spawning within Big Sheep Creek is largely supported by outplanting surplus adults from the Imnaha basin. Therefore for harvest planning purposes, managers have agreed to collectively manage the two populations together, using a critical threshold of 300 and a minimum abundance threshold of 1000.

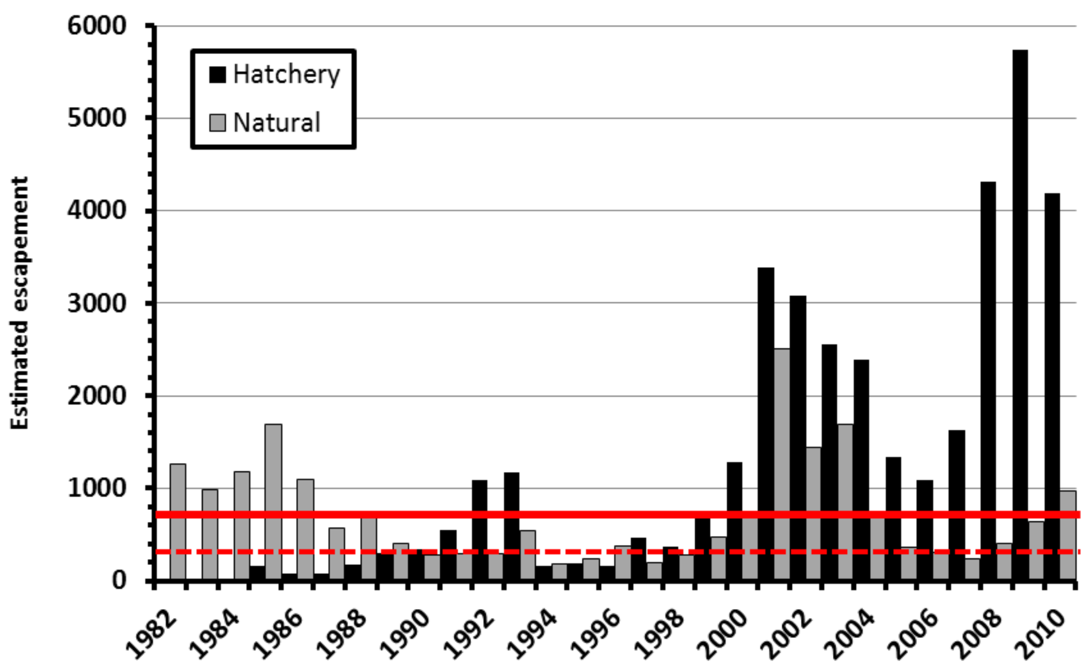

Figure 6. Estimated combined natural and hatchery origin spring Chinook escapement to the Imnaha population for years 1985 – 2010 (does not include Big Sheep Creek). The population critical threshold (300, red dotted line) and minimum abundance threshold (750, solid red line) are shown according to the ICTRT viability analysis (2010a).

Table 9. Spring Chinook redds counted during spawning surveys, including outplanting history, in the Big Sheep drainage including Lick Creek 1989 – 2010.

	Outplants from Imnaha				
Brood Year	Males	Females	Jacks	Total	Observed Redds
1989	0	0	0	0	2
1990	0	0	0	0	2
1991	0	0	0	0	7
1992	0	0	0	0	3
1993	15	33	1	49	31
1994	0	0	0	0	0
1995	0	0	0	0	0
1996	0	0	0	0	1
1997	35	21	0	188	70
1998	20	17	2	39	11
1999	0	0	0	0	1
2000	0	0	296	296	0
2001	94	143	280	517	6
2002	73	124	8	205	78
2003	82	89	201	372	27
2004	69	230	37	336	74
2005	129	163	0	292	98
2006	195	107	0	302	52
2007	136	84	68	288	25
2008	155	145	79	379	106
2009	176	125	741	1042	77
2010	136	157	0	293	103

- Provide the most recent 12 year (e.g. 1997-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.

ODFW La Grande research staff, with monitoring assistance from the Nez Perce tribe, has monitored the Imnaha program since its inception in 1982. Results from brood years 1982 through 2003 are presented in Table 10. The average progeny-to-parent ratios for hatchery origin fish was 5.94 with a high of 29.2 in brood year 1998 and a low of 0.54 in brood year 1990. The average progeny-to-parent ratios for natural origin fish was 0.89 with a high of 4.05 in brood year 1997 and a low of 0.04 in brood year 2003.

However, the interpretation of annual variations in progeny to parent ratios of naturally reproducing fish is difficult because the confounding effect of spawner density has not been removed. The progeny to parent ratio observed when the parental numbers are many, will invariably be lower than when the parental numbers are few. Without means for standardizing this density dependent dynamic, the comparison of progeny to parent ratios among different years can easily lead to erroneous conclusions about population status. In addition, this population is exposed to large variations in downstream passage and ocean survival. These variations also can seriously confound the interpretation of progeny to parent ratios, unless standardization is developed for this factor as well. In the case of this population smolt to adult survival estimates are available which could be used to a tool for this standardization.

Table 10. Comparison of progeny to parent ratios for the Imnaha Hatchery program and the natural spawning population in the Imnaha River (age-3 males included).

Brood Year	Hatchery	Natural
1982	7.43	0.98
1983	1.25	1.15
1984	3.08	0.26
1985	1.72	0.18
1986	1.53	0.43
1987	3.96	0.49
1988	11.25	0.82
1989	3.58	0.63
1990	0.55	0.28
1991	0.95	0.26
1992	0.62	0.51
1993	3.73	0.25
1994	1.76	0.72
1995	7.63	1.10
1996	8.16	1.88
1997	20.33	4.77
1998	25.63	4.09
1999	4.30	0.99
2000	6.15	0.46
2001	5.67	0.09
2002	4.11	0.11
2003	3.58	0.05
2004	3.73	0.20
2005*	12.00	0.68

* 2005 brood year contains only age 3-5 year returns (Age 5 returns=2010). Occasionally, older fish are collected.

- Provide the most recent 12 year (1999-2010) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.

Table 11. Redd counts observed in selected tributaries in the Imnaha Basin, 1997-2010.

	Imnaha River				Big Sheep Basin[1]		Imnaha Basin Total
Year	Index Redds	Above Weir	Below Weir	Total	Index Redds	Total Redds	
1997	101	145	79	224	38	70	286
1998	39	97	49	146	4	11	157
1999	87	119	71	190	0	1	191
2000	90	195	66	261	0	0	261
2001	182	416	219	635	5	6	641
2002	352	853	258	1,111	22	78	1,189
2003	269	535	192	727	11	27	754
2004	129	305	190	495	8	74	569
2005	49	183	166	349	45	98	447
2006	57	152	83	235	18	52	287
2007	24	129	123	252	7	25	277
2008	164	377	159	536	37	106	642
2009	93	162	229	391	23	77	468
2010	203	374	377	751	29	103	854

[1] Includes both Big Sheep and Lick Creeks

- **Provide the most recent 12 year (1999-2008) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.**

A portion of the spring Chinook run escapes upstream of the weir each year before the weir is installed. Approximately 28% of the returning Chinook spawn naturally below the weir (Hoffnagle et al. 2008). Between 1982 and 2005, it was estimated that 40% of the total number of fish returning to the river each year passed the weir before installation (Hoffnagle et al. 2008). On the Imnaha River, between 1990 and 2008, Hoffnagle et al. (2008) reported that carcasses of naturally reared fish of either or both sexes were recovered on spawning grounds earlier than carcasses of hatchery-reared fish for all years combined, indicating earlier spawning by naturally reared fish. The number of hatchery and natural-origin Chinook salmon recovered on spawning ground surveys between 1990 and 2008 is summarized in Table 12.

Table 12. Origin of adult (jacks excluded) Imnaha Chinook salmon carcasses recovered on spawning ground surveys in the Imnaha Basin.

Return Year	Imnaha River			Big Sheep Basin[1]		
	Hatchery origin	Natural origin	% Hatchery origin	Hatchery origin	Natural origin	% Hatchery origin
1990	22	30	42.3%	0	1	0.0%
1991	22	29	43.1%	0	1	0.0%
1992	48	103	31.8%	0	1	0.0%
1993	109	405	21.2%	30	1	96.8%
1994	23	31	42.6%	0	0	-
1995	4	15	21.1%	0	0	-
1996	6	58	9.4%	0	0	-
1997	38	74	33.9%	51	0	100.0%
1998	38	49	43.7%	1	0	100.0%
1999	58	104	35.8%	0	0	-
2000	97	210	31.6%	0	0	-
2001	128	214	37.4%	6	0	100.0%
2002	325	426	43.3%	15	15	50.0%
2003	185	388	32.3%	5	4	55.6%
2004	183	242	43.1%	35	0	100.0%
2005	72	92	43.9%	37	0	100.0%
2006	80	51	61.1%	48	0	100.0%
2007	64	32	66.7%	6	0	100.0%
2008	370	106	77.7%	59	4	96.7%
2009	246	123	66.7%	102	3	97.1%
2010	364	208	63.6%	16	2	88.9%

[1] Includes both Big Sheep and Lick Creeks and known outplanted fish to those streams.

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**.

Adult broodstock collection - Annual broodstock collection includes marked and unmarked listed Chinook returning to the Imnaha Facility weir. Adults collected are incorporated into a matrix spawning protocol to maintain genetic similarity between hatchery-origin and natural-origin populations. Adults are collected from June (as early as stream conditions allow trap installation) to September based on systematic approach to pass fish above the weir, out-plant, or retaining for broodstock based on origin, sex, and age. The approach is based on a preseason estimate of returning adults, is modified as the run develops, and disposition of trapped fish is based on the sliding scale.

Spawning, incubation and rearing – Adult fish and jacks used are killed during the spawning process. Eggs and resulting progeny are subject to mortality during incubation and rearing due to developmental, disease, injury and other causes. Every effort is made in the hatchery environment to ensure maximum survival of Chinook at all life stages.

Juveniles trapped – Wild juvenile steelhead moving upstream may enter the adult trap during operation. This may result in injury and/or mortality.

Spawning surveys – Foot surveys are conducted to determine natural spawning abundance and distribution, density and proportion of hatchery-origin fish in key natural spawning areas. These surveys are conducted annually in various reaches of spawning habitat from August through September. Experienced surveyors walk along the stream, crossing when necessary, avoiding redds, counting redds, and observing live fish and carcasses. Although every effort is made to observe adults and determine their origin without disturbance, spawners are occasionally forced to seek cover. These encounters are brief and spawning fish generally resume their activity within a short period of time. Surveyors occasionally disturbed existing redds while walking in the river.

Juvenile surveys/collections – Electro-fishing, snorkeling and hook and line sampling may be used to monitor density, size, and food habits of juvenile Chinook and to collect genetic samples from naturally produced Chinook. Also, juvenile Chinook are PIT tagged to monitor survival and migration rate and timing. These activities, which generally occur from May through October, will result in take of juvenile listed steelhead and occasionally spring Chinook and bull trout. Electro-fishing efforts conform to NMFS (NOAA) electro-fishing guidelines to minimize disturbance and injury to listed fish. Snorkeling is a low impact sampling method that may be used to identify relative proportion of residual hatchery steelhead in key stream reaches. Disturbance of rearing juveniles associated with snorkeling is generally limited to forcing individuals to seek cover and is a short duration effect. Snorkeling surveys are conducted when stream temperatures are low, so as to minimize potential for stress and incidental mortality to listed fish.

Imnaha and Lookingglass Hatchery intake maintenance – Wild juvenile Chinook, steelhead, and bull trout maybe encountered when performing seasonal gravel removal operations in the immediate proximity to Imnaha and Lookingglass facility intakes. There have been no redds observed in gravel deposited in the intake structures. Disturbance of rearing juveniles associated with gravel removal is generally limited to forcing individuals to seek cover and is a short duration effect. This may result in injury and/or mortality.

Research/Monitoring Activities

Research activities are conducted downstream of the adult weir and contribute to the take of listed Chinook salmon.

Juvenile Trapping: A smolt monitoring trap is operated at river kilometer 7, downstream of the Imnaha River weir from March-November each year by Nez Perce Tribe research staff to estimate juvenile survival, timing, and production in the Imnaha. At a minimum, all fish captured are identified and enumerated. Most fish captured are counted and released or anesthetized, measured, weighed and then released. Smaller groups of fish are PIT-tagged and then released in order to estimate survival to Lower Granite Dam and to monitor migration.

Operation of Juvenile Trapping and Marking

The trap was operated from February to November each year. The trap is located 7 rkm from the confluence of the Snake River. The screw traps are attached to a cable suspension system anchored by gabion baskets, which allow side to side and upstream/downstream movement of the trap. This setup permits the trap to be fished in the optimum position during most flow conditions. The traps consist of a trapping cone (1.5 m diameter) supported by a metal A-frame, live box, two six-meter by one-meter pontoons for flotation, and a clean-out drum. Traps used on the Imnaha River have been modified to use a customized oversize live box 1.68 m wide x 1.25 m long x 0.55 m deep and fitted with a removable baffle to dissipate water velocity during high flows plus extra flotation on each pontoon to prevent the trap from sinking in high flows. Additionally, the Imnaha trap has been modified with a bypass that is equipped with a Biomark PIT Tag Racquet Antennae tuned for underwater use. Data is logged on a standard FS2001 transceiver.

The live box of the screw trap is checked at 0800 every morning and several times throughout each night and day, if warranted by large numbers of fish or excessive debris. Non-target piscivorous fish and large numbers of other non-target fish are removed from the live box first. Non-target piscivorous fish are scanned for PIT tags and then released 30-50 m downstream through a discharge tube. The precise location of the tube outlet depends on the observed existence of predator species. The outlet is located to minimize predation of examined smolts. Fish are processed as they were removed from the trap.

Two subsampling routines are used on occasion during trapping. These routines allow crews to continue sampling when the trap gets overwhelmed with smolts. One routine consists of 1) clearing the trap of all fish, 2) collect fish for a fixed period of time, 3) isolate the collected fish from incoming fish, 4) bypass incoming fish through a PIT Tag detector to monitor for recaptures or previously tagged fish, and 5) process all fish collected. The number of processed fish is multiplied by an appropriate time ratio. For instance if the crew collected fish for 15 minutes and then bypassed fish for 45 minutes the ratio would be 1:4. The estimated total number of fish passing would equal the total processed multiplied by four. The second subsampling routine is used when clearing the trap (step one listed above) becomes too difficult. This routine consists of 1) isolating all trapped fish within the livebox, 2) divert incoming fish through a PIT Tag detector, 3) collect one net-full of captured fish for processing, 4) collect roughly equal sized net-fulls of the remaining fish and feed them through a separate PIT Tag antenna. This estimate is scaled up in a similar way to the first routine except "net fulls" becomes the multiplier. The subsample consists of a remote monitoring (RM) file of PIT Tag numbers and a text file recording the scaled up fish numbers. The PIT Tag data collected are incorporated into recapture numbers and trap efficiency calculations. The scaled up fish numbers are included in the number of fish handled and incidental species counts.

Processing procedures are similar to those used by Ashe et al. (1995) and Prentice et al. (1990b). On a daily basis, juvenile summer Chinook captured in the trap are removed, placed in 18.9-liter plastic holding buckets, and transported (40-80 meters) to a data processing area. Fish are then transferred to flow-through work-up vats or vats with appropriate aeration where they are held prior to being moved to an aerated work-up tub.

All fish are interrogated for PIT tags using a Destron® loop-style detector and reader, examined for PIT tag scars, marks, and overall physical condition. Fish are measured to the nearest millimeter and weighted to the nearest gram. Fish are anaesthetized in a plastic tub filled with 6 liters of water, 15 milliliters of standard stock solution (15 grams/liter) of MS-222, and buffered with 15 milliliters standard stock solution (30 grams/liter) of sodium bicarbonate to decrease stress and mortality (e.g., McCann et al. 1994). Stress Coat® (1 part Stress Coat® per 1 part distilled water) is also used in work up tubs, on measurement boards and scale tubs in an effort to replace the natural protective slime coating that may have been compromised by handling or measurement-related stress.

Upon anesthetization, unmarked or non-tagged fish are identified for tagging or marking. Fish selected for PIT tagging will be examined for previous PIT tagging, descaling and general health before being tagged, measured (fork length-mm) and weighed (0.1 g). All fish greater than 60 mm are selected for tagging unless they have been damaged during the trap operation. All PIT tags are implanted using methods similar to those described by Prentice et al. (1990a, 1990b) and the CBFWA PIT Tag Steering Committee (1999). Tagging is done manually using a modified hand injector unit consisting of a 10cc syringe; steel rod, compression spring, push rod and 12-gauge hypodermic needle. Tagging needles and PIT tags are disinfected before each use by soaking them for 10 minutes in 70% ethyl alcohol, and subsequently dried for 10 minutes. The needles, which are pre-loaded with PIT tags, are inserted into the fish so that the beveled tip completely penetrated beneath the surface of the skin at a point on the midline of the ventral surface posterior to the pectoral fins. Fish are measured to the nearest millimeter (fork lengths), weighed to the nearest gram using an electronic scale, and placed in a flow-through recovery vat or vat with appropriate aeration. Tagging is discontinued when water temperatures exceed 18 °C. Tagging data are proofed for mistakes. Tagging and interrogation files are submitted to the Pacific States Marine Fisheries Commission's PIT Tag Information System (PTAGIS) database within 48 hours following collection. PIT tag interrogation data are downloaded from the PTAGIS database for the annual reports.

Scale samples will be randomly collected from 25 Chinook salmon and 25 steelhead juveniles for each trap and each month to analyze early life history scale patterns. Only fish that are not going to be PIT tagged are sampled. Scales are collected from just behind the dorsal fin and above the lateral line using a blunt knife. Scale samples are filed by stream and date of collection at the Nez Perce Tribe's Department of Fisheries Resource Management. Scales are filed in envelopes commercially available and are labeled with the following collection information: date, location, length, weight, and existing marks. Nez Perce Tribe staff will read the scales and provide the age information.

