

HATCHERY AND GENETIC MANAGEMENT PLAN (HGMP)

Hatchery Program: Lookingglass Creek Spring Chinook Program

**Species or
Hatchery Stock:** Spring Chinook (Stock # 81)

Agency/Operator: Oregon Department of Fish and Wildlife

Watershed and Region: Grande Ronde / Snake River / Columbia
Basin / Oregon

Date Submitted: March 2010

Date Last Updated: September 2011

SECTION 1. GENERAL PROGRAM DESCRIPTION

1.1) Name of hatchery or program.

Lookingglass Hatchery, Lookingglass Creek Spring/Summer Chinook Program.

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

Grande Ronde River Basin spring/summer Chinook salmon (*Oncorhynchus tshawytscha*)

ESA status: The Snake River spring/summer-run Chinook Evolutionary Significant Unit (ESU) is listed as Threatened under the Federal Endangered Species Act (ESA). The Lookingglass Hatchery population of Chinook salmon (reintroduction) is considered part of the Snake River Chinook ESU and listed under the ESA effective from September 29, 2006.

Lookingglass Creek Population (Stock 081)

1.3) Responsible organization and individuals.

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

1. U. S. Fish and Wildlife Service – provides funding and oversight of the Lower Snake River Compensation Plan Program (LSRCP).
2. Confederated Tribes of the Umatilla Indian Reservation (CTUIR) – Co-managers and operators of acclimation and adult collection facilities. Responsible for evaluating Lookingglass spring Chinook reintroduction program.
3. Nez Perce Tribe (NPT) – Co-managers - Operators of acclimation and adult

- collection facilities.
4. NOAA – ESA permitting.
 5. Bonneville Power Administration (BPA) – Funding for acclimation and adult collection, and captive broodstock maintenance propagation.

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

The U.S. Army Corps of Engineers funded initial planning, construction and operation of Lookingglass Hatchery. Currently, the US Fish and Wildlife Service (LSRCP) funds operation and maintenance expenditures at Lookingglass Hatchery through an agreement with BPA. NPT, CTUIR, and the Oregon Department of Fish and Wildlife (ODFW) are co-managers of the Grande Ronde River spring Chinook salmon program.

The funding sources for the program are described below in two components: Lower Snake River Compensation Plan and BPA Endemic Program.

LSRCP - The program is part of the federally mandated LSRCP mitigation program funded through the US Fish and Wildlife Service and designed to mitigate for fish losses due to construction and operation of the Lower Snake River dams. The LSRCP spring/summer Chinook program in Northeast Oregon includes Lookingglass Hatchery, integrated with the Grande Ronde Basin Chinook program and Imnaha Basin program. A Hatchery Coordinator, Hatchery Manager, Fish and Wildlife Supervisor, four hatchery technicians, one three-month technician shared with Wallowa Hatchery, one Facilities Operations Specialist, and 2 seasonal laborers constitute the staffing at Lookingglass Hatchery. Annual operation and maintenance costs for the Lookingglass Creek spring/summer Chinook program for FY 2012 are estimated to be \$170,000.

The LSRCP also funds the CTUIR monitoring and evaluation program in Lookingglass Creek.

Endemic Program (Conventional Broodstock) - This portion of the program is directed to supplement Grande Ronde Chinook with stocks indigenous to the basin.

BPA funds CTUIR to operate the Catherine Creek adult collection facilities. Combined program staff is three full time and four seasonal CTUIR employees.

BPA funds ODFW to integrate tribal and ODFW operations at Lookingglass Hatchery to limit duplication. Annual operation and maintenance costs are estimated at \$212,000.

Captive Broodstock was a conservation measure in response to severely declining abundance of Chinook salmon in the Grande Ronde Basin. This program was initiated in 1995 using smolts collected from the 1994 cohort. Smolts were reared to maturity, spawned, and the eggs incorporated into the LSRCP program. The Catherine Creek portion was discontinued with brood year 2005. Production from this program not needed in Catherine Creek is available to meet production shortfalls in the Lookingglass Creek program.