During certain time periods a large portion of the young of the year (YOY) juveniles collected in the screw traps are too small to be PIT-tagged (e.g., CBFWA 1999). In order to represent the entire population, a sub-sample of all fish for trap efficiency estimates are uniquely marked with a mark that could be applied to any size fish that were captured. Three times a week, a sub-sample of the total trap catch are selected for staining with Bismark-Brown dye, a mark that has proven effective in the identification of fish with fork lengths as low as 30 mm (Lockhart et al. unpublished data). Fish are held in dye (0.4g/16 L solution) for 1 h. Battery powered aerators are used to maintain oxygen saturation in the dye solution and the temperature is monitored constantly. To evaluate possible delayed mortality and to reduce predation, stained fish are held in live boxes until dusk and are released at the same time and at the same site as PIT tagged fish.

Freshly marked or tagged fish are placed into an 'upstream' live box, while recaptures or incidental catches are placed into a 'downstream' live box. Larger or piscivorous specimens are placed into a separate live boxes to reduce the potential of predation. The live boxes are large, drilled-out plastic shipping boxes with lids or covered 33 gallon perforated containers, which provide containment, protection, and acclimation of the fish back to the riverine environment. Marked fish spend no less than 12 h in the live boxes and are released at dusk. These protocols help ensure complete recovery from anesthetic, minimize risk of predation, and promote reintegration and mixing with other fish during peak movement periods. Following their release, boxes are checked for mortalities and shed PIT tags.

Marked or tagged fish that are placed into the 'upstream' live box are used to derive estimates of trap efficiency through their subsequent recapture at the screw trap. The 'upstream' fish are released approximately 800-1200 m upstream of the trap or at least two riffles and a pool upstream of the trap. All other fish are held in separate live boxes and released 200-800 m downstream of the trap.

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

Imnaha River adults were held at both Imnaha facility and Lookingglass hatchery beginning in 1988. Since 1993, all adults used for broodstock have been held at Lookingglass Hatchery.

Table 13. Adults trapped at the Imnaha weir during run years 2004-2010, with associated mortality.

	Adult	Mortality	Percent
2004	1,251	31	2.5
2005	1,221	25	2.0
2006	791	5	0.6
2007	1,331	10	0.8
2008	2,072	42	2.0
2009	3,517	55	1.6
2010	2,131	21	1.0
Average Mortality = 1.5%			

Refer to section 6.2 for a description of adult collection and egg take since 1990.

- **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).**

Annual projected take for the adult collection, program monitoring, and hatchery reared fish which as a group include progeny of listed wild fish are listed in Table 14.

Table 14. Estimated take levels of Imnaha Chinook salmon by hatchery related activities.

Listed species affected: Spring/Summer Chinook **ESU/Population:** Snake River **Activity:** Imnaha River spring/summer Chinook hatchery program				
Location of hatchery activity: Imnaha and Snake Basin **Dates of activity:** Annual **Hatchery program operator:** ODFW				
Type of Take	**Annual Take of Listed Fish By Life Stage** (***Number of Fish***)			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass
Observe or harass a)	675,000	500	1,000	280
Collect for transport b)	675,000	0	660	280
Capture, handle, and release c)	0	10,000	7,500	0
Capture, handle, tag/mark/tissue sample, and release d)	490,000	490,000 300,000 screwtrap	7,500	0
Removal (e.g. broodstock) with numbers of natural origin and hatchery origin fish as per sliding scale schedule of Table 1 of this plan e)	0	0	322W/H	0
Intentional lethal take f)	67,500	480	322W/H	0
Unintentional lethal take g)	135,000	50,000	70	0
Other Take (gravel removal) h)	0	5	0	0

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

- 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.

During the adult trapping period, instream temperatures will be monitored to reduce the risk of exceeding take levels. A contingency plan is in place that stipulates trapping activity and adult handling will cease if water temperatures exceed 21.1°C for three consecutive days. The plan also suggests the daily work schedule may be altered to take advantage of early morning cooler temperatures to keep the actual fish handling parameter below 18.3°C. Any further necessary inseason modifications will be applied immediately prevent excess take levels.

Established ODFW fish health protocols are and will continue to be utilized throughout the Imnaha program to eliminate or minimize exceeding allowable take.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan or other regionally accepted policies.

The proposed program outlined in this HGMP is consistent with the NWPCC Artificial Production Review (Report and Recommendations), Imnaha Subbasin Plan (NPPC 2004), expired section 10 permit (1128), draft HGMP submittal in 2002, and addresses issues of concern outlined in the NOAA Hatchery Biological Opinion.

RPA Hatchery Strategy 2, Action # 42 of 2008 Federal Columbia River Power System Biological Opinion specifically calls for implementation of the Imnaha spring Chinook program; "For the Lostine and Imnaha rivers, contingent on a NOAA approved HGMP, fund these hatchery programs, including capital construction, operation and monitoring and evaluation costs to implement supplementation programs using local broodstock and following a sliding scale for managing the composition of natural spawners comprised of hatchery origin fish."

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

- *Lower Snake River Compensation Plan* **–** The program is consistent with smolt production levels as outlined in original LSRCP. The proposed program will continue to support a substantial tribal and sport harvest level.
- *U.S. vs. Oregon* - The hatchery program outlined within this HGMP is consistent with the 2008-2017 *US vs. Oregon* management agreement.
- *Columbia River Fish Management Plan* – The program would continue to provide substantial harvest in Zone 6 tribal net fisheries as well as in-basin tribal harvest opportunity.
- *Annual Operation Plan (AOP 2010/11 LSRCP)*—The program is consistent with co-manager agreements outlined in the Annual Operation Plan.

3.3) Relationship to harvest objectives.

The level of hatchery production proposed by this program contributes to meeting the harvest objectives of the Nez Perce Tribe and those of the Oregon Fish and Wildlife Department. Evidence to the magnitude of this contribution is presented in the next section (3.3.1).

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin and associated natural origin fish for the last twelve years (1998-2010), if available.

Fisheries that benefit from the hatchery fish produced by this program occur mainly in the mainstem Columbia River and the Imnaha River basin. Program contributions to ocean fisheries are minimal, as is the case for all Snake River spring/summer Chinook. A description of the various fisheries that benefit from the Imnaha hatchery production follow.

Lower Columbia River non-tribal commercial fisheries. Lower Columbia River non-tribal commercial fisheries occur below Bonneville Dam in the mainstem (statistical zones 1-5) and in Select Areas (off-channel fishing areas). Currently, winter and spring fisheries in the mainstem are mark selective but summer and fall fisheries are not. The lower Columbia River commercial fisheries primarily target white sturgeon during the early portion of the winter season (January through mid-April) and spring Chinook beginning in early March. In some years, target spring Chinook fisheries may not occur until April and can occasionally extend through the spring season (mid-April through June 15).

Lower Columbia River non-tribal recreational fisheries. The lower Columbia River mainstem below Bonneville Dam is separated into two main areas for recreational harvest; Buoy 10 (ocean/in-river boundary) to the Rocky Point/Tongue Point line, and the Rocky Point/Tongue Point line to Bonneville Dam. These fisheries are mark-selective for spring Chinook. Catch in recreational fisheries above Bonneville is very low compared to the fisheries below Bonneville.

Mainstem Columbia tribal fisheries. Treaty tribal harvest includes commercial and ceremonial and subsistence (C&S) fisheries. The tribal C&S fisheries are of highest priority and generally occur before tribal commercial fishing. The tribal set net fishery above Bonneville Dam (statistical Zone 6) involves members of the four Columbia River treaty Indian tribes: Yakama Nation, Nez Perce Tribe, the Confederated Tribes of the Umatilla Indian Reservation and Confederated Tribes of the Warm Springs Reservation. These fisheries are managed under the jurisdiction of *U.S. vs. Oregon*. The *U.S. vs. Oregon* Management Agreement for 2008-2017 implements abundance-based management on Snake River Chinook and steelhead in the lower mainstem and treaty mainstem fisheries such that fishery impacts increase in proportion to the abundance of natural-origin fish forecast to return once a minimum run-size has been achieved.

Tributary fisheries – Recreational sport fisheries, and treaty fisheries reserved for the Nez Perce Tribe (NPT), occur for spring/summer Chinook in the Imnaha Subbasin. Coordinated long term harvest management plans for the Imnaha are being developed by the NPT and ODFW, and are intended to describe how annual fishery impact rates will be set pre-season consistent with fishery management protocol authorized by NOAA Fisheries. This protocol will be based on a sliding scale that ties allowed fishery impact rates to forecast return of natural-origin adults. When the return of natural-origin spawners is low, then the fishery will be managed to keep impact rates low. When a large number of natural-origin fish is expected, allowable fishery impact levels will be higher. The allowable impact for each year's fishery will then be allocated by the tribal and state managers. Comanagers will report catch statistics in season and all fishing stops when the allowable impact for the year is met.

After nearly 30 years of closure (since 1978), harvest opportunity was restored to treaty and sport fisheries in 2001. Since then, sport fishing opportunities have been available to anglers from 2001-2005, and 2008-2010. The sport fishery management area currently extends from the Imnaha River mouth to the upstream to the bridge near Summit Creek (river mile 45). Treaty fisheries have occurred since 2001, and within the Imnaha subbasin, fishing occurs from the Imnaha River mouth upstream to the Imnaha Weir. Estimates of catch and harvest for sport fisheries, and census treaty harvest (Joe Oatman, NPT, personal communication), including collecting impacts are listed in Table 15. Estimated tag recoveries of Imnaha spring/summer Chinook harvested in ocean, and mainstem fisheries are listed in Table 16.

Table 15. Imnaha River tributary fishery summary 2001-2010, including estimated sport fishery harvest and actual treaty harvest. Collective fishery impacts, as a proportion of the estimated return to river mouth (age-4 and 5 only) are also reported.

	Estimated Escapement[a]			Actual Treaty Harvest (Nez Perce)			Estimated Sport Fishery Impacts			Collective Fishery Impacts		
Year	Natural[b]	Hatchery[b]	Total	Natural Harvest	Hatchery Harvest	Total Harvest	Natural Released	Natural Impacts[c]	Hatchery Harvest	% Nat. Run	% Hat. Run	% Total Run
2001	2,215	2,665	4,880	0	33	33	433	43	302	1.9%	1.2%	7.7%
2002	858	3,211	4,069	47	196	243	15	2	152	5.7%	7.6%	9.8%
2003	1,445	2,326	3,771	17	190	207	83	8	125	1.7%	10.3%	9.0%
2004	366	1,355	1,721	28	288	316	29	3	192	8.5%	41.3%	29.7%
2005	301	1,084	1,385	6	98	104	22	2	22	2.7%	28.7%	9.2%
2006	227	1,059	1,454	6	56	62	*no sport fishery*			2.6%	5.3%	2.6%
2007	173	938	1,794	2	62	64	*no sport fishery*			1.2%	6.6%	1.2%
2008	234	2,540	2,774	8	299	307	17	2	64	4.3%	14.5%	13.4%
2009	268	1,565	1,833	19	535	554	50	5	197	9.0%	39.5%	41.2%
2010	791	3,053	3,844	14	542	556	108	11	336	3.2%	28.3%	23.5%

[a] Estimated to river mouth
[b] J. Feldhaus, ODFW, personal communication 1/4/11
[c] Sport impact includes an 10% fishery mortality for both hatchery and wild fish caught and released

Table 16. Estimated tag recoveries, adjusted for tag rate, of Imnaha River hatchery adult spring/summer Chinook salmon in tribal and non-tribal fisheries for the 1982-2006 brood years. Brood years 2005 and 2006 are incomplete. Estimated CWT recovery data was obtained from the PSMFC Regional Mark Processing Center (RMPC) database (www.rmpc.org) and summarized through October 2010.

		Zone 1-5			Zone 6			Above McNary			
Brood Year	Ocean	Sport	Tribal	Non-tribal Net	Sport	Tribal	Tributary	Columbia above MCN	Snake Below LGD	Snake above LGD sport	Snake above LGD tribal
1982	0	0	0	0	0	0	0	0	0	0	0
1983	13	0	0	0	0	4	3	0	0	0	0
1984	0	0	0	23	0	8	5	0	0	0	0
1985	0	3	0	14	0	30	0	0	0	0	0
1986	2	18	0	5	0	15	9	0	0	0	0
1987	0	0	0	0	0	2	0	0	0	0	0
1988	10	0	0	3	0	0	3	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	0	0
1990	0	0	0	1	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0
1993	3	0	0	2	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0
1995	0	2	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	1	0	0	0	0	0
1997	11	43	0	33	0	84	6	0	0	0	0
1998	11	128	0	23	3	82	17	0	0	8	0
1999	6	36	0	5	1	10	0	0	0	4	0
2000	9	89	0	5	2	90	1	0	0	0	0
2001	12	59	0	17	4	27	0	0	0	4	0
2002	4	190	0	32	4	56	0	0	0	21	0
2003	2	65	0	9	4	113	0	0	0	0	0
2004	15	158	0	11	7	53	0	0	0	0	0
2005	8	28	0	60	5	16	0	0	0	0	0
2006	6	61	0	45	8	9	0	0	0	0	0
Total	**112**	**880**	**0**	**288**	**38**	**600**	**44**	**0**	**0**	**37**	**0**

3.4) Relationship to habitat protection and recovery strategies.

Human development and land management impacts consistent with those identified across the Columbia Basin affect Chinook production in the Imnaha Basin. Major impacts to the Imnaha Chinook habitat are from roads, past logging practices, and land development (NPPC 2004). There are some impacts from livestock grazing and feedlots. State programs in place through the Department of Environmental Quality, Department of Forestry and Division of State Lands along with federal Clean Water Act and Corps of Engineer 404 regulations provide standards for activities on private land that might otherwise contribute to the problems listed above. Additionally, activities on public lands or federally funded must meet Endangered Species Act listed species protection criteria developed through consultation with US Fish and Wildlife Service and NOAA, as well as National Environmental Policy Act (NEPA) review.

These protection programs in conjunction with ongoing private and publicly funded restoration efforts have resulted in an improvement in Chinook and steelhead habitat in many Imnaha Basin streams. Most watershed restoration/improvement projects are funded through the Grande Ronde Model Watershed Program, Oregon Watershed Enhancement Board, Bonneville Power Administration funded Northwest Power and Conservation Council's Fish and Wildlife Program, Mitchell Act Program and Natural Resource Conservation Service's (NRCS) Conservation Reserve Enhancement Program (EQIP and CREP). Efforts include fencing streamside corridors to promote riparian vegetative recovery, improved fish passage at road crossings and diversions, reduce sediment production from roads and cropland and screening of irrigation diversions. Some programs like the Mitchell Act screening program began almost 50 years ago while others like CREP are very recent. Taken together habitat protection and improvement measures are (and will continue to be) improving habitat, and productivity, for the basin's natural spring/summer Chinook.

3.5) Ecological interactions.

The narrative below is adapted from Biological Assessments completed by ODFW for Imnaha spring Chinook salmon hatchery program and submitted, as part of LSRCP Programmatic Assessments, to NMFS in 1993 and 1997. The LSRCP spring Chinook hatchery program in the Imnaha Basin has the potential to affect wild Chinook, summer steelhead, and bull trout in a number of ways including predation, competition, behavior, and disease.

Predation- Little evidence exists of predation by hatchery released spring Chinook on other salmonids. Hatchery spring Chinook smolts are programmed for release in the Imnaha River at 20 fish per pound and should range in size from 100 to 150 mm fork length. Release timing and methods (volitional release following acclimation) are intended to result in rapid emigration from the Imnaha and limit interaction with other species in the river. The small size of hatchery migrants, rapid migration from the Imnaha River, and limited time for conversion from a hatchery diet to a natural diet reduce the likelihood of predation by hatchery Chinook on other salmonids in the Imnaha Basin.

There is potential for predation by other salmonids, especially bull trout, on hatchery and natural Chinook in the Imnaha Basin. Releases of hatchery Chinook and any potential increase in natural production of Chinook resulting from the LSRCP program could enhance listed bull trout populations by increasing available forage.

Avian predation, especially by mergansers and herons, on hatchery and natural Chinook are concern post release. Total consumption is unknown, but numerous PIT tags have been recovered in the Ladd Marsh heron rookery (ODFW Fish Research, unpublished data).

Competition- Hatchery Chinook smolts have the potential to compete with natural Chinook, natural steelhead and bull trout juveniles for food, space, and habitat. If significant interaction does occur in the Imnaha Basin, it is restricted to a short duration as smolts move downstream or to the immediate vicinity of release sites where hatchery fish are most concentrated. Rapid departure of hatchery Chinook smolts from the basin is likely to limit competition with rearing wild Chinook, steelhead, and bull trout. Differences in food habits and habitat preferences are likely to limit competition with bull trout. Bull trout associated with areas influenced by hatchery Chinook smolts are generally fluvial adults and are more likely to out compete and prey on hatchery Chinook due to a significant size advantage.

There is potential for competitive interactions between hatchery Chinook and wild Chinook and steelhead smolts in migration corridors. We do not have information to assess competitive interactions during downstream migration, however, hatchery Chinook smolts are released at a size similar or slightly larger than natural Chinook smolts (20 fish per pound) and should not have a competitive advantage as a result of size.

Behavioral - There are limited data describing adverse behavioral effects of hatchery Chinook salmon releases on natural/wild Chinook salmon populations. Hillman and Mullan (1989) reported that larger hatchery fingerling Chinook salmon, released in June and July in the Wenatchee River in Washington, apparently "pulled" smaller wild/natural Chinook salmon with them as they drifted downstream resulting in predation on the smaller fish by other salmonids. While the effects of migrating hatchery smolts (yearlings) on wild/natural Chinook salmon are unknown at this time the potential for similar effects exists especially with large concentrated releases within natural rearing areas.