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

Lookingglass Hatchery - Lookingglass Hatchery is located 19 miles north of the town of Elgin, Oregon, adjacent to Lookingglass Creek (ODFW watershed code 080440000) and 2.2 miles above its confluence with the Grande Ronde River at about river mile (RM) 86. Elevation at the hatchery is 2,550 feet above sea level at latitude 45° 43' 55" N (45.73194) and longitude 117° 51' 45" W (117.8625). Activities at this hatchery facility include brood collection, spawning, egg incubation, rearing, and release into Lookingglass Creek. Juveniles are transferred to Irrigon Hatchery in late April for further rearing and marking before they are returned to Lookingglass Hatchery in late September or early October, for final rearing and release into Lookingglass Creek in the following year.

Irrigon Hatchery - Irrigon hatchery is located along the Columbia River above John Day Dam 3 miles west of Irrigon, Oregon. The facility is at an elevation of 277 feet above sea level, at a latitude 45° 54' 33" N (45.9090) and longitude 119° 32' 39" W (119.5453). Activities at Irrigon Hatchery include juvenile rearing and fish marking. The fish are then returned to Lookingglass Hatchery for additional rearing and release into Lookingglass Creek.

Catherine Creek Adult Collection Facility - The Catherine Creek Adult Collection Facility is located at RM 20 of Catherine Creek.

1.6) Type of program.

Integrated Recovery - The Lookingglass Creek stock component of the Grande Ronde propagation project uses locally adapted stock in an integrated recovery program intended to restore naturally spawning Chinook in Lookingglass Creek upstream of Lookingglass Hatchery, and to provide harvest.

The Lookingglass Creek spring/summer Chinook salmon (ODFW stock ID 081) propagation program is funded through LSRCP and managed to contribute to adult return objectives of LSRCP, meet U.S. v. Oregon production objectives, support tributary harvest and contribute to restoration and sustainability of the natural population. The program contributes to sport, commercial, and tribal harvest opportunities in the mainstem Columbia and Snake rivers and Lookingglass Creek.

1.7) Purpose (Goal) of program.

The goal of the Lookingglass Creek spring Chinook hatchery program is to reintroduce spring Chinook into Lookingglass Creek using the Catherine Creek stock to support tributary harvest, natural population restoration, and maintenance of a gene bank for the Catherine Creek stock.

Program specific goals for the Lookingglass Creek program include:

- a. Restore and maintain viable naturally spawning population of Chinook salmon in Lookingglass Creek.
- b. Contribute to recreational, commercial and tribal fisheries in the mainstem Columbia River consistent with agreed upon abundance based harvest rate schedules established in the 2008 – 2017 U.S. vs. Oregon Management Agreement.
- c. Establish an adequate broodstock population to meet annual production goals.
- d. Establish a consistent total return of Chinook salmon that meets the LSRCP mitigation goal. There are no LSRCP or Tribal Recovery Plan (TRP) hatchery and natural adult return goals identified specifically for Lookingglass Creek. However, the LSRCP does have a specific spring/summer Chinook goal of 58,700 hatchery adults for the Snake River and 5,820 hatchery adults into the Grande Ronde Basin. The TRP return goal for the Grande Ronde Basin is 16,000 adults.
- e. Re-establish historic tribal and recreational fisheries.
- f. Minimize impacts of hatchery programs on other indigenous species.
- g. Operate the hatchery program so that the genetic and life history characteristics of hatchery fish mimic those of natural fish, while achieving mitigation goals.

This program is part of the Lower Snake River Compensation Plan, which purpose is to replace adult salmon, steelhead and rainbow trout lost by the 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 a 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 be 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 (Table 1). 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.

Table 1. Lower Snake River Compensation Plan goals for escapement and harvest of spring/summer Chinook salmon.

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 needing to be 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.
- The *U.S. v. Oregon* court stipulated Columbia River Fish 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.

1.8) Justification for the program.

Lookingglass Creek is co-managed by ODFW, the CTUIR, and the NPT. Historically, spring Chinook salmon abundance in Lookingglass Creek exceeded 1,000 adults based on redd count data from the 1950’s-1970’s. These abundant runs supported tribal and recreational fisheries. The original wild stock of Chinook salmon in Lookingglass Creek, however, is considered extinct. The focus of the current hatchery production effort for Lookingglass Creek is to reintroduce and reestablish a naturally spawning population using the Catherine Creek stock (201) from captive brood hatchery production released into Lookingglass Creek and surplus Catherine Creek conventional adults that returned to Catherine Creek.

The Lookingglass Creek spring/summer Chinook salmon (ODFW stock ID 081) propagation program is funded through LSRCP. The LSRCP is a congressionally mandated program pursuant to PL 99-662. The goals of the LSRCP program are to provide adult Chinook for recreational and tribal harvest within the LSRCP mitigation

area (Snake River and tributaries above Ice Harbor Dam) and the Columbia River, as well as provide for hatchery broodstock. The co-manager goal is to manage a reintroduced population of spring Chinook in Lookingglass Creek as a separate natural, integrated-hatchery population relative to other populations of spring Chinook in the Grande Ronde River.

The Lookingglass Creek spring/summer Chinook propagation program is managed to contribute to adult return objectives of the LSRCP, meet U.S. v. Oregon production objectives, support tributary harvest and contribute to restoration and sustainability of the natural population. The program contributes to sport, commercial, and tribal harvest opportunities in the mainstem Columbia and Snake Rivers and Lookingglass Creek.

Managers have identified both harvest and reintroduction objectives for Lookingglass Creek spring Chinook. The managers' intent is to develop this hatchery program to provide (1) spawners to meet broodstock needs; (2) adults to escape to the habitat upstream of the hatchery; and (3) harvest opportunities.

Program overview: The Lookingglass Creek spring Chinook program currently operates as a reintroduction program to restore spring Chinook to Lookingglass Creek. The native population of spring Chinook in Lookingglass Creek is considered extirpated. In 2001, co-managers selected spring Chinook from Catherine Creek as the appropriate stock for reintroduction into Lookingglass Creek. Juvenile spring Chinook from the Catherine Creek hatchery program (see below) were first released into Lookingglass Creek in 2001 and adult spring Chinook from Catherine Creek were first released in 2004. The program is intended to ultimately operate as an integrated-harvest program with both hatchery and natural origin adults returning to Lookingglass Creek used for broodstock. The long-term goal of the program is to support harvests of spring Chinook within the Grande Ronde River watershed and contribute to the LSRCP mitigation goal of returning 5,860 hatchery-origin adult spring/summer Chinook from the Grande Ronde River basin to upstream of Lower Granite Dam. A directed harvest in Lookingglass Creek is allowed per a sliding scale management scheme documented in the ODFW FMEP and CTUIR TRMP (ODFW 2011; CTUIR 2011). The broodstock goal is to annually collect 158 adult spring Chinook (79 females and 79 males) to yield approximately 286,000 green eggs and 250,000 yearling smolts for release into Lookingglass Creek. A maximum of 250,000 juvenile spring Chinook are reared at Lookingglass Hatchery and up to 250,000 juveniles may be transferred and reared at Irrigon Fish Hatchery. The goal for broodstock composition is to incorporate 30% natural origin adults to maintain genetic diversity and counteract the potential for domestication selection in the program. In addition, no more than 25% of the returning natural origin adults shall be retained for brood. The broodstock collection schedule is adjusted annually based on preseason run projections.

1.9) List of program “Performance Standards”.

As part of the “Artificial Production Review”, the Northwest Power and Conservation Council (NPCC) (2001) identified performance standards and indicators in several

categories for evaluating the effectiveness of hatchery programs and the risks they pose to associated natural populations. The categories are as follows: 1) legal mandates, 2) harvest, 3) conservation of wild/naturally produced spawning populations, 4) life history characteristics, 5) genetic characteristics, 6) quality of research activities, 7) artificial production facilities operations, and 8) socio-economic effectiveness.