Fish Health - Hatchery operations potentially amplify and concentrate fish pathogens and parasites that could affect wild Chinook, steelhead and bull trout growth and survival. Because the hatchery produced spring Chinook for the Imnaha program are reared at Lookingglass Hatchery, outside the Imnaha watershed, potential disease impacts on wild salmonids are limited to periods of smolt acclimation and migration, adult returns, trapping, holding, and natural spawning. There are several diseases of concern including bacterial kidney disease (BKD) and infectious hematopoietic necrosis (IHN). Infectious hematopoietic necrosis virus (IHNV) has also occurred at Lookingglass Hatchery. Vertical transmission (parent to progeny) of IHNV is prevented by the ongoing prudent fish culture practice of draining coelomic fluid at spawning and disinfecting eggs in iodophor. Steps have been taken to prevent horizontal transmission (fish to fish) of IHNV and other pathogens present in the surface water supply by the installation of a ultraviolet light water disinfection system. Prudent fish health actions of culling eggs from females with higher levels of *Renibacterium salmoninarum* antigens have helped with controlling BKD. In general, fish have usually demonstrated good health (only occasional disease problems) in fish reared at Lookingglass Hatchery, with the exception of finding more IHN in recent years, which indicates potential for minimal to low level transmission of any agents they harbor to natural population. Documentation of fish health status of Imnaha hatchery Chinook is accomplished through monthly and pre-liberation fish health examinations. Hatchery and natural adults spawned at Lookingglass Fish Hatchery are screened for BKD. There is no evidence of increasing prevalence of diseases (e.g., BKD) in the Imnaha River Salmon (Hoffnagle et al. 2009). Kidney samples are also collected on spawning ground surveys to monitor for potential increase in BKD prevalence due to hatchery adult spawning in nature (O'Connor and Hoffnagle 2007).

Incidental Take at Trapping Facilities - Installation of the Imnaha weir and trapping facilities for collection of adult Chinook broodstock has the potential to affect wild steelhead and bull trout. These facilities could delay or otherwise alter migrations and some handling of listed species will occur. In the Imnaha Basin, Chinook are trapped at the Imnaha satellite located 0.5 miles below the mouth of Gumboot Creek. Installation of the Imnaha weir will occur after most adult steelhead have completed upstream spawning migrations. If adult steelhead are trapped, they will be checked for marks and passed above the trapping facilities. Steelhead kelts moving downstream are more likely to encounter Chinook trapping facilities. Kelts observed upstream of trapping facilities that can be captured (netted) will be checked for adipose clips and immediately passed downstream.

Bull trout have been captured at the Imnaha trapping facility. Bull trout that are trapped are passed upstream with minimal handling and an "eyeball" estimate of their length is recorded whether greater than or less than 300 mm in length.

Hatchery Effluent—Hatchery effluent discharges directly into Lookingglass Creek, after passing through the settling basin, and may affect survival, growth, and migration of spring Chinook salmon. The pollution abatement system was designed to provide for NPDES (0300-J) permit compliance. The settling basin has a 2 hour retention time, based on a continuous inflow of 1500 gpm, and has an active water volume above the sludge reservoir of 27,000 ft^3. Effluent discharges meet DEQ criteria and there is no indication that the effluent is affecting fish or fish habitat in Lookingglass Creek. There are no plans to study effluent effects in the creek.

Chemicals used at the hatchery include iodophor, erythromycin, and formalin. These chemicals are approved fishery compounds and their use is regulated by label instruction or Investigative New Animals Drug (INADS) permits. Both iodophor and formalin undergo high dilution rates before entering the stream, which renders them innocuous to the fish and the ecosystem. Erythromycin is injected into broodstock adults or fed to juvenile fish for 28 days. A second 28 day erythromycin medicated feed treatment is administered to progeny of Captive broodstock parents with moderate to high ELISA levels. By either route, the drug is assimilated and metabolized within the fish. Any residual antibiotic present in the effluent would come almost exclusively from uneaten food. It is highly unlikely the effluent containing erythromycin would affect the ecosystem in any way.

Water Withdrawal—Water withdrawals to operate facilities, Lookingglass Hatchery in specific, may effect egg survival, juvenile growth and abundance, adult migrations and spawning of Chinook salmon. Lookingglass Hatchery water intake diverts a maximum of 50 cfs that results in reduced flows between the diversion and the out fall of the hatchery, approximately 500 meters. These reduced flows are most prominent during late July, August, and September when hatchery water demands are high and the creek is at its lowest flow. During this period, adult upstream passage is restricted; however, there is enough water to allow some passage, spawning activity and juvenile rearing.

Redds have been observed in the section of river that has reduced flow because of hatchery water withdrawal. Spawning takes place from mid-August until late September. Spawning in this area would be initiated during the time of the lowest flow, so de-watering of redds is unlikely.

It is highly unlikely that water withdrawals are a problem at the Imnaha River facility. Stream discharge is sufficiently high during smolt acclimation and adult collection periods and the distance between the intake and outflow is short.

SECTION 4. WATER SOURCE

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

The main water source for Lookingglass Hatchery is Lookingglass Creek (total surface water right of 72 cfs from Lookingglass Creek; 42 cfs for hatchery operations and 30 cfs for fish ladder operations). Water temperatures fluctuate daily and seasonally with mean daily temperatures ranging between 1^{o}C and 16^{o}C. An additional well right of 14.4 cfs (6,459 GPM) is comprised from four well locations. The production well of interest is the Tempering Well #2 (TW2), which is capable of pumping approximately 5 cfs for hatchery use, (2,245 GPM at 14^{o}C). Water discharge is monitored under the general NPDES 0300 J permits. High spring run-off has created problems with turbid water and sediment deposition in egg incubation trays, early rearing troughs, large raceways, and associated water delivery pipes.

The main water source for Imnaha Satellite Facility is the Imnaha River (9.9 cfs water right March-June and 15 cfs July-October). Water temperatures fluctuate daily and seasonally with mean daily temperatures ranging between 0.5^{o}Cand 16^{o}C. Compliance for intake-screening criteria will be evaluated.

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 will be added to the intake and at the head end of raceways to help prevent native fish from entering the hatchery intake water supply and commingling with hatchery fish. In addition, the screens should reduce the debris load entering the hatchery.

A new weir and improvements to adult holding, handling and juvenile acclimation and release at the Imnaha satellite facility are designed and proposed for construction as part of the NEOH (Northeast Oregon Hatchery) project. As it relates to this section, improvements identified for the Imnaha satellite facility include: 1) relocation of the intake rock sluiceway to a settling basin east of the existing storage building and 2) replacement of the existing intake structure with a larger structure capable of delivering more surface water to the facility. In May of 2006 the Northwest Power and Conservation Council recommended proceeding with construction of NEOH (including these modifications) however, initiation of construction is pending a decision from Bonneville Power Administration.

SECTION 5. FACILITIES

Contingent on construction of the Lostine Hatchery (Ashe et al. 2002), some of the Imnaha production may be raised at this facility on the Lostine River. In addition, the Northeast Oregon Hatchery Master Plan contains proposed facility modification to the Imnaha Satellite Facility. Where applicable, we include a description of 1) current facilities at the Imnaha satellite facility, and Lookingglass Hatchery; and 2) proposed facilities at the Lostine Hatchery.

5.1) Broodstock collection facilities and methods.

Imnaha Satellite Facility - The Imnaha Satellite Facility consists of one support cabin (800 ft^2), one outside acclimation pond with rearing volume of raceways 13,000 ft^3 (125'x26'x4'), picket-style weir, and adult trap (1,040 ft^3). Trapped adults are transported to Lookingglass Hatchery on a weekly or as needed basis for use as broodstock, released above the weir, outplanted to the Big Sheep Creek watershed, re-cycled through the fishery, or taken to Wallowa Fish Hatchery for distribution to food banks and for ceremonial and subsistence use by the Nez Perce and CTUIR.

The Imnaha spring/summer Chinook program uses the endemic population for hatchery broodstock. Because fish spawn below the weir location and some fish pass above the weir prior to installation, mean trap efficiency has been 40%, of the total Imnaha River adult escapement and 60% of the run passing the weir site (Hoffnagle et al. 2008). Broodstock collection guidelines (sliding scale) are based on estimated escapement to the mouth of Imnaha River. The sliding scale was developed cooperatively with NPT (Table 1).

Mangers are currently unable to completely implement the sliding scale due to the inability to trap the entire run. Not only do fish pass upstream before the current weir can be operated, but a portion of the Imnaha population spawns below the weir site. As noted in section 1.11.1, the solution to this problem is improvements to weir as proposed under the NEOH Master Plan. However, should the existing weir not be fixed with the next three years, alternatives to ensure the sliding scale elements are adhered to will be developed by the co-managers and with acceptance by NOAA Fisheries. This weir management contingency plan would then need to be implemented as soon as possible.

In addition to a new weir, improvements to adult holding and handling facilities are designed and proposed for construction as part of the NEOH (Northeast Oregon Hatchery) project. Facility improvements identified for the Imnaha satellite facility include: 1) redesign of the new acclimation and holding ponds to the east side of the existing holding ponds, 2) extension of the existing storage building and addition of vehicle parking area, 3) relocation of the vehicle access ramp, 4) addition of adult holding area extension, 5) additional portable generator and skid-mounted air compressor for pneumatically-controlled weir and intake screen cleaning, and 6) replacement of the existing intake structure with a larger structure capable of delivering more surface water to the facility. In May of 2006 the Northwest Power and Conservation Council recommended proceeding with construction of NEOH (including these modifications) however, initiation of construction is pending a decision from Bonneville Power Administration.

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

Imnaha Satellite Facility - The adult holding trap at the Imnaha satellite facility is 1,040 ft^3. The water flow of 4,000 to 6,000 gpm used to operate the ladder also flows through the adult trap. Fish are transported weekly or as needed to Lookingglass Hatchery in 800 or 250 gallon transport tanks. Tanks are equipped with supplemental oxygen, aeration, and alarms.

5.3) Broodstock holding and spawning facilities.

Lookingglass Hatchery - Lookingglass Hatchery consists of one hatchery building complex. The complex includes an office, spawning room, incubation, rearing, cold storage, shop, lab, visitor center, and dormitory. The spawning room consists of an anesthetizing tank, brail, spawning table, and adult return pipes to holding pond. All Imnaha origin adults are held in one adult pond (divided in half by a fence) 6,400 ft^3 (20'x80'x4') with a maximum inflow of 3,990 gpm. Maximum holding capacity is 560 adults (1 adult/8 ft^3).

Proposed Lostine Hatchery **-** The broodstock holding facility will consist of six 50 ft long X 8 ft. wide X 8ft. deep ponds. Three ponds will be utilized to hold the estimated 352 Imnaha program broodstock. The ponds will be equipped with a spray system and jump panels. Adult holding facilities meet preferred adult salmon space criteria (10 cf/fish) and will have acceptable flow criteria of one pond turnover per hour. The rectangular holding ponds and center channel will be equipped with crowders. Manual crowders will be provided for the holding ponds while a mechanically operated unit will serve the central channel.

The 1,270 sq ft spawning area will be located contiguous to the adult holding ponds. It will feature of a fish lock to transport fish from the center channel up to the spawning work area. The covered spawning work space will house the necessary modern fish husbandry components: a shock tank, a live tank, a guillotine, egg mixing stations, data collection station, two carcass racks, a chest freezer, and a visitor viewing section. Also integrated into this area are return tubes to send fish back to ponds 1 and 2 or the center channel.

5.4) Incubation facilities.

Lookingglass Hatchery - Lookingglass Hatchery contains 28 inside rearing containers and 504 incubation trays in 63 stacks. Approximately 150gpm of chilled well water is available for incubation. Up to 1500 gpm of ultraviolet (UV) treated river water is available to incubate eggs and rear fry in Canadian troughs. A total of 4.5 cfs is available (combination of well and treated river) for early rearing prior to transfer to the 18 outside raceways, seven of which are designated to the Imnaha program.

Proposed Lostine Hatchery - The egg incubation room will consist of 18 double stack vertical flow incubators. Each stack holds 16 trays. The Lostine program fertilized gametes will be contained in trays until their transfer to early rearing vessels. The Imnaha program eggs will be incubated until the eyed stage, at which time half of the Imnaha production will be shipped to Lookingglass Hatchery. The pathogen free ground water will supply the proposed Lostine River Hatchery incubation, and the capacity to chill or heat it will be an option. Two header pipes will feed the incubation stacks: one for heated/chilled groundwater supply and one for natural groundwater supply. Individual feed for each stack will allow differential growth management by varying the water temperature supplied. Incubation facilities meet the preferred criteria for space (one tray per female) and inflow (10 gpm pathogen free water per double stack).

A Formalin drip distribution system will provide treatment for the developing eggs. This system is designed to feed each stack individually at a typical 1:600 dilution. The bulk Formalin will be contained in a separate storage room and pumped to the distribution apparatus at each stack. Hatchery incubation process water containing Formalin treated water should be diluted 1:100 before discharge. Therefore, egg treatments when incubation is full, will occur in two separate applications.

The proposed mechanical, chemical storage and incubation areas will be located on the east side of the incubation/early rearing building separated from the early rearing facility. In addition, a segregation wall will split the incubation room in two parts, to facilitate fish health management.

Temperature control will be provided for the pathogen-free well water used for incubation and part of early rearing. Temperature control is needed to allow hatchery managers to manipulate fish growth in order to meet the program’s smolt release target size of 20 fpp in April. The groundwater temperature is expected to vary relative to the seasonal river water temperature fluctuations. Therefore, during the winter months, the capability to raise water temperatures to 42°F for egg incubation and 47°F for early rearing is needed. Conversely, the capacity to cool the water during late summer incubation will be necessary to reduce temperatures. An energy efficient glycol based recycle loop chiller system will be provided to meet chilled inflow temperature criteria.

A diesel powered boiler featuring a glycol based hot water loop heat exchanger will provide heated pathogen free water. Diesel fuel will be stored in an outside, above ground storage tank that is shared with the engine generator.

5.5) Rearing facilities.

Lookingglass Hatchery **-** Outside rearing containers include 18 raceways, each with a rearing volume of 3,000 ft^3 (10'x100'x3'), two adult holding raceways 6,400 ft^3 (20'x80'x4'), and three adult circular holding tanks 942 ft^3 (20'x3'). Inside rearing containers include 28 troughs and 504 incubation trays in 63 stacks.

Proposed Lostine Hatchery - The early rearing facility at the Lostine River Hatchery has been designed with forty- four 18ft x 3ft x 2ft fiberglass deep troughs. Working capacity will be approx. 112 ft^3 to meet preferred juvenile rearing density index criteria of 0.3. Each trough will have both well and surface water supply. Fish will be transferred from incubation to these early rearing troughs post hatching when they are approximately 1100 fish per pound (fpp). The fry will be reared in these vessels until they reach approximately 180 fpp. At this size, they will be marked and transferred to the final rearing raceways. To allow for the time needed for marking, the facility can safely rear juvenile salmon in these vessels to 150 fpp.

The proposed hatchery final rearing area will consist of eight 120ft L x 10ft W x approximately 5ft. deep raceways. The units are arranged in two banks of four vessels to provide the flexibility to reuse water between the raceways. Each bank will have one outermost unit with the capability to be divided into three individual sections each with dedicated inflow headers and drains. The maximum flow per raceway will be 674 gpm. Imnaha Chinook will be reared at the same density index until March of each year and then transferred at 23 fpp to the Imnaha Satellite Facility for acclimation and released at 20 fpp.

5.6) Acclimation/release facilities.

The Imnaha Satellite Facility consists of one support cabin (800 ft^2), one shop and storage building, a covered spawning structure, and one acclimation pond with volume of 13,000 ft^3 (125'x26'x4').

Improvements to juvenile acclimation and release facilities at the Imnaha satellite facility are designed and proposed for construction as part of the NEOH (Northeast Oregon Hatchery) project. Improvements identified for the Imnaha satellite facility include: 1) redesign of the new acclimation and holding ponds to the east side of the existing holding ponds, 2) additional portable generator and skid-mounted air compressor for pneumatically-controlled weir and intake screen cleaning, and 3) replacement of the existing intake structure with a larger structure capable of delivering more surface water to the facility. In May of 2006 the Northwest Power and Conservation Council recommended proceeding with construction of NEOH (including these modifications) however, initiation of construction is pending a decision from Bonneville Power Administration.

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

- Water quality problems resulting from upstream landslides in the Eagle Cap Wilderness on Imnaha River (Imnaha Satellite Facility) lead to increased sedimentation and turbidity that result in high adult pre-spawn mortality.

- Icing events at Lookingglass Hatchery intake. Three scenarios can cause ice buildup and blockage of the intake:

    - Icing of Lookingglass Creek brought on by weather events producing zero and sub-zero temperatures.
    - Icing of Lookingglass Creek followed by heavy snow results in slush ice.
    - Icing events on Lookingglass Creek followed by quick warming result in ice sheet dams that break loose and lodge against the intake.

- Water quality problems resulting from upstream landslides in the Blue Mountains on Lookingglass Creek lead to increased sedimentation and turbidity that result in some juvenile mortality or contribute to fish health issues.

- Deposition of gravel in the water supply intake can reduce flow to the hatchery used for rearing and adult holding. Low flows can result in oxygen deprivation.

In 2008, maintenance of the water intake at Lookingglass Hatchery (deepening for more water) caused the mortality of over 60 (out of around 170) upper Grande Ronde River broodstock being held in a circular in the same building as the Lostine fish. The maintenance stopped flow into the circular and the fish used all of the oxygen before water flow could be returned. No mortality of Lostine stock adults occurred during this event.

In June of 2010, operational difficulties resulted in substantial fish mortality at Lookingglass Hatchery. During the night of June 2nd, the UV treated water supply flowing to the juvenile Salmon rearing troughs became blocked. High levels of intake debris coupled with a nonfunctioning automated drum filter cleaning system, led to fatal plugging of the UV treatment system. In this incident, the main water supply to the pump that cleans the debris screens was unintentionally severed during a construction project on the hatchery grounds. After the damaged line was repaired hours later, the specific water supply valve serving UV intake cleaning system was mistakenly never reopened. Without the vital additional rinsing action of the spray bar, a high amount of debris built up inside the apparatus and clogged a protective perforated plate. The obstructed system outflow resulted in a critical lack of rearing vessel inflow and the subsequent catastrophic fish loss due to suffocation. The predicament was not discovered by ODFW staff until the following morning.