In a report prepared for Northwest Power and Conservation Council, the Independent Scientific Review Panel (ISRP) and the Independent Scientific Advisory Board (ISAB) reviewed the nature of the demographic, genetic and ecological risks that could be associated with supplementation, and concluded that the current information available was insufficient to provide an adequate assessment of the magnitude of these effects under alternative management scenarios (ISRP and ISAB 2005). The ISRP and ISAB recommended that an interagency working group be formed to produce a design(s) for an evaluation of hatchery supplementation applicable at a basin-wide scale. Following on this recommendation, the *Ad Hoc* Supplementation Workgroup (AHSWG) was created and produced a document (Beasley et al. 2008) that describes a framework for integrated hatchery research, monitoring, and evaluation to be evaluated at a basin-wide ESU scale.

Included below are 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).

Because the recovery plan for the Grande Ronde/Imnaha MPG does not require the Lookingglass population to achieve full viable status, the following indicators and performance standards are advisory and not requirements.

Legal Mandates – Program contribute to federal tribal trust responsibilities by providing adult spring/summer Chinook within the LSRCP mitigation area while minimizing adverse impacts to listed fish. 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. Program addresses ESA responsibilities.

Performance Standard (1): Grande Ronde 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 Lookingglass Creek wild Chinook harvested in tribal fisheries by run year.

Indicator 1(c): Number of hatchery Chinook smolts released each year in Lookingglass Creek.

Performance Standard (2): Program contributes to annual mitigation goals of LSRCP

Indicator 2(a): Estimated total return to compensation area.

Indicator 2(b): Estimated annual harvest in LSRCP mitigation areas and annual escapement to the hatchery facility.

Indicator 2(c): Estimated number of recreational angler days in the Chinook fishery by run year.

Harvest

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 natural fish, by fishery.

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 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.

Hatchery Performance

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

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

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

Indicator 7(a): Scientifically based monitoring and 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.

Indicator 9 (d): Results of adult fish health monitoring at Lookingglass Hatchery and in streams.

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.

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

Indicator 11(a): Monitor effluent water qualities as per NPDES permit requirements.

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

Performance Standard (12): Juvenile production costs are comparable 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 broodstock.

Indicator 13(b): Number of smolts released produces equivalent adults (R:S ratio).

Indicator 13(c): Returning adults do not stray into non-target spawning areas above an acceptable rate (5%).

Conservation Objectives - Conserve genetic and life history diversity of spring Chinook within the Grande Ronde River Basin 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 natural spring Chinook retained for broodstock is consistent with weir management guidelines in Table 2.

Indicator 14(b): Percentage of natural-origin fish returning to the facility taken for broodstock is consistent with weir management guidelines in Table 2.

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.

Indicator 15(c): Adult trap does not hinder upstream migration of adults.

Performance Standard (16): Juveniles are released after sufficient acclimation in Lookingglass Hatchery to reduce handling stress and to maximize homing.

Indicator 16(a): After return from Irrigon Hatchery, smolts are acclimated at Lookingglass Hatchery for 2-6 weeks prior to release.

Indicator 16(b): The number of marked spring Chinook returning to the Grande Ronde facilities is equal to or greater than 95% of reported escapement (i.e., < 5% straying).

Performance Standard (17): Patterns of genetic variation within and among natural-

origin spring Chinook populations do not diverge as a result of artificial production programs.

Indicator 17(a): Compare genetic profiles and divergence of naturally produced adults from indicator areas within the Grande Ronde Basin over time.

Performance Standard (18): Escapement of hatchery produced adults above the weir is consistent with weir management guidelines in Table 2.

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): Percentage of natural-origin fish in the broodstock comprises at least 30% of the hatchery broodstock.

Indicator 19(a): Percentage of natural-origin fish in the broodstock is consistent with the weir management guidelines in Table 2.

Indicator 19(b): Timing of hatchery adult returns to the collection facilities and spawn timing mimic natural-origin Chinook returns.

Indicator 19(c): Genetic profile of natural-origin and hatchery Chinook in Grande Ronde Basin does not significantly diverge.

Indicator 19(d): Size and age composition of returning adults is consistent with natural-origin run.

Performance Standard (20): Broodstock collection does not significantly alter spatial and temporal distribution of naturally spawning spring 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 Chinook are captured and sorted by gender, 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) standardized for spawner density effects 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 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 quick smolt emigration.

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

Indicator 23(c): Releases of excess parr and adults are made to outlet streams.

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): In stream flow between hatchery facility intake and out-fall are maintained in all facilities.