A substantial number of fish were contained in the early rearing troughs and this incident resulted in a total loss of 494,584 brood year 2009 Chinook fry. The specific program loss due to this event per was:

- 113,410 Lostine River Conventional Production progeny
- 93,406 Lostine River Captive Brood progeny
- 193,855 Imnaha River progeny
- 93,913 Catherine Creek Conventional Production progeny

At the time this loss occurred, the UV system did not have an audible alarm, nor did the rearing troughs. As a result of this lack of preparedness, ODFW and LSCRP have implemented measures to reduce the risk involved with this type of water treatment device. The following is a list of the recent activity regarding alarm system infrastructure improvements and revised hatchery operations to increase vigilance:

- ODFW reports installation an alarm on the UV tank headbox. This is should alert staff if a similar debris blockage is affecting the system's flow.
- ODFW/NPT/CTUIR/LSRCP participated in an initial review and needs assessment of the Lookingglass Hatchery alarm system. The meeting determined an updated alarm panel with additional alarm points was necessary to provide early warning to hatchery staff of flow disruption to the early rearing vessels.
- ODFW reports an updated hatchery operation plan to address staffing goals and rearing season vessel transfer timelines.
- ODFW reports increased efforts to label and train staff on flow operations along with reiteration of emergency response procedures.
- ODFW and LSRCP report recently constructed additional onsite employee housing will facilitate an increase in on station hatchery personnel.
- ODFW reports completion of updated alarm panel installation and the requested additional alarm points in January 2011.

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.

- Transfer of adults from Imnaha Satellite Facility to Lookingglass Hatchery
- Operate intake well (TW2) for icing emergencies
- Maintain back-up diesel motor for TW2

- TW2 alarms
- Low water alarm
- Low temperature alarm
- Monitor facilities operation during high flow events
- Maintain screens in working order
- Keep trap and ladder area free of debris
- Adjust diversions to maintain flow in passage facilities and bypass reaches
- Staff facility 24 hours a day, seven days a week during hatchery operation
- Risk aversion measures implemented after 2010 fish kill, see above in section 5.7
- Construction of NEOH Lostine hatchery would provide for risk aversion by providing rearing at two separate facilities

SECTION 6. BROODSTOCK ORIGIN AND IDENTITY

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

6.1) Source.

Broodstock for the Imnaha River spring/summer Chinook salmon program is collected from natural and hatchery-origin adults trapped at Imnaha weir and then transferred to Lookingglass Hatchery for spawning. The ratio of hatchery to wild fish collected for broodstock is based on adult escapement sliding scale (Table 1). However, as noted earlier because of flaws in current weir, it is not possible to implement the sliding scale as intended. In addition the fish collected for hatchery broodstock are from the second half of the return (because the weir cannot be fished earlier) and therefore artificial selection is effectively being carried out for later run timing. Therefore, changes are needed in the methods used to collect broodstock. A continuation of current practices over the long term will likely cause the hatchery stock to diverge substantially from the natural origin population that was used to initiate the hatchery program.

6.2) Supporting information.

6.2.1) History.

Since the beginning of this program in 1982 only natural or hatchery produced Imnaha River spring/summer Chinook salmon have been used for brood stock.

6.2.2) Annual size.

The program broodstock collection goal is 322 adults spawned to produce 490,000 smolts; however, in the short term 228 adults (sex ratio 1:1) will be collected to produce 420,000 smolts. Actual collection goals are established each year through development of the annual operation plan that is based on an adult sliding scale (Table 1). Actual number of males and females spawned since 1990 are reported in Table 17.

The program incorporates age-three males or jacks in the broodstock to fertilize a maximum of 10% of the eggs. Milt from a maximum of six jacks can be pooled to fertilize one cell of eggs. An egg cell is typically one-half or one-third of one female's eggs.

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

Naturally spawned fish included in the brood stock, are reported in Table 17. The proportion of the broodstock that were natural origin fish (pNOB) has averaged 0.318 and ranged from 0.085 to 0.711 for the 1990-2010 brood years (Table 17).

6.2.4) Genetic or ecological differences.

Broodstock annually incorporates locally-adapted, naturally-produced fish that should minimize differences (Table 17). However, inability to install the weir during high flows (>900cfs), in June and early July, has resulted in differences in run timing and spawn timing between hatchery and natural origin fish (Hoffnagle et al. 2008). Also, acclimating smolts solely at the Imnaha Satellite Facility has resulted in differential spawning distributions, which exacerbate the potential for genetic differentiation between hatchery and natural-origin salmon.

6.2.5) Reasons for choosing.

Broodstock is indigenous to the Imnaha Basin. Broodstock collected at the Imnaha weir incorporates naturally-produced fish from the Imnaha population to maintain local adaptation and avoid domestication of the hatchery stock.

Table 17**.** Imnaha River spring/summer Chinook salmon spawning data 1990-2010 spawn years.

Brood Year	Marked Males Spawned	Marked Females Spawned	Unmarked Males Spawned	Unmarked Females Spawned	% Un-marked	Spawning Ratio F/M	Average Fecundity	Egg Take (1,000's)	Fry Ponded (1,000's)	Smolts released (1,000's)
1990	35	49	39	25	43.2%	1.00	4,414	327	270	0
1991	11	24	27	15	54.5%	1.03	4,954	193	163	0
1992	46	86	69	28	42.4%	0.99	4,754	542	465	0
1993	134	139	58	54	29.1%	1.01	5,425	1,047	1,010	283
1994	15	13	6	9	34.9%	1.05	5,082	112	96	0
1995	16	9	30	6	59.0%	0.33	4,541	68	51	0
1996	15	7	37	17	71.1%	0.46	4,276	103	102	0
1997	54	50	8	7	12.6%	0.92	4,962	283	206	0
1998	53	33	31	28	40.7%	0.59	5,059	309	183	0
1999	183	31	14	6	8.5%	0.16[a]				0
2000	240	58	46	10	15.8%	0.19[a]	5,048	334	311	0
2001	114	56	54	49	37.8%	0.38[a]	4,371	459	275	0
2002	117	83	14	14	12.3%	0.62	4,695	455	397	398
2003	125	72	24	26	20.2%	0.65	5,081	498	434	435
2004	74	79	32	25	27.1%	0.98	4,652	488	447	442
2005	108	88	21	29	20.3%	0.90	4,545	532	437	433
2006	85	74	28	24	24.6%	0.86	4,138	406	363	349
2007	82	72	23	21	15.7%	0.88	4,391	408	300	294
2008	123	82	82	22	33.6%	0.50	4,627	472	408	390
2009	73	75	33	34	31.2%	1.02	4,710	513	437	
2010	61	80	38	29	26.6%	1.10	4,756	518	470	

[a] Three-year olds males (jacks) are included in the marked males spawned. Milt was pooled and used to fertilize a maximum of 10% of the available eggs; therefore, the % marked fish and spawning ratio (F/M) is skewed.

6.3) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish that may occur as a result of broodstock selection practices.

Broodstock is selected in a representative fashion from those fish trapped at the weir. However, as noted earlier, a varying portion of the run passes the weir without being captured (before the weir can be installed; Table 18). Therefore, the current practices impose strong selection for the hatchery fish to have a later run timing. As noted in section 6.1, this problem needs correction as soon as possible. Pass/keep ratio varies annually, depending on return projections and is adjusted in-season to insure representation from across the captured run. Only hatchery fish are outplanted in the Big Sheep Creek watershed.

SECTION 7. BROODSTOCK COLLECTION

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

Adults

7.2) Collection or sampling design.

Adults moving upstream in the Imnaha River are blocked by a picket weir with attraction water supplied through a fish ladder leading to a fish trap. Fish ascend the ladder and swim into a 1,040 ft^3 holding area. From the holding area fish are directed to a processing location where data relating to the fish is collected. Information is collected from every adult that enters the Imnaha weir trap. This data consists of the date entering the trap, gender, fin clips, VIE, PIT, or CWT marks or tags, and fork length. Fish selected for broodstock are given antibiotic injections. After processing, following guidelines established in the AOP, fish are selected for broodstock and transferred to Lookingglass Hatchery. Contingent on the construction of the Lostine Hatchery, adults may be transferred to this facility on the Lostine River.

Fish not selected for broodstock needs are re-cycled through the fishery, outplanted, taken to Wallowa Hatchery for distribution to food banks and tribal use, or released above the weir to spawn naturally. Fish released above the weir are released following guidelines established in the AOP. Hatchery jacks released above the weir are limited to <10% of the total males. In most years, wild jacks comprise the majority of this 10% or exceed the 10% target. Re-cycling fish through the fishery is dependent upon the quantity of fish expected to return and having an authorized fishing season. During the peak of the run when substantial numbers of fish enter the trap, not all fish are processed and are put back in the trap holding area.

Table 18. Imnaha satellite facility weir operation, spring/summer Chinook salmon collected, and spawning dates during run years 2000-2010.

Run Year	Operation of Imnaha weir		Collection at Imnaha Weir		Spawning at Lookingglass Hatchery	
	Beginning	Ending	Beginning	Ending	Beginning	Ending
2000	28-Jun	12-Sep	28-Jun	12-Sep	9-Aug	13-Sep
2001	24-May	29-Sep	25-May	19-Sep	14-Aug	18-Sep
2002	10-July	18-Sep	10-Jul	18-Sep	21-Aug	11-Sep
2003	07-July	17-Sep	7-Jul	17-Sep	12-Aug	16-Sep
2004	15-Jun	17-Sep	15-Jun	17-Sep	17-Aug	14-Sep
2005	14-Jun	12-Sep	14-Jun	12-Sep	16-Aug	13-Sep
2006	16-Jun	11-Sep	16-Jun	11-Sep	22-Aug	15-Sep
2007	14-Jun	19-Sep	14-Jun	19-Sep	14-Aug	13-Sep
2008	10-July	23-Sep	4-July	9-Sep	13-Aug	12-Sep
2009	24-June	16-Sep	25-June	9-Sep	19-Aug	8-Sep
2010	6-July	8-Sep	7-July	8-Sep	24-Aug	14-Sep

7.3) Identity.

7.3.1 Methods for identifying target populations (if more than one population may be present).

Naturally produced fish are identified based on lack of marks or tags. The Imnaha weir is in a location where only one natural population should be encountered.

7.3.2 Methods for identifying hatchery origin fish from naturally spawned fish.

Since 1992 (BY 1990), all hatchery Chinook released in the Imnaha Basin have been marked with an adipose fin clip (AD) and/or marked with a coded-wire tag (CWT). A proportion of the release is implanted with PIT tag. Marking schemes for the Imnaha program are defined in the U.S vs. Oregon 2008-2017 management agreement. Should the expected production fall below 100,000 juveniles for the Imnaha or Lostine program co-managers may initiate discussions to modify marking levels from those specified in Table B1 of the 2008-17 *U.S. vs. Oregon* management agreement, with the interest of escaping enough adults to collect broodstock.

7.4) Proposed number to be collected.

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

Due to rearing constraints at Lookingglass Hatchery, co-managers have targeted a collection of 228 adults to produced 420,000 smolts for brood year 2011. This collection would be increased to 342 adults (166 males and 166 females) when hatchery capacity to raise the full 490,000 smolt mitigation level is provided via the construction of the Lostine Hatchery as proposed by the NEOH master plan.

7.4.2 Broodstock collection levels for the last twelve years (e.g. 1996-08), or for most recent years available.

Table 19 describes spawner information, egg take, and smolts produced for the Imnaha hatchery program from brood year 1996 to 2010.

Table 19. Imnaha hatchery program spawner information, egg take, and produced smolts from brood year 1996 to 2010.

Brood Year	Adults		Jacks	Eggs (×1000)	Smolts
	Females	Males			
1996	24				93,108
1997	57				184,725
1998	61	47	37		179,716
1999	37	64	133		123,014
2000	68	76	210	333	303,769
2001	98	87	78	459	268,426[a]
2002	97	131	n/a	455	398,469[a]
2003	98	149	n/a	498	435,186[a]
2004	104	106	n/a	488	441,680[a]
2005	117	129	n/a	532	432,530[a]
2006	98	113	n/a	406	348,910[a]
2007	93	105	n/a	408	293,802[a]
2008	104	105	30	472	390,064[a]
2009	109	108	35	513	
2010	109	99	42	518	

[a] Number acclimated before mortality. Data source - Lookingglass Fish Hatchery

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

- Adults are passed upstream consistent with pre-season estimate using guidelines outlined in the adult sliding scale (Table 1).
- Out-plant adults into the Big Sheep Creek watershed according to co-management agreements established as part of the annual LSRCP AOP process.
- Tribal and recreational fisheries.
- Tribal subsistence and ceremonial purposes (hatchery fish)
- Distribution to food banks (hatchery fish)
- Nutrient enhancement (hatchery fish)

- Landfill (hatchery fish)

7.6) Fish transportation and holding methods.

Adult collection and transportation methods are described above in section 5. Fish may be held a maximum of 7 days; however, during the peak return fish are held for approximately 3 days.

Adults used for broodstock can be anesthetized at the Imnaha Facility with MS -222 prior to biological sampling and antibiotic injections. Only fish used for broodstock are injected with oxytetracycline (10 mg/kg) and erythromycin (Erythro-100 @ 20 mg/kg). Fish re-cycled in a fishery or provided for food distribution are not anesthetized.

Adults retained for broodstock are transported to Lookingglass Hatchery in an 800 or 250-gallon tank. Transportation time is approximately 2.5 to 3.5 hours from Imnaha Satellite to Lookingglass Hatchery. Once the new hatchery on the Lostine River becomes functional, adults from the Imnaha will be held at this location. This lessens the distance adults must be transported and will likely reduce the transit time to less than 1.5 hours.

All adults are held in one adult pond with a maximum inflow of 3,990 gpm. Maximum holding capacity is 800 adults (1 adult/8 ft^3). Fish are treated with formalin at 167 ppm on Monday, Wednesday, and Friday to control fungus. Fish are treated more often if required.

7.7) Describe fish health maintenance and sanitation procedures applied.

Collection - Adults retained for broodstock are injected with oxytetracycline (10 mg/kg) and erythromycin (Erthro-100 @ 20 mg/kg) at the Imnaha Facility.

Holding - At Lookingglass Hatchery, formalin is dripped into the inflowing water to achieve a maximum concentration of 167ppm. The treatment is applied for one hour to control fungus and parasites three times per week. The frequency of treatment is adjusted as necessary from mid-August through the end of spawning.

Spawning - All hatchery-spawned females are screened for *R. salmoninarum* (BKD) using enzyme-linked immunosorbent assay (ELISA) techniques. A minimum of 20 dead or moribund adults are examined by culture for systemic bacteria and BKD. A minimum of 60 spawned fish are sampled for culturable viruses using ovarian fluid and caeca/kidney/spleen tissue samples in 5 fish sample pools.

Progeny - Eggs are water hardened in a 100ppm iodophor solution for a minimum of 15 minutes to control vertical transmission of pathogens including IHNV. Vertical transmission of BKD (*R. salmoninarum*) is a concern. Eggs are culled or segregated in groups based on ELISA titers. The following titer ranges identify groups:

- $\leq$ 0.199 =Low
- 0.2 - 0.399 = Moderate
- 0.4 - 0.799 = High
- $\geq$ 0.800 = Clinical

Progeny receive a minimum of one 28 day therapeutic erythromycin medicated feed treatment to help control BKD (INAD 090RLOSCS1).

Disease outbreaks are treated on a case-by-case basis. Therapeutants and treatment measures are based on conventional and available treatments, new information, and innovation. Warm water therapy may be used if EIBS becomes a problem. It would be used, based on priorities of stocks and raceways affected, after consultation with ODFW Fish Health Services. Formalin treatments can be implemented for parasitic infestations Disinfections and sanitation guidelines for Lookingglass Hatchery are outlined in Appendix Table 3.

7.8) Disposition of carcasses.

Carcasses are disposed of by burying in a pit. Carcasses may be screened for pathogens causing BKD, IHN, and whirling disease.

7.9) Indicate risk aversion measures that will be applied to minimize the likelihood for adverse genetic or ecological effects to listed natural fish resulting from the broodstock collection program.

- The risk of fish disease amplification will be minimized by consulting with the Fish Pathologist and following Fish Health Policy sanitation and fish health maintenance recommendations discussed annually with co-managers during the development of the AOP (2011). Prudent fish health measures can be implemented to cull eggs from females with gross signs of BKD or elevated BKD ELISA values.

- Although natural origin broodstock are collected in a representative manner from those fish captured at the weir, this sample is strongly biased to those fish with later run timing. As described earlier, the current weir cannot be used during high flows and first portion (to a varying degree) of each year's return passes upstream before the weir can be installed. In addition, the proportion of hatchery fish in the natural spawning population (pHOS) may be effectively greater than targeted under the sliding scale protocols in years of large returns. These features of the present program, if continued over the long-term, will likely lead to the genetic divergence of the Imnaha population from its pre-hatchery state. A revised weir that can trap fish during the entire run is the critical element to remedy this situation. This weir revision is included in the yet to be funded NEOH master plan. As a contingency for the possibility that the construction of a new weir is not funded, the co-managers will explore alternative means to ensure the collection of broodstock is representative across the entire run and the guidance under the sliding scale for managing pHOS will be adhered to (see Sections 1.11.1 and 1.11.2).

SECTION 8. MATING

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

8.1) Selection method.

Chinook adults that enter the trap are collected throughout the operation of the weir. From the trapped fish, a predetermined number of adults by age, sex, and origin, are selected on a weekly basis based on the proportion of the expected run. The number and ratio of hatchery and wild fish collected are based on the adult sliding scale (Table 1). Hatchery broodstock are selected at random for spawning as they mature.

8.2) Males.

To include contribution of hatchery origin jacks, milt can be collected from 6 jacks and used to one female's eggs (6:1 matrix). Total contribution by jacks is <10% of the available eggs. Frequently, natural origin males are used more than once to increase their contribution. Starting in 2010, 30% of the eggs will be fertilized with larger (>85 cm) and presumably older males. Older males can be used up to 3 times.

8.3) Fertilization.

The goal of the program is to produce a minimum mating of 100 family pairs. Matrix or factorial spawning is generally accomplished in 2x2 combinations; therefore, each matrix generates four family pairs. The goal is that, at a minimum, each matrix contains at least one natural-origin adult. Occasionally, natural-origin males are used multiple times to increase their contribution.

Target sex ratio for this program has been a 1:1 male-to-female adult spawning ratio. However, due to rearing in a hatchery, the ratios are often skewed towards males. In years of abundant jack returns, 10 hatchery jacks equal one adult male. Fish health and sanitation procedures are outlined in section 7.

8.4) Cryopreserved gametes.

Cryopreserved sperm was collected by the Nez Perce Tribe and is available from past brood years. The cryopreservation program ended in 2008 although it is stored at the University of Idaho and Washington State University. There are currently no plans to use the cryopreserved sperm.

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.

A factorial or matrix-mating scheme is applied to ripe fish on each spawning day. The number of ripe fish, their gender and age determine the matrices. Natural fish are included in each matrix to maximize contribution of natural fish.

SECTION 9. INCUBATION AND REARING

Specify any management *goals* (e.g. "egg to smolt survival") that the hatchery is currently operating under for the hatchery stock in the appropriate sections below. Provide data on the success of meeting the desired hatchery goals.

An estimate of 80.5% survival from green egg to smolt is used to determine adult collections in the sliding scale.

9.1) Incubation.

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

While the program smolt goal has remained constant since initiation, egg take has varied over time due to low spawner numbers in some years (1991, 1994 and 1995), elimination of across the run egg culling after 1997, and disagreement between co-managers regarding use of surplus adults (1998; Table 20). The current program attempts to meet the current 420,000 smolt goal using average fecundity and survival to calculate the number of spawners needed (AOP 2011). For the short term, up to 300 hatchery-origin adults surplus to escapement and broodstock needs can be outplanted into the Big Sheep Creek watershed.

Table 20. Egg take and loss data for Imnaha spring/summer Chinook at Lookingglass Hatchery, 1990-2010 brood years (Data source - Lookingglass Fish Hatchery).

Year	Total Egg Take	Egg Loss		Percent Survival to eyed egg Stage
		Total	% Loss	
1990	326,612	53,862	16.5	**83.5**
1991	193,206	27,256	14.4	**85.6**
1992	524,005	72,955	13.5	**86.5**
1993	1,047,064	35,085	3.4	**96.6**
1994	111,794	15,619	14.0	**86.0**
1995	68,121	15,471	22.7	**77.3**
1996	110,146	7,911	7.2	**93.8**
1997	282,823	76,112	26.9	**73.1**
1998	308,572	78,617	25.5	**74.5**
1999	168,930	40,153	23.8	**76.2**
2000	333,824	18,338	5.5	**94.5**
2001	459,276	180,427	39.3	**61.7**
2002	455,372	54,107	11.9	**88.1**
2003	497,969	59,919	12.0	**88.0**
2004	488,475	36,574	7.5	**92.5**
2005	531,706	78,973	14.9	**85.1**
2006	405,538	39,317	9.7	**90.3**
2007	408,336	103,202	25.3	**74.7**
2008	480,620	47,449	9.9	**90.1**
2009	513,432	33,463	7.3	**92.7**
2010	518,403	43,171	8.3	**91.7**

9.1.2 Cause for, and disposition of surplus egg takes.

During the past 12 years there have been no releases of spring/summer Chinook salmon unfed fry in the Imnaha Basin. The only non-smolt release consisted of 283,046 (98 fish/lb) fingerlings from the 1993 brood year released in July 1994. The fingerlings were excess to smolt production goals and were out-planted for natural rearing in the Imnaha Basin. Locations included Big Sheep, Little Sheep, Cow, Freezeout, Horse, Lightning Creeks, and the main stem Imnaha River. The fish were 100% marked with an adipose fin clip. No unfed fry or fingerling releases are planned.

9.1.3 Loading densities applied during incubation.

Eggs are incubated in vertical Heath style or flow through trays. One female's eggs are incubated per tray. Flows are regulated at 4 to 5 gpm per vertical stack. Moist air incubators are also being considered for future use. If implemented for us, approximately 1,400 eggs will be loaded in 1.2 liter containers.

9.1.4 Incubation conditions

Co-managers have agreed to incubate eggs and early rear fry on pathogen free well water and/or near pathogen free UV treated water.

Lookingglass Hatchery - Incubation at Lookingglass Hatchery uses UV treated creek water or chilled well water. Silt has been a concern in the past, but the UV system has a drum filter at 40 microns that filters most silt or suspended solids out of the creek water supply. Low levels of dissolved oxygen in the water is not a problem for egg survival.

9.1.5 Ponding

Fry are ready to pond at about 1,000 CTU's (1,800 TU). Fry weigh approximately 0.3 grams (1,300 fish per pound) and measure 25 to 30 mm in length.

9.1.6 Fish health maintenance and monitoring

Fungus is controlled with formalin treatments at a concentration of 1,667 ppm. Treatments are scheduled three times per week for 15 minutes; however, daily treatment will be applied if needed. Little mortality has been attributed to yolk-sac malformation. Eyed eggs are picked using a mechanical egg sorter and counter. The machine separates live eggs from dead eggs and enumerates both groups of eggs. Hand picking is performed on a weekly basis to remove any additional mortality.

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.

Green eggs are taken and incubated at Lookingglass Hatchery. Eggs are fertilized and water hardened in 100 ppm iodophor solution for a minimum of 15 minutes. Eggs are incubated on well water and UV treated creek water to minimize the risk of disease and loss due to siltation.

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 (1997-2008), or for years dependable data are available.

From 1995 to 2008 the observed green egg to smolt survival at Lookingglass Hatchery has ranged from 0.407 to 0.901, with an average of 0.748 (Table 21). For the purposes of production planning a green egg to smolt survival rate of 0.805 has been assumed in the past with life stage specific survival rates as follows:

- Green to eye-egg: 90%
- Eye-egg to swim-up fry: 97%
- Swim-up fry to marking: 95%
- Marking to release: 99%

Table 21. Imnaha hatchery program fish inventories, from green eggs to release, for brood years 1995-2010.

BY	Green Eggs	Eyed Eggs	Marked Inventory	Release Inventory	Green Egg to Smolt Survival	Culled	Stage Culled
1995	68,121	52,650	No MPR	50,911	0.747	0	
1996	110,146	103,125	No MPR	93,108	0.845	0	
1997	282,823	208,215	202,461	194,967	0.689	0	
1998	308,572	185,095	183,164	179,797	0.583	0	
1999	168,930	128,777	125,184	123,014	0.728	0	
2000	333,824	315,486	310,027	303,737	0.910	0	
2001	462,968	282,541	269,585	268,426	0.580	3,692	eyed
2002	455,372	401,265	398,865	398,469	0.875	0	
2003	497,969	438,050	443,471	435,186	0.874	0	
2004	488,475	451,901	444,732	441,680	0.904	4,116	eyed
2005	1,063,412	905,486	435,227	432,530	0.407	11,486	eyed
2006	405,536	366,221	359,834	348,910	0.860	0	
2007	408,336	305,134	299,102	293,802	0.720	2,077	eyed
2008	480,621	424,553	399,841	390,064	0.811		
2009	513,432	475,730	299,081			4,239	eyed
2010	518,403	475,232					

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

At Lookingglass Hatchery, co-managers agreed to a loading rate of 60,000 fish per raceway.

Table 22. Density and loading criteria goals and actual levels for Lookingglass Hatchery, using brood year 2007 for example.

Metric	Goals	Actual
Fish per Raceway	60,000	**54,365**
Rearing Density (lb/ft^3)	0.86	**0.71**
Density Index	0.16	**0.14**
Flow (lbs/gpm)	4.0	**4.9**
Flow Index	0.76	**0.97**

Table 23. Density and loading criteria goals and actual levels for Imnaha acclimation facility, using brood year 2007 for example.

Metric	Goals	Actual
Fish per Raceway	360,000	**303,000**
Rearing Density (lb/ft^3)	1.38	**1.17**
Density Index	0.26	**0.22**
Flow (lbs/gpm)	4.5	**3.8**
Flow Index	0.85	**0.72**

Proposed Lostine River Hatchery
As described in the Lostine River Hatchery Genetic Management Plan (section1.16), 247,000 Imnaha spring Chinook juveniles are expected to be produced at the proposed facility. The planned density and loading criteria goals are as follows:
Number of fish/rcy: 61,750
Density of 0.52 lb/ft3
Density Index of 0.10

9.2.3 Fish rearing conditions

Lookingglass Hatchery - Incubation is described in section 9.1.4. Around the end of April and beginning of May, fish are ponded into the outside raceways at approximately 200 to 250 fpp. Water inflow is adjusted to maintain a flow index that will provide life support. Low creek flows and higher water temperatures in July and August require increased monitoring of fish culture parameters to support survival. Raceways are cleaned weekly and mortalities picked daily.

Proposed Lostine Hatchery - The early rearing facility at the proposed Lostine River Hatchery has been designed with forty- four fiberglass deep troughs Working capacity will be approximately 112 ft3 to meet preferred juvenile rearing density index criteria of 0.3 to 0.76. Start tank rearing at the proposed Lostine River hatchery will begin each January with fry ponded into the indoor start tanks. Inflow provided will be sourced from 42-46 degree F pathogen free well water with UV treated surface water as a contingent.

This type of rearing vessel is beneficial for administering initial feedings and quantifying loss to aid in maintaining correct population statistics. Other benefits favoring quality rearing conditions include ease of daily maintenance and protection from predation to minimize hatchery environment rearing stress. Once they have reached approximately 180 fpp the fish will be marked and transferred to large raceways and reared there until release.

The proposed hatchery final rearing area will consist of eight 6,000 ft3 raceways. This volume provides low density rearing and eliminates the frequency of stressful population splits. The shaded rearing units are arranged in two banks of four vessels to provide the flexibility to reuse water between the raceways. The maximum flow per raceway will be 674 gpm. Further reducing handling stress and improving the rearing conditions, volitional release will occur from the raceways to the adjacent Lostine River.

Lostine spring Chinook will be reared to 20 fpp at preferred densities (density index 0.1) once transferred to the final rearing raceways. Imnaha Chinook will be reared at the same density index until March of each year and then transferred at 23 fpp to the Imnaha Satellite Facility for acclimation and released at 20 fpp.

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 24. Estimated monthly weight of Imnaha program juvenile Chinook, using brood year 2007 for example. Data collected from brood year 2007 fish reared at Lookingglass Hatchery from January 2007 through February 2009.

Month	Weight (g)	Fish /Pound
January	0.35	1300
February	0.48	950
March	1.25	364
April	3.01	151
May	5.10	89
June	6.58	69
July	10.81	42
August	16.81	27
September	17.46	26
October	18.92	24
November	19.74	23
December	19.74	23
January	19.70	23
February	19.00	23

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

Typical growth rates for the Imnaha program are charted in Figure 7. The highest growth rates occurred in March 2007 by fry right after ponding at Lookingglass Hatchery. Growth rates varied from April through August. Most of the variations are attributed to off feeding days, such as, the April/May transfer into outdoor raceways, and June/July fish marking. In August, daily rations were targeted at 1.9% BW per day for therapeutic erythromycin medicated feed treatment. Growth rates declined in September and October 2007 with little weight gain in November, December, and January 2008 due to colder water temperatures. A slight decrease in growth was observed in January and a significant increase in growth rates was observed in February prior to transfer to the Imnaha Satellite Facility. Modest growth was observed at the Imnaha site, as fish are fed in moderation prior to release. No hepatosomatic index (liver weight/body weight) and body moisture content was collected to estimate body fat concentration during rearing.

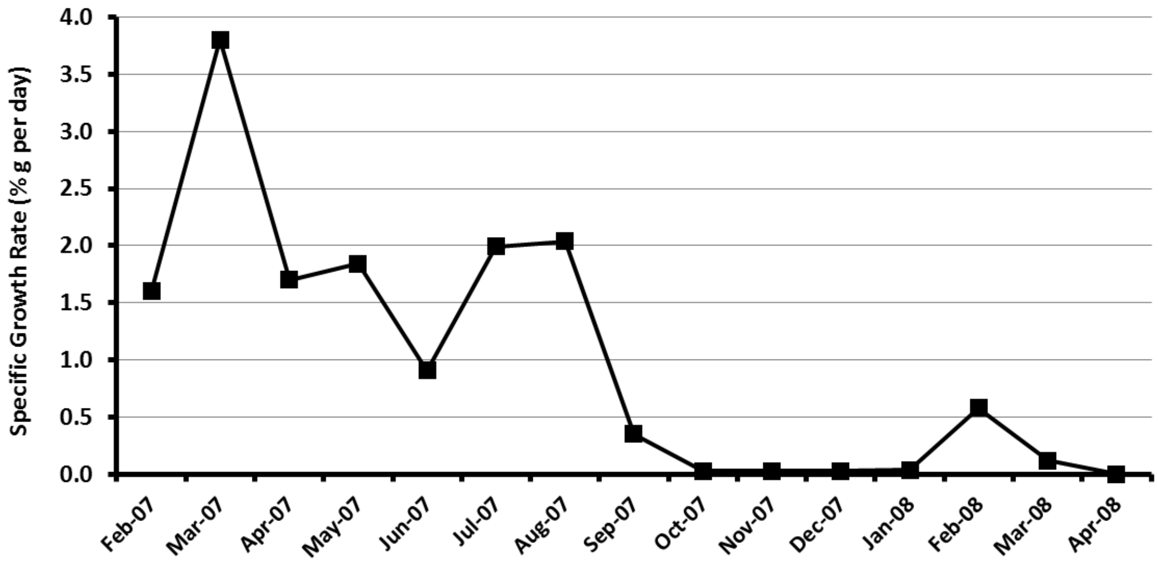

Figure 7. Specific growth rates (% grams per day) for Imnaha program Chinook reared at Lookingglass Hatchery, using brood year 2007 for example.

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*).

- At Lookingglass, swim-up fry are started on BioDiet and remain on Skretting/Bio-Oregon BioDiet throughout their feeding regime. One 28-day erythromycin medicated feed treatment is given to all fish following ad clipping and CWT marking. Feed is distributed by automatic feeders.
- At Lookingglass Hatchery, fish are fed Skretting/Bio-Oregon BioClark’s fish feed. The feed is distributed to the raceways with Garon feeders and to fry in the Canadian troughs by hand or Nielsen feeders.
- Feed rate: Beginning feeding rate is 3.50% body weight/day. November through January fish are fed intermittently at “maintenance” ration 1.0 %.

Prior to release, 2.0% body weight/day.

- Overall food conversions average 1.1 to 1.25.

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

Monthly sample of about 10 (or available) moribund and/or dead fish will be examined for *R. salmoninarum* (BKD) and systemic bacteria. Every other month, examine 5 grab-sampled fish and any moribund fish for erythrocytic inclusion body syndrome (EIBS) using blood smears and hematocrits. If EIBS is detected expand monitoring on that raceway to 10 fish per month. Examine gill and skin wet mounts by microscopy from a minimum of five fish. These may be from a combination of moribund and healthy fish. If bacterial gill or cold water disease is suspected, make smears from the gills on agar medium.

BKD – see section 7.7. Adult salmon are sampled for BKD at both the hatchery and Imnaha acclimation facility.

EIBS - There is no treatment for EIBS except avoidance of the infectious agent. Warm water therapy may be used if EIBS becomes a problem. Warm water therapy would be used, based on priorities of stocks and raceways affected, after consultation with Fish Health Services.

Bacterial coldwater disease is the most common secondary infection. Lookingglass Hatchery will follow treatment protocols provided by Fish Health Services.

Fungus - Formalin treatments are administered for two consecutive days after fin clipping and CWT marking in the spring and after PIT-tagging in the fall. Formalin is administered to incubating eggs and adult broodstock on a Monday, Wednesday, Friday schedule or more often as needed.

Fish Health Plan - Disease outbreaks are treated on a case-by-case basis. Lookingglass follows and adopts the treatment strategy as provided by Fish Health Services. Therapies and remedial measures are based on conventional and available treatments, new information and innovation.

Table 25. Disease history at Lookingglass Hatchery (2003 to present) of Imnaha Chinook adults and juveniles[a].

Disease or Organism	Life stage	
	Adults	Juveniles
IHN Virus	Yes	Yes
EIBS Virus	No	Yes[b]
Aeromonas salmonicida	Yes	No
Aeromonas/Pseudomonas	Yes	Yes
Flavobacterium psychrophilum (CWD)	Yes	Yes
Fl. columnare	No	No
Renibacterium salmoninarum	Yes	Yes
Yersinia ruckeri	No	Yes
Carnobacterium sp	No	No
Ichthyobodo	No	Yes
Gyrodactylus	No	No
Ichthyophthirius multifilis	No	Yes
Epistylis	No	Yes
Ambiphrya (Scyphidia)	No	Yes
Trichodinids	No	No
Gill Copepods	Yes	No
Coagulated Yolk Disease	No	Yes
External Fungi	Yes	Yes
Internal Fungi	No	Yes
Myxobolus cerebralis	Yes[c]	No
Ceratomyxa shasta	Yes	No

[a] "Yes" indicates detection of the pathogen but in many cases no disease or fish loss was associated with presence of the pathogen. "No" indicates the pathogen has not been detected in that stock.
[b] EIBS was detected prior to 1996 and in brood year 2009 fish (spring 2011).
[c] Two of 26 Imnaha adults (unmarked fish) tested in 2007 were confirmed positive for *Myxobolus cerebralis*.

Note: The Imnaha Chinook Fish Health Monitoring Plan is explained in the Lower Snake Program Annual Operation Plan document developed annually by the co-managers in this program. Refer to section 7 for fish health and sanitation procedures.

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

Not available.

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

At Lookingglass Hatchery, fingerlings are reared with natural water temperatures and photoperiods. Daily feed rations are distributed with automatic feeders to limit human interaction. Fish are acclimated in the Imnaha River 2 to 3 weeks prior to release.

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.

Adults are collected using a sliding scale that incorporates natural origin fish into the broodstock (Table 1). The incorporation of natural fish into production is intended to reduce the long-term impacts of domestication. Progeny are reared to a size of 20-25 fpp. Fish are released to mimic natural fish emigration timing and to reduce the natural and hatchery fish interactions in freshwater.

SECTION 10. RELEASE

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

10.1) Proposed fish release levels.

Release levels, by life stage, for the Imnaha program are listed in Table 26.