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 experimental objectives and evaluating the beneficial and adverse affects 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.

We modified the set of management objectives from Beasley et al. (2008) for use as performance measures for the program. These performance measures, and the assumptions that need to be tested for each standard, are listed below (Table 2).

Table 2. Standardized performance measures and definitions for status and trends and monitoring of hatchery effectiveness (modified from Beasley et al. 2008). Note: Performance Standard Indicators 7a and 26a, related to monitoring and evaluation, are appropriate for each Performance Measure.

Performance Measure		Definition	Performance Standard Indicators
Abundance	Adult Escapement to Tributary	Number of adults (including jacks) that have escaped to a certain point (e.g., 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.	2a, b 3a
	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.	18a 20a 26b
	Female Spawners 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 prespawm female 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.	18a 20a
	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.	18a 20a 22c
	Population Level Spawner Abundance	In-river: Estimated total number of spawners on the spawning ground. Calculated as the number of fish that return to an adult monitoring site, minus broodstock removals, weir mortalities, harvest, number of 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 fish. Calculations include jack salmon. In-hatchery: Total number of fish actually used in hatchery production. Partitioned by gender and origin.	18a 20a 21a 22c 26b
Abundance	Population Level 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 calculated as in 1 above, and 3) Use 2 above and carcasses above and below weir.	14a, b 15a, b 18a 19a 20a, b 22c 27a
	Harvest Abundance in Tributary	Number of fish caught in tributary fisheries (tribal, sport, or commercial), identified as to-origin - hatchery or natural.	1a, b 2b
	Run Prediction	Predicted number of adults that will return to the population in a given spawn year. This estimate is modified as the run occurs and data become available. It is used to determine the number of adults to be collected for hatchery broodstock.	1a, b 2a, b 21a 22a, b 27a

Survival – Productivity	Smolt-to-Adult Return Rate (SAR)	<p>Smolt-to-Adult Return (SAR) is the number of adults from a given brood year returning to the LSRCP area above Lower Granite Dam divided by the number of smolts that were released from that brood year 1-5 years prior. Smolt-to-Adult Survival (SAS) is similarly calculated to Bonneville Dam. Adult data are calculated two ways: using coded-wire-tag mark and recovery, and with PIT-tag detections at mainstem dam sites. SAR accounts for all harvest below the LSRCP area.</p> <p>The adult PIT tag detection probabilities at mainstem dams are assumed to be near 100 percent.</p> <p>The number (\pm 95 confidence intervals) of PIT-tagged juveniles arriving at Lower Granite Dam is estimated using SURPH 2.2 or PIT Pro 4.8 programs. The variance around the SAR estimate using PIT tags is then 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:</p> $\text{Var}\left(\frac{X}{Y}\right) = \left(\frac{EX}{EY}\right)^2 \cdot \left(\frac{\text{Var}(Y)}{(EY)^2}\right)$	1a, b, c 2a, b, c 3a 4a, b 13c
	Recruits-per-Spawner Ratio (R:S)	Adult to adult calculated separately for naturally spawning fish and hatchery fish as the brood year ratio of returned adult to parent spawner abundance. For the natural salmon, R:S is standardized for spawner density. Two variants calculated: 1) escapement and 2) spawners.	2a, b 13a, b 21a, b
Survival – Productivity	Juvenile Survival to first mainstem dam (Lower Granite 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 Lower Granite Dam (LGD) to estimate abundance by life stage at the tributary and the sum of those is total smolt abundance surviving to LGD. Juvenile survival to LGD = total estimated smolts surviving to LGD divided by the total estimated juveniles leaving tributary.	6a 16a
	Juvenile Survival to all Mainstem Dams	<i>Juvenile survival to first mainstem dam and subsequent Mainstem Dam(s)</i> - 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.	6a 16a
	Post-release Survival	Post-release survival of natural and hatchery-origin fish is calculated as described above in the performance measure “survival to first mainstem dam and subsequent mainstem dams”.	6a 16a
Distribution	Adult Spawner Spatial Distribution	Extensive area tributary spawner distribution. Target GPS redd locations or reach specific summaries, with information from carcass recoveries to identify hatchery-origin vs. natural-origin spawners across spawning areas within populations.	14a 20a, b 22c 27a

	Stray Rate (percentage)	An estimate of the number and percent of hatchery-origin fish recovered in locations outside of the target stream or the direct migration path to the target stream. Calculated as the number of CWTs recovered in “stray areas” divided by the total number of CWTs recovered.	2a 4a, b 13c 16b 27a
	Disease Frequency	Natural fish mortalities are provided to certified fish health lab for routine disease testing protocols. Hatcheries routinely sample fish for disease and we defer to them for sampling numbers and periodicity.	8a, b 9a, b, d 10b 11a
Genetic	Genetic Diversity	Indices of genetic diversity - measured within a tributary (heterozygosity - allozymes, microsatellites), or among tributaries across population aggregates (e.g., FST).	14a, b 17a 18a 19a, b, c, d 22a, b, c
	Effective Population Size (N _e)	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	14a, b 19a
Life History	Age Structure	Proportion of escapement composed of adult individuals of different brood years. Calculated for wild and hatchery-origin conventional and captive broodstock adult returns. Assessed via scale or dorsal fin ray ageing, or mark recoveries.	4a, b 19c, d
	Age-at-Return	Age distribution of spawners on spawning ground. Calculated for wild and hatchery conventional and captive broodstock adult returns. Assessed via scale or dorsal fin ray ageing, or mark recoveries.	13a 17a 18a 19b, c, d 22a, b
	Size-at-Return	Size distribution of spawners using fork length and mid-eye hypural length. Data are obtained at weirs or during carcass surveys or at hatchery spawning.	13a
	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 life stage-specific emigration period are generated (mean length by week then averaged by life stage). For entire juvenile abundance leaving a weighted mean (by life stage) is calculated. Size-at-emigration for hatchery production is generated from pre-release sampling of juveniles at the hatchery.	6a 25a
	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 1892).	6a 25a
	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.	19c, d 20b
Life History	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.	13a 15b 19b, c 22a, b, c

	Spawn-timing	Time that a female deposits her eggs in the gravel (as estimated by the recovery date of her carcass) or the date on which a female is spawned at the hatchery. These data are usually recorded weekly.	19b, c 22a, b, c
	Juvenile Emigration Timing	Juvenile emigration timing is characterized by individual life stages at the rotary screw trap and LGD. 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 LGD.	16a, b 23a, c
	Mainstem Arrival Timing	Detections of juvenile PIT-tagged fish at LGD are used to estimate migration timing for natural and hatchery-origin tag groups by life stage. 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 life stage divided by tributary abundance estimate by life stage). Daily products are added and rounded to the nearest integer to determine weighted median, 0%, 50%, 90% and 100% detection dates.	19b, c 22a, b, c
	Water Temperature	Various, mainly Hobo® and other temp loggers at screw trap sites and throughout the streams	11a
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).	3a 6a 13b 16a 21a, b, c, d 25a
	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. Estimated survival of various in-hatchery juvenile stages (green egg to eyed egg, eyed egg to hatch, hatch to ponded fry, fry to parr, parr to smolt and overall green egg to release).	6a 8a, b 13b
In-Hatchery Measures	Size-at-Release	Mean fork length measured in millimeters (mm) and mean weight measured in grams (g) 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, Presmolt, Parr, etc.).	6a 25a
	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 (g) and L is the length (mm) (Everhart and Youngs 1892).	6a 25a
	Fecundity by Age	The reproductive potential of an individual female. Estimated as the number of eggs in the ovaries of the individual female - calculated by weight or enumerated by egg counter.	4a, b 13a
	Spawn Timing	Spawn date of broodstock by age, sex and-origin. Also reported as cumulative timing and median dates.	19b