Table 26. Proposed release levels, by life stage, for Imnaha program hatchery Chinook.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	0	NA	NA	NA
Unfed Fry	0	NA	NA	NA
Fry	0	NA	NA	NA
Fingerling	0	NA	NA	NA
Yearling	**490,000**	20-25	mid-April	Imnaha River

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

Stream, river, or watercourse: Imnaha River – waterbody code 0800200000
Release point: River mile 45.5 (Latitude 117 51' 45" Longitude 45 44' 00")
Major watershed: Imnaha River
Basin or Region: Snake River

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

Imnaha program release numbers, by age class, for release years 1997-2010 are listed in Table 27.

Table 27. Imnaha program release numbers by life stage and size, 1997-2010 (Data source - Oregon Department of Fish and Wildlife Hatchery Management Information System(HMIS) and Lookingglass Fish Hatchery).

Release year	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Fingerling	Avg size	Smolts	Avg size
1997	n/a	n/a	n/a	n/a	n/a	n/a	50,911	17.0
1998	n/a	n/a	n/a	n/a	n/a	n/a	93,108	21.1
1999	n/a	n/a	n/a	n/a	n/a	n/a	194,967	18.2
2000	n/a	n/a	n/a	n/a	n/a	n/a	179.797	19.1
2001	n/a	n/a	n/a	n/a	n/a	n/a	123,014	16.0
2002	n/a	n/a	n/a	n/a	n/a	n/a	303,737	14.1
2003	n/a	n/a	n/a	n/a	n/a	n/a	268,426	16.0
2004	n/a	n/a	n/a	n/a	n/a	n/a	398,469	26.0
2005	n/a	n/a	n/a	n/a	n/a	n/a	435,186	25.0
2006	n/a	n/a	n/a	n/a	n/a	n/a	441,680	24.2
2007	n/a	n/a	n/a	n/a	n/a	n/a	432,530	21.7
2008	n/a	n/a	n/a	n/a	n/a	n/a	348,910	20.3
2009	n/a	n/a	n/a	n/a	n/a	n/a	293,863	19.9
2010	n/a	n/a	n/a	n/a	n/a	n/a	390,064	21.9

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

Smolts are released in mid-April to mimic natural fish emigration timing and reduce natural and hatchery fish interactions in freshwater. During the last four years, fish have been acclimated for 3 weeks, allowed to volitionally emigrate for 3 to 4 weeks before being forced into the river in mid-April. No culling is applied to non-migrants.

Table 28. Summary of acclimation and release dates since 2004.

Year	Arrival	Volitional Release	Forced release
2004	March 9-11	March 22	April 15
2005	March 9-10, and 29*	March 21	April 15
2006	March 8-10, and 30*	March 21	April 14
2007	March 13-14, 28-29*	March 21	April 12
2008	March 12-14	March 25	April 10
2009	March 6-7*	March 30	April 15
2010	March 10-11	March 30	April 14

* Excess to program taken to Imnaha Acclimation pond on 28th & 29th and added to population still remaining in pond; volitional release suspended for 48 hours and then started again on the 31st.

NOTE: Direct stream release of 145,742 smolts in March 2005, for BY 2003 smolts, 120,928 in March 2006 for BY 2004 smolts, and 58,839 in March 2009 for BY 2007 smolts.

10.5) Fish transportation procedures, if applicable.

Chinook smolts are loaded onto fish transport tankers using a fish pump. Fish are loaded at maximum rate of 1.0 lb/gallon. Transport time averages 2.5 to 3.5 hours. Supplemental oxygen and aeration are provided.

10.6) Acclimation procedures

In general, Chinook smolts arrive at the Imnaha Satellite acclimation pond in early to mid-March and are held on Imnaha River water for two to three weeks. Pond screens are then removed and fish are allowed to volitionally leave the pond for two weeks. All fish are forced out of the pond around April 15. Should the Lostine Hatchery be constructed, some of the Imnaha production will be raised at this facility. When appropriate, co-managers will agree on a scheme to transport and acclimate smolts for both rearing facilities in a safe and efficient manner.

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

Marking of smolt production is done consistent with Table B1 of the 2008-17 of the U.S.v. Oregon Management Agreement. Typically, all smolt production is ad-clipped. A portion (~50%) is implanted with a coded wire tag. Up to an additional 21,000 fish are PIT tagged for M&E purposes. Should the expected production fall below 100,000 juveniles co-managers may initiate discussions to modify marking (ad-clipping) levels with the interest of escaping enough adults to ensure broodstock needs are met.

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

There is no plan for surplus smolt production. Fish surplus to programmed needs would be released at an earlier life stage or culled as eggs.

10.9) Fish health certification procedures applied pre-release.

Sixty healthy-appearing smolts will be sampled by grab-sample at Lookingglass Hatchery prior to transfer to Imnaha Satellite Facility. Individual fish will be examined for *R. salmoninarum* by ELISA, and EIBS. Gill/kidney/spleen are examined in 3-fish samples and assayed for viruses. Wet mounts of skin and gill tissue from a minimum of five fish will be examined by microscopy. At the acclimation site, thirty healthy-appearing fish will be examined for *R. salmoninarum* (ELISA), and EIBS. Gill/kidney/spleen samples as 3 fish sample pools will be assayed for viruses. Wet mounts of skin and gill tissue from a minimum of five fish will be examined by microscopy. These will be sampled within three weeks of the forced release. A target of 10 (or available) moribund and/or dead fish will be sampled for *R. salmoninarum* (BKD), viruses, and systemic bacteria.

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

The Lookingglass Hatchery manager has authority to release fish in an emergency at Lookingglass Hatchery and Imnaha. Section (5.7.2) describes winter icing conditions that can result in the intake being blocked preventing water flow into the hatchery. In 1987, Imnaha fish were released into Lookingglass Creek due to icing events. Environmental conditions are a concern at Imnaha and may lead to early releases. In the event of an emergency release, the Lookingglass Hatchery manager will notify the ODFW region manager, co-managers, and federal cooperators.

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.

Chinook smolts are acclimated and volitionally released in late March with a forced release in mid-April. Releases coincide with warming water temperatures and increasing river flows. The intent is to reduce the time fish reside in freshwater, therefore, reducing the interactions with naturally-produced Chinook and steelhead.

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.

- Mark all smolts and determine mark rate.
  - (*Indicators: 1a, 1b, 2b, 3a, 4a, 4b, 7a, 27a).*
- Analyze marked fish recovery data collected by others from Columbia, Snake River and other fisheries to determine harvest numbers and rate.
  - *(Indicators: 1a, 1b, 2b, 3a, 24a, 24b, 27a, 27c).*
- Conduct statistically valid creel surveys in the Imnaha system to determine effort and harvest of hatchery fish and incidental handling rate for other fish.
  - *(Indicators: 2a, 3a, 3b, 4a, 5a, 24a, 24b).*
- Monitor smolt release size, numbers, timing, location and smolt movement.
  - *(Indicators: 7a, 13b, 16b, 17a, 23a, 23b, 23c, 25a, 27a, 27b).*
- Monitor adult collection, numbers, status and disposition.
  - *(Indicators: 1a, 1b, 2a, 2b, 2c, 3a, 3b, 10a, 13a, 14a, 14b, 15a, 15b, 18a, 19a, 19b, 20a, 20b, 27c).*
- Monitor survival, growth and performance of hatchery fish in the hatchery and in

nature.

  - *(Indicators: 6a, 27a, 27b, 27c).*

- Determine proportion of hatchery adults in key natural spawning areas and population as a whole via adult mortality recoveries or other methods.
  - *(Indicators: 18a, 20a, 20b, 23c, 27c).*
- Develop genetic profiles for hatchery and natural Chinook populations in the basin and conduct regular monitoring.
  - *(Indicators: 17a, 19a, 19c).*
- Monitor wild fish escapement trend in key natural spawning areas and population as a whole via redd count surveys and adult origin reconstruction via adult mortality recoveries or other methods.
  - *(Indicators: 15a, 18a, 19a, 20a, 20b, 21a, 21b, 23c, 27c).*
- Develop and implement evaluation plans and report findings consistent with needs of the program for adaptive management.
  - *(Indicators: 26a, 26b).*
- Monitor discharge water quality and water withdrawals and report annually on compliance with related permits.
  - *(Indicators: 11a, 22a, 22b, 22c, 22d).*
- Monitor health of adult and juvenile Chinook associated with hatchery production.
  - *(Indicators: 8a, 8b, 9a, 9b, 9c, 10b).*

It is expected that these monitoring activities will provide the basic information needed to evaluate this program and its impact on the natural population (both positive and negative). However, additional data or analyses may be necessary to ensure the following key pieces of information are available to evaluate this program. The key information pieces are:

1. A time series of wild and hatchery spawner escapement estimates for the entire Imnaha population.
2. Distribution of spawners within the watershed that the population occupies.
3. Proportion of hatchery fish, by year, for the entire population.
4. Age composition of spawners, preferably by year, but if not a summary from multiple years that is useable.
5. Estimated annual impact of tributary and downstream fisheries (including mainstem Columbia and ocean as appropriate).
6. Number of wild fish removed for hatchery broodstock and proportion of the hatchery broodstock that are wild fish (i.e. pNOB).
7. Green egg to smolt survival for hatchery program.
8. Smolt to adult survival for hatchery releases.
9. Hatchery strays recovered from other basins based on CWT or PIT recoveries.
10. The size of hatchery smolts relative to wild fish.

11. The timing of the hatchery smolt release versus out-migration timing of the wild smolts.
12. An index on how quickly the hatchery smolts migrate after release and how many of them do not migrate at all (residualize).
13. In addition, information for items 1 through 4 should be collected for the Big Sheep population area to evaluate the present and future impact of the hatchery program on this production area.

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 monitoring and evaluation funding covers most activities listed above. However, further studies and monitoring are needed to improve the Imnaha River Chinook Salmon Hatchery Program, which will require increased funding. Consistent with conservation objectives outlined in section 1.9, it is imperative that we examine methodologies for minimizing effects of the hatchery program. Therefore, our desire is to find ways to improve the hatchery program and our ability to manage it.

Strategies to Minimize Early Age of Maturation – **High Importance**
Age-2 (minijacks) and age-3 (jacks) are consistently more prevalent in hatchery production. Therefore, we propose to evaluate alternative rearing and release strategies to minimize early age at maturation. We plan to test smaller sizes at release (the same as natural smolt size or closer to that size than we have tested in the past) and differing growth profiles (e.g., slowing growth in the fall) to reduce the prevalence of jacks and minijacks.

Genetic Monitoring – **Moderate Importance**
We propose to continue our examination of hatchery supplementation on the genetic composition and diversity of the natural Imnaha River Chinook salmon population. Specifically, we propose to examine genetic samples collected recently with those collected in the early stages of the program to look for trends in allele frequencies over time and divergence in these frequencies between the hatchery and natural salmon.

Spawning Distribution – **Moderate Importance**
Hatchery salmon returning to the Imnaha River tend to spawn in the vicinity of the acclimation site (in the middle and lower reaches of the spawning area), from which they were released, while natural salmon are more likely to spawn in upper reaches of the spawning area. This reduces hybridization between the hatchery and natural salmon and contributes to a divergence in their genetic composition. Therefore, we propose to transport smolts to upper reaches of the Imnaha River for direct release into the river in the expectation that they will imprint on these reaches and return there to spawn, thereby expanding the spawning distribution of the hatchery salmon.

Acclimated vs. Direct Release – **Moderate Importance**
Acclimation of salmon at acclimation sites is an expensive task that is conducted with the expectation that this will increase homing fidelity (thereby reducing straying) and survival. However, preliminary data for the Imnaha River indicates that this may not be the case. Therefore, we propose to test the effectiveness of acclimation by releasing some smolts directly into the Imnaha River, at the acclimation site and comparing their survival, return and straying rates with salmon that are acclimated.

Database Development and Maintenance – **High Importance**
We see the need for a "data steward" within the ODFW LSRCP Program to develop and maintain the databases needed for organizing the data collected while monitoring the LSRCP hatchery programs and supplemented natural populations. These databases will allow us to conduct analyses within specific populations, as well as among LSRCP Chinook salmon populations, and will facilitate the effective compilation and transfer of information to the LSRCP databases. They will also have to be coordinated with those from LSRCP, BPA and NOAA Fisheries, the agencies to which we will submit these data, and be available to all co-management agencies.

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.

- NOAA guidelines will be followed in all electro-fishing activities.
- Experienced surveyors will be utilized to conduct spawning surveys. Surveyors will walk the stream counting redds and observing fish.
- Experienced fish culturists and fish pathologists will perform activities associated with fish production within the hatcheries.
- Experience fish culturists will respond to alarms 24 hours per day 7 days per week.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Research and monitoring have been an integral part of the LSRCP since its inception. The purpose of all past, present or planned research project in these programs is to find ways to improve these and other hatchery programs in order to improve their effectiveness and to increase the numbers of natural salmon returning to these streams. The ongoing LSRCP program research is designed to:

- Document hatchery rearing and release activities and subsequent adult returns.
- Document natural adult abundance and productivity.
- Determine success of the program in meeting mitigation goals and index annual smolt survival and adult returns to Lower Granite Dam.
- Provide management recommendations aimed at improving program effectiveness and efficiency.
- Provide management recommendations aimed at reducing program impacts on listed fish.

12.2) Cooperating and funding agencies.

Lower Snake River Compensation Program
Nez Perce Tribe
Confederated Tribes of the Umatilla Indian Reservation
Bonneville Power Administration

12.3) Principal investigator or project supervisor and staff.

Richard W. Carmichael
Tim Hoffnagle
Joseph Feldhaus
Debra Eddy
Shelby Warren
Nick Albrecht

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

Same as described in Section 2.

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

Monitoring hatchery/wild ratios in natural spawning streams - Adult summer/spring Chinook will be captured and enumerated at the existing Imnaha Facility. See section 2.2.3.

Spawning surveys – In addition to adult trapping, density and hatchery/wild ratio of spawners in selected natural spawning areas will be monitored via observation and carcass recoveries. See section 2.2.3.

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

Research is an ongoing activity.

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

Handling of listed fish will generally be restricted to enumeration, measurement and release at the site of capture. Fish will be held in containers with well-aerated water at temperatures less than 64° F. If handling involves more than determining species and enumeration i.e., measurement, marking or tissue sampling, fish will be anesthetized with MS-222 before the procedure and allowed to recover before release.

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

Monitoring and evaluation will involve take of all types. Injury due to capture, marking and tissue sampling is inevitable. Hooking wounds, electro-fishing injury and other physical damage are generally temporary in nature. Some fish, however, succumb to the effects of such injury. This mortality in addition to occasional direct loss due to capture and handling account for the lethal take estimates that occur during monitoring and evaluation activities.

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 14).

Information is provided in section 2 and Table 14.

12.10) Alternative methods to achieve project objectives.

Unknown, we believe project objectives are best using the methods outlined in this report.

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

Occasionally, we expect to encounter summer steelhead juveniles and bull trout during sampling. However, the number of threatened species encountered is expected to be less than ten juvenile fish per species. Mortality is expected to be low to 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.

- Every effort will be made to insure that steelhead, Chinook, and bull trout sampled during early life history studies will not be significantly injured or killed.
- Every effort will be made to insure that adult trapping facilities do not delay

movement or cause injury to listed fish, including daily trap checks.

SECTION 13. ATTACHMENTS AND CITATIONS

Appendix Table 1. Compilation of performance standards described by the Northwest Power and Conservation Council (NPCC 2001), regional questions for monitoring and evaluation for harvest and supplementation programs, and performance standards and testable assumptions as described by the Ad Hoc Supplementation Work Group (2008).

Category	Standards	Indicators
1. LEGAL MANDATES	1.1. Program contributes to fulfilling tribal trust responsibility mandates and treaty rights, as described in applicable agreements such as under U.S. v. OR and U.S. v. Washington.	1.1.1. Total number of fish harvested in Tribal fisheries targeting this program. 1.1.2. Total fisher days or proportion of harvestable returns taken in Tribal resident fisheries, by fishery. 1.1.3. Tribal acknowledgement regarding fulfillment of tribal treaty rights.
	1.2. Program contributes to mitigation requirements.	1.2.1. Number of fish released by program, returning, or caught , as applicable to given mitigation requirements.
	1.3. Program addresses ESA responsibilities.	1.3.1. Section 7, Section 10, 4d rule and annual consultation
2. IMPLEMENTATION AND COMPLIANCE	2.1. Program contributes to mitigation requirements.	2.1.1. Hatchery is operated as a segregated program. 2.1.2. Hatchery is operated as an integrated program 2.1.3. Hatchery is operated as a conservation program
	2.2. Program addresses ESA responsibilities.	2.2.1. Hatchery fish can be distinguished from natural fish in the hatchery broodstock and among spawners in supplemented or hatchery influenced population(s)
	2.3. Restore and maintain treaty-reserved tribal and non-treaty fisheries.	2.3.1. Hatchery and natural-origin adult returns can be adequately forecasted to guide harvest opportunities. 2.3.2. Hatchery adult returns are produced at a level of abundance adequate to support fisheries in most years with an acceptably limited impact to natural-spawner escapement.
	2.4. Fish for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while avoiding over-harvest of non-target species.	2.4.1. Number of fish release by location estimated and in compliance with AOPs and US vs. OR Management Agreement. 2.4.2. Number if adult returns by release group harvested 2.4.3. Number of non-target species encountered in fisheries for targeted release group.