In-Hatchery Measures	Hatchery Broodstock Fraction	Percent of hatchery broodstock actually used to spawn the next generation of hatchery F ₁ s. Does not include prespawn mortality.	13a
	Hatchery Broodstock Prespawn Mortality	Percent of adults that die while retained in the hatchery, but before spawning.	13a
	Hatchery Broodstock Genetics	Fin clips of all hatchery broodstock are collected for genetic analysis. This is a Snake River Basin wide project to genotype each hatchery steelhead stock.	19c
	Female Spawner ELISA Values	Screening procedure for diagnosis and detection of BKD in adult female kidney tissue. The enzyme linked immunosorbent assay (ELISA) detects antigen of <i>R. salmoninarum</i> and indicates a current or previous infection, which is used to cull eggs from females that may have transmitted the bacterium to their offspring.	8a, b 9d
	In-Hatchery Juvenile Disease Monitoring	Screening procedure for bacterial, viral and parasitic diseases common to juvenile salmonids. Ten moribund or fresh-dead fish examined monthly per stock	8a, b 9a, b
	Size of Broodstock Spawner	Mean fork length (mm) and weight (g) by age of male and female broodstock. Measured at spawning and/or at weir collection. Is used in conjunction with scale reading for ageing and to calculate condition factor (K; see above).	15a 19d
	Prerelease Mark Retention	Percentage of a hatchery group that have retained a mark until release from the hatchery - estimated from a sample of fish as either "present" or "absent." ("Marks" refer to adipose fin clips or VIE batch marks)	4b 27a
	Prerelease Tag Retention	Percentage of a hatchery group that have retained a tag until release from the hatchery. Estimated from a sample of fish passed through a CWT detector or PIT tag detector. (All types of tags)	4b 27a
	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).	13c 16a 23a, b, c, d 25a
	Chemical Water Quality	Hatchery operational measures include: dissolved oxygen (DO) - measured with DO meters, continuously at the hatchery, and manually 3 times daily at acclimation facilities; ammonia (NH ₃) and nitrite (NO ₂).	8a, b 11a
	Water Temperature	Hatchery operational measure: temperature (° C) – measured continuously at the hatchery with thermographs and 3 times daily at acclimation facilities with hand-held devices.	8a, b 11a
	UV system	Monthly testing of UV water disinfection system for effectiveness, including UV transmissibility of the water	

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 NPPC “Artificial Production Review” document referenced above 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. If an ESU-wide hatchery plan is available, use the performance indicator list already compiled. 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 are presented in section 1.9. These performance measures are taken from Beasley et al. (2008). 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.

(e.g. “Evaluate smolt-to-adult return rates for program fish to harvest, hatchery broodstock, and natural spawning.”).

Evaluation of the Lookingglass Creek program utilizes the performance standards and associated performance indicators in Section 1.9 and Table 2, respectively. These will be utilized for addressing the project benefits and risks. In addition to yearly evaluations, every five years the Lookingglass Creek project will perform 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 Lookingglass Creek and other hatchery programs that may lead to greater program benefits to the natural Lookingglass Creek Chinook population and attainment of mitigation level adult returns.

1.10.2) “Performance Indicators” addressing risks.

(e.g. “Evaluate predation effects on listed fish resulting from hatchery fish releases.”).

Evaluation of the Lookingglass Creek program utilizes the performance standards and associated performance indicators in Section 1.9 and Table 2. These indicators will be utilized for addressing the project benefits and risks. In addition to yearly evaluations, every five years the Lookingglass Creek project will perform a comprehensive review of

the program to include adaptive management recommendations addressing the benefits and risks of the program. These recommendations will incorporate the findings from studies conducted on Lookingglass Creek and other hatchery programs that may lead to a further reduction in program risks to the Lookingglass Creek natural population.

1.11) Expected size of program.

Per Table B1 of the 2008-2017 *United States v. Oregon* Management Agreement, the production goal for the Lookingglass Creek program is 250,000 smolts.

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

Conventional Broodstock - Adult (ages four and five) collection level is not expected to exceed 158 adults (79 males and 79 females). Age composition and fecundity of adults varies from year to year. However, given expected program adult pre-spawning survival, fecundity (3,840 eggs/female) and egg to smolt survival, 158 adults (1:1 sex ratio) will produce approximately 250,000 smolts.