Category	Standards	Indicators
	2.5. Hatchery incubation, rearing, and release practices are consistent with current best management practices for the program type.	2.5.1. Juvenile rearing densities and growth rates are monitored. and reported. 2.5.2. Numbers of fish per release group are known and reported. 2.5.3. Average size, weight and condition of fish per release group are known and reported. 2.5.4. Date, acclimation period, and release location of each release group are known and reported.
	2.6. Hatchery production, harvest management, and monitoring and evaluation of hatchery production are coordinated among affected co-managers.	2.6.1. Production adheres to plans documents developed by regional co-managers (e.g. US vs. OR Management agreement, AOPs etc.). 2.6.2. Harvest management harvest, harvest sharing agreements, broodstock collection schedules, and disposition of fish trapped at hatcheries in excess of broodstock needs are coordinated among co-management agencies. 2.6.3. Co-managers react adaptively by consensus to monitoring and evaluation results. 2.6.4. Monitoring and evaluation results are reported to co-managers and regionally in a timely fashion.
3. HATCHERY EFFECTIVENESS MONITORING REGIONAL FOR AUGMENTATION AND SUPPLEMENTATION PROGRAMS	3.1. Release groups are marked in a manner consistent with information needs and protocols for monitoring impacts to natural- and hatchery-origin fish at the targeted life stage(s)(e.g. in juvenile migration corridor, in fisheries, etc.).	3.1.1. All hatchery origin fish recognizable by mark or tag and representative known fraction of each release group marked or tagged uniquely. 3.1.2. Number of unique marks recovered per monitoring stratum sufficient to estimate number of unmarked fish from each release group with desired accuracy and precision.
	3.2. The current status and trends of natural origin populations likely to be impacted by hatchery production are monitored.	3.2.1. Abundance of fish by life stage is monitored annually. 3.2.2. Adult to adult or juvenile to adult survivals are estimated. 3.2.3. Temporal and spatial distribution of adult spawners and rearing juveniles in the freshwater spawning and rearing areas are monitored. 3.2.4. Timing of juvenile outmigration from rearing areas and adult returns to spawning areas are monitored. 3.2.5. Ne and patterns of genetic variability are frequently enough to detect changes across generations.
	3.3. Fish for harvest are produced and released in a manner enabling effective harvest, as described in all applicable fisheries management plans, while avoiding over-harvest of non-target species.	3.3.1. Number of fish release by location estimated and in compliance with AOPs and US vs. OR Management Agreement. 3.3.2. Number if adult returns by release group harvested 3.3.3. Number of non-target species encountered in fisheries for targeted release group.

Category	Standards	Indicators
	3.4. Effects of strays from hatchery programs on non-target (unsupplemented and same species) populations remain within acceptable limits.	3.4.1. Strays from a hatchery program (alone, or aggregated with strays from other hatcheries) do not comprise more than 10% of the naturally spawning fish in non-target populations. 3.4.2. Hatchery strays in non-target populations are predominately from in-subbasin releases. 3.4.3. Hatchery strays do not exceed 10% of the abundance of any out-of-basin natural population.
	3.5. Habitat is not a limiting factor for the affected supplemented population at the targeted level of supplementation.	3.5.1. Temporal and spatial trends in habitat capacity relative to spawning and rearing for target population. 3.5.2. Spatial and temporal trends among adult spawners and rearing juvenile fish in the available habitat.
	3.6. Supplementation of natural population with hatchery origin production does not negatively impact the viability of the target population.	3.6.1. Pre- and post-supplementation trends in abundance of fish by life stage is monitored annually. 3.6.2. Pre- and post-supplementation trends in adult to adult or juvenile to adult survivals are estimated. 3.6.3. Temporal and spatial distribution of natural origin and hatchery origin adult spawners and rearing juveniles in the freshwater spawning and rearing areas are monitored. 3.6.4. Timing of juvenile outmigrations from rearing area and adult returns to spawning areas are monitored.
	3.7. Natural production of target population is maintained or enhanced by supplementation.	3.7.1. Adult progeny per parent (P:P) ratios for hatchery-produced fish significantly exceed those of natural-origin fish. 3.7.2. Natural spawning success of hatchery-origin fish must be similar to that of natural-origin fish. 3.7.3. Temporal and spatial distribution of hatchery-origin spawners in nature is similar to that of natural-origin fish. 3.7.4. Productivity of a supplemented population is similar to the natural productivity of the population had it not been supplemented (adjusted for density dependence). 3.7.5. Post-release life stage-specific survival is similar between hatchery and natural-origin population components.

Category	Standards	Indicators
	3.8. Life history characteristics and patterns of genetic diversity and variation within and among natural populations are similar and do not change significantly as a result of hatchery augmentation or supplementation programs.	3.8.1. Adult life history characteristics in supplemented or hatchery influenced populations remain similar to characteristics observed in the natural population prior to hatchery influence. 3.8.2. Juvenile life history characteristics in supplemented or hatchery influenced populations remain similar to characteristics in the natural population those prior to hatchery influence. 3.8.3. Genetic characteristics of the supplemented population remain similar (or improved) to the unsupplemented populations.
	3.9. Operate hatchery programs so that life history characteristics and genetic diversity of hatchery fish mimic natural fish.	3.9.1. Genetic characteristics of hatchery-origin fish are indistinguishable from natural-origin fish. 3.9.2. Life history characteristics of hatchery-origin adult fish are indistinguishable from natural-origin fish. 3.9.3. Juvenile emigration timing and survival differences between hatchery and natural-origin fish must be minimal.
	3.10. The distribution and incidence of diseases, parasites and pathogens in natural populations and hatchery populations are known and releases of hatchery fish are designed to minimize potential spread or amplification of diseases, parasites, or pathogens among natural populations.	3.10. Detectable changes in rate of occurrence and spatial distribution of disease, parasite or pathogen among the affected hatchery and natural populations.
4. OPERATION OF ARTIFICIAL PRODUCTION FACILITIES	4.1. Artificial production facilities are operated in compliance with all applicable fish health guidelines and facility operation standards and protocols such as those described by IHOT, PNFHPC, the Co-Managers of Washington Fish Health Policy, INAD, and MDFWP.	4.1.1. Annual reports indicating level of compliance with applicable standards and criteria. 4.1.2. Periodic audits indicating level of compliance with applicable standards and criteria.
	4.2. Effluent from artificial production facility will not detrimentally affect natural populations.	4.2.1. Discharge water quality compared to applicable water quality standards and guidelines, such as those described or required by NPDES, IHOT, PNFHPC, and Co-Managers of Washington Fish Health Policy tribal water quality plans, including those relating to temperature, nutrient loading, chemicals, etc.
	4.3. Water withdrawals and instream water diversion structures for artificial production facility operation will not prevent access to natural spawning areas, affect spawning behavior of natural populations, or impact juvenile rearing environment.	4.3.1. Water withdrawals compared to applicable passage criteria. 4.3.2. Water withdrawals compared to NMFS, USFWS, and WDFW juvenile screening criteria. 4.3.3. Number of adult fish aggregating and/or spawning immediately below water intake point. 4.3.4. Number of adult fish passing water intake point. 4.3.5. Proportion of diversion of total stream flow between intake and outfall.

Category	Standards	Indicators
	4.4. Releases do not introduce pathogens not already existing in the local populations, and do not significantly increase the levels of existing pathogens.	4.4.1. Certification of juvenile fish health immediately prior to release, including pathogens present and their virulence. 4.4.2. Juvenile densities during artificial rearing. 4.4.3. Samples of natural populations for disease occurrence before and after artificial production releases.
	4.5. Any distribution of carcasses or other products for nutrient enhancement is accomplished in compliance with appropriate disease control regulations and guidelines, including state, tribal, and federal carcass distribution guidelines.	4.5.1. Number and location(s) of carcasses or other products distributed for nutrient enrichment. 4.5.2. Statement of compliance with applicable regulations and guidelines.
	4.6. Adult broodstock collection operation does not significantly alter spatial and temporal distribution of any naturally produced population.	4.6.1. Spatial and temporal spawning distribution of natural population above and below weir/trap, currently and compared to historic distribution.
	4.7. Weir/trap operations do not result in significant stress, injury, or mortality in natural populations.	4.7.1. Mortality rates in trap. 4.7.2. Prespawning mortality rates of trapped fish in hatchery or after release.
	4.8. Predation by artificially produced fish on naturally produced fish does not significantly reduce numbers of natural fish.	4.8.1. Size at, and time of, release of juvenile fish, compared to size and timing of natural fish present. 4.8.2. Number of fish in stomachs of sampled artificially produced fish, with estimate of natural fish composition.
5. SOCIO-ECONOMIC EFFECTIVENESS	5.1. Cost of program operation does not exceed the net economic value of fisheries in dollars per fish for all fisheries targeting this population.	5.1.1. Total cost of program operation. 5.1.2. Sum of ex-vessel value of commercial catch adjusted appropriately, appropriate monetary value of recreational effort, and other fishery related financial benefits.
	5.2. Juvenile production costs are comparable to or less than other regional programs designed for similar objectives.	5.2.1. Total cost of program operation. 5.2.2. Average total cost of activities with similar objectives.
	5.3. Non-monetary societal benefits for which the program is designed are achieved.	5.3.1. Number of adult fish available for tribal ceremonial use. 5.3.2. Recreational fishery angler days, length of seasons, and number of licenses purchased.

Appendix Table 2. Standardized performance measures and definitions for status and trends and hatchery effectiveness monitoring and the associated performance indicator that it addresses. (Taken from Beasley et al. 2008, also consistent with Hesse et al. 2006).

Performance Measure		Definition	Related Indicator
Abundance	Adult Escapement to Tributary	Number of adults (including jacks) that have escaped to a certain point (i.e. - mouth of stream). Population based measure. Calculated with mark recapture methods from weir data adjusted for redds located downstream of weirs and in tributaries, and maximum net upstream approach for DIDSON and underwater video monitoring. Provides total escapement and wild only escapement. [Assumes tributary harvest is accounted for]. Uses TRT population definition where available	2.3.2, 3.1.2, 3.2.1, 3.2.2, 3.2.4, 3.6.1, 3.7.1, 3.7.4, 5.3.1

Performance Measure		Definition	Related Indicator
	Fish per Redd	Number of fish divided by the total number of redds. Applied by: The population estimate at a weir site, minus broodstock and mortalities and harvest, divided by the total number of redds located upstream of the weir.	3.2.1, 3.2.3, 3.2.4, 3.6.3, 3.7.3
	Female Spawner per Redd	Number of female spawners divided by the total number of redds above weir. Applied in 2 ways: 1) The population estimate at a weir site multiplied by the weir derived proportion of females, minus the number of female prespawn mortalities, divided by the total number of redds located upstream of the weir, and 2) DIDSON application calculated as in 1 above but with proportion females from carcass recoveries. Correct for mis-sexed fish at weir for 1 above.	3.2.1, 3.2.3, 3.2.4, 3.6.3, 3.7.3
	Index of Spawner Abundance - redd counts	Counts of redds in spawning areas in index area(s) (trend), extensive areas, and supplemental areas. Reported as redds and/or redds/km.	3.2.3, 3.2.4, 3.6.3, 3.7.3, 4.6.1
	Spawner Abundance	In-river: Estimated number of total spawners on the spawning ground. Calculated as the number of fish that return to an adult monitoring site, minus broodstock removals and weir mortalities and harvest if any, subtracts the number of female prespawning mortalities and expanded for redds located below weirs. Calculated in two ways: 1) total spawner abundance, and 2) wild spawner abundance which multiplies by the proportion of natural origin (wild) fish. Calculations include jack salmon. In-hatchery: Total number of fish actually used in hatchery production. Partitioned by gender and origin.	3.2.1, 3.2.3, 3.2.4, 3.6.3, 3.7.3
	Hatchery Fraction	Percent of fish on the spawning ground that originated from a hatchery. Applied in two ways: 1) Number of hatchery carcasses divided by the total number of known origin carcasses sampled. Uses carcasses above and below weirs, 2) Uses weir data to determine number of fish released above weir and calculate as in 1 above, and 3) Use 2 above and carcasses above and below weir.	2.2.1, 3.1.1, 3.4.1, 3.4.2, 3.4.3, 3.7.2, 3.7.4
	Ocean/Mainstem Harvest	Number of fish caught in ocean and mainstem (tribal, sport, or commercial) by hatchery and natural origin.	1.1.1, 1.1.2, 2.3.1, 2.4.2, 2.6.2, 3.3.2, 3.3.3
	Harvest Abundance in Tributary	Number of fish caught in ocean and mainstem (tribal, sport, or commercial) by hatchery and natural origin.	1.1.1, 1.1.2, 2.3.1, 2.4.2, 2.6.2, 3.3.2, 3.3.3
	Index of Juvenile Abundance (Density)	Parr abundance estimates using underwater survey methodology are made at pre-established transects. Densities (number per 100 m2) are recorded using protocol described in Thurow (1994). Hanken & Reeves estimator.	3.2.1, 3.5.1, 3.5.2
	Juvenile Emigrant Abundance	Gauss software is (Aptech Systems, Maple Valley, Washington) isused to estimate emigration estimates. Estimates are given for parr pre-smolts, smolts and the entire migration year. Calculations are completed using the Bailey Method and bootstrapping for 95% CIs. Gauss program developed by the University of Idaho (Steinhorst 2000).	3.2.1, 3.6.1, 3.7.4

Performance Measure		Definition	Related Indicator
	Smolts	Smolt estimates, which result from juvenile emigrant trapping and PIT tagging, are derived by estimating the proportion of the total juvenile abundance estimate at the tributary comprised of each juvenile life stage (parr, presmolt, smolt) that survive to first mainstem dam. It is calculated by multiplying the life stage specific abundance estimate (with standard error) by the life stage specific survival estimate to first mainstem dam (with standard error). The standard error around the smolt equivalent estimate is calculated using the following formula; where X = life stage specific juvenile abundance estimate and Y = life stage specific juvenile survival estimate: $Var(X \cdot Y)$ $= E(X)^2 \cdot Var(Y) + E(Y)^2 \cdot Var(X) + Var(X) \cdot Var(Y)$	3.2.1, 3.6.1, 3.7.4
	Run Prediction	This will not be in the raw or summarized performance database.	2.3.1

Performance Measure		Definition	Related Indicator
Survival – Productivity	Smolt-to-Adult Return Rate	The number of adult returns from a given brood year returning to a point (stream mouth, weir) divided by the number of smolts that left this point 1-5 years prior. Calculated for wild and hatchery origin conventional and captive brood fish separately. Adult data applied in two ways: 1) SAR estimate to stream using population estimate to stream, 2) adult PIT tag SAR estimate to escapement monitoring site (weirs, LGR), and 3) SAR estimate with harvest. Accounts for all harvest below stream. *Smolt-to-adult return rates* are generated for four performance periods; tributary to tributary, tributary to tributary, tributary to first mainstem dam, first mainstem dam to first mainstem dam, and first mainstem dam to tributary. *First mainstem dam to first mainstem dam S*AR estimates are calculated by dividing the number of PIT tagged adults returning to first mainstem dam by the estimated number of PIT tagged juveniles at first mainstem dam. Variances around the point estimates are calculated as described above. *Tributary to tributary SAR* estimates for natural and hatchery origin fish are calculated using PIT tag technology as well as direct counts of fish returning to the drainage. PIT tag SAR estimates are calculated by dividing the number of PIT tag adults returning to the tributary (by life stage and origin type) by the number of PIT tagged juvenile fish migrating from the tributary (by life stage and origin type). Overall PIT tag SAR estimates for natural fish are then calculated by averaging the individual life stage specific SAR's. Direct counts are calculated by dividing the estimated number of natural and hatchery-origin adults returning to the tributary (by length break-out for natural fish) by the estimated number of natural-origin fish and the known number of hatchery-origin fish leaving the tributary. *Tributary to* first mainstem dam SAR estimates are calculated by dividing the number of PIT tagged adults returning to first mainstem dam by the number of PIT tagged juveniles tagged in the tributary. There is no associated variance around this estimate. The adult detection probabilities at first mainstem dam are near 100 percent. First mainstem dam *to tributary* SAR estimates are calculated by dividing the number of PIT tagged adults returning to the tributary by the estimated number of PIT tagged juveniles at first mainstem dam. The estimated number of PIT tagged juveniles at first mainstem dam is calculated by multiplying lifestage specific survival estimates (with standard errors) by the number of juveniles PIT tagged in the tributary. The variance for the estimated number of PIT tagged juveniles at first mainstem dam is calculated as follows, where X = the number of PIT tagged fish in the tributary and Y = the variance of the lifestage specific survival estimate: $Var(X \cdot Y) = X^2 \cdot Var(Y)$ The variance around the SAR estimate is calculated as follows, where X = the number of adult PIT tagged fish returning to the tributary and Y = the estimated number of juvenile PIT tagged fish at first mainstem dam : $Var\left(\frac{X}{Y}\right) = \left(\frac{EX}{EY}\right)^2 \cdot \left(\frac{Var(Y)}{(EY)^2}\right)$	3.2.1, 3.2.2, 3.7.4

Performance Measure		Definition	Related Indicator
	Progeny-per- Parent Ratio	Adult to adult calculated for naturally spawning fish and hatchery fish separately as the brood year ratio of return adult to parent spawner abundance using data above weir. Two variants calculated: 1) escapement, and 2) spawners.	3.2.1, 3.2.2, 3.7.4
	Recruit/spawner (R/S)(Smolt Equivalents per Redd or female)	Juvenile production to some life stage divided by adult spawner abundance. Derive adult escapement above juvenile trap multiplied by the prespawning mortality estimate. Adjusted for redds above juv. Trap. *Recruit per spawner* estimates, or *juvenile abundance (can be various life stages or locations) per redd/female*, is used to index population productivity, since it represents the quantity of juvenile fish resulting from an average redd (total smolts divided by total redds) or female. Several forms of juvenile life stages are applicable. We utilize two measures: 1) juvenile abundance (parr, presmolt, smolt, total abundance) at the tributary mouth, and 2) smolt abundance at first mainstem dam.	3.2.1, 3.2.2, 3.7.4
	Pre-spawn Mortality	Percent of female adults that die after reaching the spawning grounds but before spawning. Calculated as the proportion of "25% spawned" females among the total number of female carcasses sampled. ("25% spawned" = a female that contains 75% of her egg compliment].	3.2.3, 4.5.1
	Juvenile Survival to first mainstem dam	Life stage survival (parr, presmolt, smolt, subyearling) calculated by CJS Estimate (SURPH) produced by PITPRO 4.8+ (recapture file included), CI estimated as 1.96*SE. Apply survival by life stage to first mainstem dam to estimate of abundance by life stage at the tributary and the sum of those is total smolt abundance surviving to first mainstem dam . Juvenile survival to first mainstem dam = total estimated smolts surviving to first mainstem dam divided by the total estimated juveniles leaving tributary.	3.2.2, 3.6.2, 3.7.5, 3.9.3,
	Juvenile Survival to all Mainstem Dams	*Juvenile survival to first mainstem dam and subsequent Mainstem Dam(s)*, which is estimated using PIT tag technology. Survival by life stage to and through the hydrosystem is possible if enough PIT tags are available from the stream. Using tags from all life stages combined we will calculate (SURPH) the survival to all mainstem dams.	3.2.2, 3.6.2, 3.7.5, 3.9.3,
	Post-release Survival	Post-release survival of natural and hatchery-origin fish are calculated as described above in the performance measure "Survival to first mainstem dam and Mainstem Dams". No additional points of detection (i.e screwtraps) are used to calculate survival estimates.	3.2.2, 3.6.2, 3.7.5, 3.9.3,
Distribution	Adult Spawner Spatial Distribution	Extensive area tributary spawner distribution. Target GPS red locations or reach specific summaries, with information from carcass recoveries to identify hatchery-origin vs. natural-origin spawners across spawning areas within populations.	3.2.3, 3.2.4, 3.6.3, 3.7.3, 4.3.3, 4.6.1
	Stray Rate (percentage)	Estimate of the number and percent of hatchery origin fish on the spawning grounds, as the percent within MPG, and percent out of ESU. Calculated from 1) total known origin carcasses, and 2) uses fish released above weir. Data adjusted for unmarked carcasses above and below weir.	3.4.1, 3.4.2, 3.4.3
	Juvenile Rearing Distribution	Chinook rearing distribution observations are recorded using multiple divers who follow protocol described in Thurow (1994).	

Performance Measure		Definition	Related Indicator
	Disease Frequency	Natural fish mortalities are provided to certified fish health lab for routine disease testing protocols. Hatcheries routinely samples fish for disease and will defer to then for sampling numbers and periodicity	3.10, 4.4.3
Genetic	Genetic Diversity	Indices of genetic diversity – measured within a tributary) heterozygosity – allozymes, microsatellites), or among tributaries across population aggregates (e.g., FST).	3.2.5, 3.8.3, 3.9.1
	Reproductive Success (Nb/N)	Derived measure: determining hatchery:wild proportions, effective population size is modeled.	3.7.2
	Relative Reproductive Success (Parentage)	Derived measure: the relative production of offspring by a particular genotype. Parentage analyses using multilocus genotypes are used to assess reproductive success, mating patterns, kinship, and fitness in natural populations and are gaining widespread use of with the development of highly polymorphic molecular markers.	3.2.1, 3.2.2, 3.2.4, 3.6.1, 3.7.1, 3.7.2 3.7.4, 5.3.1
	Effective Population Size (Ne)	Derived measure: the number of breeding individuals in an idealized population that would show the same amount of dispersion of allele frequencies under random genetic drift or the same amount of inbreeding as the population under consideration.	3.2.5
Life History	Age Structure	Proportion of escapement composed of adult individuals of different brood years. Calculated for wild and hatchery origin conventional and captive brood adult returns. Accessed via scale method, dorsal fin ray ageing, or mark recoveries. Juvenile Age is determined by brood year (year when eggs are placed in the gravel) Then Age is determined by life stage of that year. Methods to age Chinook captured in screwtrap are by dates; fry – prior to July 1; parr – July 1-August 31; presmolt – September 1 – December 31; smolt – January 1 – June 30; yearlings – July 1 – with no migration until following spring. The age class structure of juveniles is determined using length frequency breakouts for natural-origin fish. Scales have been collected from natural-origin juveniles, however, analysis of the scales have never been completed. The age of hatchery-origin fish is determined through a VIE marking program which identifies fish by brood year. For steelhead we attempt to use length frequency but typically age of juvenile steelhead is not calculated.	3.8.1, 3.8.2, 3.9.2
	Age–at–Return	Age distribution of spawners on spawning ground. Calculated for wild and hatchery conventional and captive brood adult returns. Accessed via scale method, dorsal fin ray ageing, or mark recoveries.	3.8.1, 3.8.2, 3.9.2
	Age–at-Emigration	Juvenile Age is determined by brood year (year when eggs are placed in the gravel) Then Age is determined by life stage of that year. Methods to age Chinook captured in screwtrap are by dates; fry – prior to July 1; parr – July 1-August 31; presmolt – September 1 – December 31; smolt – January 1 – June 30; yearlings – July 1 – with no migration until following spring. The age class structure of juveniles is determined using length frequency breakouts for natural-origin fish. Scales have been collected from natural-origin juveniles, however, analysis of the scales have never been completed. The age of hatchery-origin fish is determined through a VIE marking program which identifies fish by brood year. For steelhead we attempt to use length frequency but typically age of juvenile steelhead is not calculated.	3.8.1, 3.8.2, 3.9.2

Performance Measure		Definition	Related Indicator
	Size-at-Return	Size distribution of spawners using fork length and mid-eye hypural length. Raw database measure only.	3.8.1, 3.9.2
	Size-at-Emigration	Fork length (mm) and weight (g) are representatively collected weekly from natural juveniles captured in emigration traps. Mean fork length and variance for all samples within a lifestage-specific emigration period are generated (mean length by week then averaged by lifestage). For entire juvenile abundance leaving a weighted mean (by lifestage) is calculated. Size-at-emigration for hatchery production is generated from pre release sampling of juveniles at the hatchery.	3.8.2, 3.9.2
	Condition of Juveniles at Emigration	Condition factor by life stage of juveniles is generated using the formula: $K = (w/l^3)(10^4)$ where K is the condition factor, w is the weight in grams (g), and l is the length in millimeters (Everhart and Youngs 1992).	3.8.2, 3.9.2
	Percent Females (adults)	The percentage of females in the spawning population. Calculated using 1) weir data, 2) total known origin carcass recoveries, and 3) weir data and unmarked carcasses above and below weir. Calculated for wild, hatchery, and total fish.	3.8.1, 3.9.2
	Adult Run-timing	Arrival timing of adults at adult monitoring sites (weir, DIDSON, video) calculated as range, 10%, median, 90% percentiles. Calculated for wild and hatchery origin fish separately, and total.	3.2.4, 3.6.4, 3.8.1, 3.9.2
	Spawn-timing	This will be a raw database measure only.	3.2.4, 3.6.4, 3.8.1, 3.9.2
	Juvenile Emigration Timing	Juvenile emigration timing is characterized by individual life stages at the rotary screw trap and Lower Granite Dam. Emigration timing at the rotary screw trap is expressed as the percent of total abundance over time while the median, 0%, 10, 50%, 90% and 100% detection dates are calculated for fish at first mainstem dam.	3.2.4, 3.6.4, 3.8.2, 3.9.2, 3.9.3, 4.8.1
	Mainstem Arrival Timing (Lower Granite)	Unique detections of juvenile PIT-tagged fish at first mainstem dam are used to estimate migration timing for natural and hatchery origin tag groups by lifestage. The actual Median, 0, 10%, 50%, 90% and 100% detection dates are reported for each tag group. Weighted detection dates are also calculated by multiplying unique PIT tag detection by a life stage specific correction factor (number fish PIT tagged by lifestage divided by tributary abundance estimate by lifestage). Daily products are added and rounded to the nearest integer to determine weighted median, 0%, 50%, 90% and 100% detection dates.	3.2.4, 3.6.4, 3.8.2, 3.9.2, 3.9.3, 4.8.1
Habitat	Physical Habitat	TBD	
	Stream Network	TBD	
	Passage Barriers/Diversions	TBD	
	Instream Flow	USGS gauges and also staff gauges	
	Water Temperature	Various, mainly Hobo and other temp loggers at screw trap sights and spread out throughout the streams	
	Chemical Water Quality	TBD	
	Macroinvertebrate Assemblage	TBD	

	Performance Measure	Definition	Related Indicator
	Fish and Amphibian Assemblage	Observations through rotary screwtrap catch and while conducting snorkel surveys.	2.4.3, 3.3.3, 3.4.1
In-Hatchery Measures	Hatchery Production Abundance	The number of hatchery juveniles of one cohort released into the receiving stream per year. Derived from census count minus prerelease mortalities or from sample fish- per-pound calculations minus mortalities. Method dependent upon marking program (census obtained when 100% are marked).	2.5.2, 2.5.3, 2.6.1, 4.4.2
	In-hatchery Life Stage Survival	In-hatchery survival is calculated during early life history stages of hatchery-origin juvenile Chinook. Enumeration of individual female's live and dead eggs occurs when the eggs are picked. These numbers create the inventory with subsequent mortality subtracted. This inventory can be changed to the physical count of fish obtained during CWT or VIE tagging. These physical fish counts are the most accurate inventory method available. The inventory is checked throughout the year using 'fish-per-pound' counts. Estimated survival of various in-hatchery juvenile stages (green egg to eyed egg, eyed egg to ponded fry, fry to parr, parr to smolt and overall green egg to release) Derived from census count minus prerelease mortalities or from sample fish- per-pound calculations minus mortalities. Life stage at release varies (smolt, premolt, parr, etc.).	2.5.1, 2.5.2, 2.5.3, 2.5.4
	Size-at-Release	Mean fork length measured in millimeters and mean weight measured in grams of a hatchery release group. Measured during prerelease sampling. Sample size determined by individual facility and M&E staff. Life stage at release varies (smolt, premolt, parr, etc.).	2.5.1, 2.5.3
	Juvenile Condition Factor	Condition Factor (K) relating length to weight expressed as a ratio. Condition factor by life stage of juveniles is generated using the formula: $K = (w/l^3)(10^4)$ where K is the condition factor, w is the weight in grams (g), and l is the length in millimeters (Everhart and Youngs 1992).	2.5.3,3.8.2, 3.9.2
	Fecundity by Age	The reproductive potential of an individual female. Estimated as the number of eggs in the ovaries of the individual female. Measured as the number of eggs per female calculated by weight or enumerated by egg counter.	3.8.1, 3.8.2, 3.9.2
	Spawn Timing	Spawn date of broodstock spawners by age, sex and origin, Also reported as cumulative timing and median dates.	3.2.4, 3.6.4, 3.8.1, 3.9.2
	Hatchery Broodstock Fraction	Percent of hatchery broodstock actually used to spawn the next generation of hatchery F1s. Does not include prespawn mortality.	2.2.1
	Hatchery Broodstock Prespawn Mortality	Percent of adults that die while retained in the hatchery, but before spawning.	4.7.2
	Female Spawner ELISA Values	Screening procedure for diagnosis and detection of BKD in adult female ovarian fluids. The enzyme linked immunosorbent assay (ELISA) detects antigen of *R. salmoninarum.*	3.10, 4.4.3
	In-Hatchery Juvenile Disease Monitoring	Screening procedure for bacterial, viral and other diseases common to juvenile salmonids. Gill/skin/ kidney /spleen/skin/blood culture smears conducted monthly on 10 mortalities per stock	3.10, 4.4.3
	Length of Broodstock Spawner	Mean fork length by age measured in millimeters of male and female broodstock spawners. Measured at spawning and/or at weir collection. Is used in conjunction with scale reading for aging.	3.9.2

Performance Measure		Definition	Related Indicator
	Prerelease Mark Retention	Percentage of a hatchery group that have retained a mark up until release from the hatchery. Estimated from a sample of fish visually calculated as either “present” or “absent”	3.1.1, 3.1.2
	Prerelease Tag Retention	Percentage of a hatchery group that have retained a tag up until release from the hatchery - estimated from a sample of fish passed as either “present” or “absent”. (“Marks” refer to adipose fin clips or VIE batch marks).	3.1.1, 3.1.2
	Hatchery Release Timing	Date and time of volitional or forced departure from the hatchery. Normally determined through PIT tag detections at facility exit (not all programs monitor volitional releases).	2.5.4, 4.8.1
	Chemical Water Quality	Hatchery operational measures included: dissolved oxygen (DO) - measured with DO meters, continuously at the hatchery, and manually 3 times daily at acclimation facilities; ammonia (NH_3) nitrite (NO_2), -measured weekly only at reuse facilities (Kooskia Fish Hatchery).	4.2.1
	Water Temperature	Hatchery operational measure (Celsius) - measured continuously at the hatchery with thermographs and 3 times daily at acclimation facilities with hand-held devices.	

Appendix Table 3. Summary of recommended disinfectants (concentration and time) and application.

Disinfectant*	Application	Concentration	Time	Comments
Iodophor	Nets, gear and equipment, clipping & tagging van, PIT tag stations, large tub disinfectant containers, spawning colanders and buckets, lib truck, footbaths, floors Note: For raceway sanitization**- thoroughly clean the unit to remove dirt, spray or brush on 75-100 ppm iodophor and let this remain for a minimum of 3 days. Allow iodophor to dry and break down with exposure to light.	100 ppm Note: to make 100 ppm solution mix 6.7 oz of jug strength iodophor to 5 gallons H_2O or 6.7 oz.=189ml.	10 min.	-Equipment should be pre-rinsed to remove dirt, mucus or other organic material which reduces the efficacy of disinfectant. -Rinse equipment to remove harmful residue if equipment is going into standing water containing fish or fish are being placed into the equipment (tank or bucket). -Argentyne or other buffered iodophors such as Western Chemicals “PVP iodine” would be acceptable.

Disinfectant*	Application	Concentration	Time	Comments
	**If the above recommendation cannot be done then sanitize raceways by thoroughly cleaning them and leaving to dry for a minimum of three days. Water hardening eggs Egg transfers- dis-Infection at receiving station	100 ppm 100 ppm	Minimum 15 minutes 10 minutes	This is the statewide general practice. Usually applies to Captive Broodstock eggs received
Isopropyl Alcohol	PIT tag needles and any other apparatus used to insert into fish.	70%	10 min. Note: Air dry	-No re-use until air dried -use drying oven to enhance air drying step.
Virkon Aquatic Disinfectant and Virucide	Footbaths.	1% solution .Equivalent to 9.75% Chlorine	7 day solution	For use in cleaning and disinfecting environmental surfaces associated with aquaculture. Breaks down into a neutral salt.
Chlorine or Aqueous solution as sodium hypochlorite (Household Bleach).	Lib truck tanks, raceways Raceway disinfection	100 ppm 100 ppm	10 min.	Organic matter binds and neutralizes. Left to dry and breakdown in sunlight. Assure that no bleach goes to effluent.

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

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

Name, Title, and Signature of Applicant:

Certified by: , ODFW NE Region Hatchery Coordinator
Date: April 29, 2011

SECTION 15. PROGRAM EFFECTS ON OTHER (NON-ANADROMOUS SALMONID) ESA-LISTED POPULATIONS. Species List Attached (Anadromous salmonid effects are addressed in Section 2)

15.1) List all ESA permits or authorizations for all non-anadromous salmonid programs associated with the hatchery program.

Activities associated with the operation of this Imnaha Chinook hatchery program as they affect bull trout are authorized under the Operation of the Lower Snake River Compensation Plan Program Biological Opinion (file # 1024.0000, 1-4-99-F-2) issued by the U. S. Fish and Wildlife Service's Snake River Basin Office, Boise, Idaho, April 8, 1999.

15.2) Description of non-anadromous salmonid species and habitat that may be affected by hatchery program.

Bull trout – Both fluvial and resident life history forms of bull trout inhabit the Imnaha River and a number of tributaries. Bull trout utilize suitable habitat within the Imnaha River including mainstem Imnaha River, its' North and South forks and the lower reaches of several smaller tributaries to the upper Imnaha system, Big Sheep Creek and tributary Lick Creek and Little Sheep Creek and several of its' small tributaries. Fluvial adults migrate into headwater areas during summer and early fall after over-wintering in mainstem tributaries and the Snake River. Spawning for both resident and fluvial adults occurs in September and October. Fry emerge during the spring. Juvenile rearing is restricted to headwater areas where water remains cooler above approximately river kilometer 67 on the Imnaha and river kilometer 40 on Big Sheep and Little Sheep creeks.

The bull trout population in the Imnaha River appears reasonably robust based on recent spawning inventory. Spawning counts on the Imnaha River accounted for nearly 400 redds in 2001. Habitat conditions vary widely across the basin and affect bull trout productivity in some areas. As a result, the basin's bull trout population(s) vary from areas of relative strength in wilderness streams (mainstem Imnaha River and upper Big Sheep Creek) to areas where bull trout are less productive (Little Sheep Creek and middle reaches of Big Sheep Creek). Two-pass electrofishing density estimates in Big Sheep, Lick, Salt and Little Sheep creeks were conducted in 1992. That work suggested moderate to high densities of rearing bull trout in streams except Little Sheep Creek. No bull trout were collected from sample reaches of Little Sheep Creek. Densities ranged from 5.6 to 15.8 (1+ and older) fish per $100m^2$ within sample sections containing bull trout in the other Imnaha tributaries, in addition to varying densities of 0-age bull trout (Smith and Knox, 1992).

15.3) Analysis of effects.

The only identified direct effect of the hatchery operation on bull trout is trapping migrant fluvial fish in the adult Chinook trap at the Imnaha River Facility. The trap is operated June through September. Number of fish trapped annually ranges from 0 to 20. Fish are held a maximum of four days, handled and passed upstream.

Hatchery operations - Water withdrawal for Chinook smolt acclimation occurs in the late winter and spring at a time when stream flow is moderate. Facility maintenance such as intake excavation, occurs in the summer months, if necessary, when water temperatures preclude the presence of bull trout.

Fish health –See section 3.5 and 7.7.

Ecological/biological - Releases of smolts and juveniles occur downstream of most bull trout rearing areas minimizing potential competition and predation. Releases of listed hatchery steelhead may however provide substantial forage for larger fluvial bull trout over-wintering in the lower reaches of the system (see section 3.5).

Predation/competition – A small percentage of residual steelhead smolts have been found to migrate upstream in Big Sheep and Little Sheep creeks over 35 km in to reside at low densities in the lower reaches of bull trout rearing distribution (Whitesel, et. al., 1993). Some limited predation of and competition with smaller bull trout may occur in this overlap zone.

Monitoring and evaluations - see section 12.11.

Habitat - The Little Sheep Creek facility does not affect juvenile/resident bull trout rearing habitat. Migratory behavior of fluvial bull trout is, however, disrupted briefly as they encounter the adult steelhead trap during its operation.

15.4) Actions taken to mitigate for potential effects.

- Smolts are released at a time and size designed to optimize the percentage migrating out of the system and minimize interaction with bull trout.
- Bull trout handled at the adult trap are sorted and released immediately upstream.

15.5) References

Smith, B. and W. Knox. 1992. Report of findings, bull trout density sampling. Unpublished report, Oregon Department of Fish and Wildlife, Wallowa Fish District, Enterprise, Oregon.

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