Broodstock for the program will be collected from returns to either the Lookingglass Hatchery weir and/or the Catherine Creek weir. Either conventional or captive hatchery adults may be used for brood. The goal for broodstock composition will be to incorporate at least 30% natural origin adults to maintain genetic diversity and to counteract the potential for domestication selection in the hatchery population. In addition, no more than 25% of the returning natural origin adults shall be retained for brood. The broodstock collection goal will not be constrained by the 25% cap on natural adult collection. If a shortage of natural adults occurs, then additional hatchery adults will be collected in order to meet the brood target. It is estimated that 158 adults (47 natural origin and 111 hatchery origin) will be required for brood to meet the 250,000 smolt production goal (Lookingglass Creek Spring Chinook Management Plan 2011).

Broodstock is collected at the Lookingglass Hatchery weir per the pass-keep schedule in Table 3.

Table 3. Pass:Keep Disposition of spring Chinook adults (hatchery and wild combined) returning to the Lookingglass Hatchery Weir.

Escapement Level	% Passed Above	% Keep for Brood
150	67	33
200	60	40
250	55	45
300	50	50
>300 – adjustments will be made based on broodstock needs. If broodstock need has been met, the remainder of the fish will be released upstream		

1.11.2) Proposed annual fish release levels (maximum number) by life stage and location (Table 4).

The proposed annual fish release levels by life stage and release location for Lookingglass spring Chinook are included in Table 4.

Table 4. Proposed annual fish release levels by life stage and release location for Lookingglass spring Chinook.

Life Stage	Release Location	Annual Release Level
Eyed Eggs	Hatchery–origin production only Lookingglass Creek	None anticipated; however, eyed eggs can be outplanted when surplus to smolt production goals.
Unfed Fry	Lookingglass Creek	There is no planned release of unfed fry
Fry	Lookingglass Creek	There is no planned release of fry
Fingerling	Lookingglass Creek	There are no planned releases; however, fingerlings can be outplanted when surplus to production goal.
Yearling smolts	Lookingglass Creek	Maximum 250,000
Adults	Lookingglass Creek	Surplus hatchery adults can be used in Lookingglass Creek broodstock, or for harvest or spawning.

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 broodstock is a combination of natural and hatchery origin anadromous Chinook salmon adults collected at the adult trap on Lookingglass Creek or the Catherine Creek trap. This population was established by surplus eggs and smolts from Catherine Creek captive broodstock starting in 2001. Preliminary release information is provided in Table 5.

Table 5. Preliminary data from Lookingglass Creek parr and smolt releases between 2001 and 2011, summarized by ODFW Fish Research staff. Adult returns include age 3+ fish.

Brood Year	Release Year	Release Type	Release Number	Total Return to Mouth of Lookingglass	SAR Percent
2000	2001	Catherine Creek Captive Parr	51,864	40 ^d	0.077 ^e
2001	2002	Catherine Creek Captive Parr	17,880	23 ^d	0.0129 ^e
2002	2003	Catherine Creek Captive Smolts	53,195	106	0.199
2003	2004	Catherine Creek Captive Smolts	98,023	151	0.154
2004	Fall 2005 Spring 2006 Total	Experimental volitional parr release Conventional Smolts Conventional Smolts	18,347 125,023 143,370	434 ^c	0.621
2005 ^a		No Releases			
2006 ^a		Catherine Creek Captive Smolts	43,218	842	1.949
2007 ^b	2009	Conventional Smolts Catherine Creek Captive Smolts Total	50,027 100,450 150,477	Incomplete	NA
2008 ^b	2010	Conventional Smolts	262,911	Incomplete	NA
2009 ^b	2011	Conventional Smolts	102,828	Incomplete	NA

^a No Lookingglass Creek stock adults were spawned in 2005 or 2006.

^b Adult returns for brood year 2007, 2008, and 2009 will not be complete until 2012-2014.

^c Includes returns from parr releases.

^d CTUIR minimum return estimate.

^e CTUIR parr to adult return estimate.

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

Conventional Broodstock - The LSRCP program completed Lookingglass Hatchery in 1982, however the first releases of Rapid River stock spring Chinook salmon occurred in 1980 (1978 brood) in Lookingglass Creek. Rapid River and Carson origin fish were released in the early 1980s. The last Rapid River fish were released as parr into Lookingglass Creek in 2000.

Production from Lookingglass Hatchery has transitioned from composite stocks to an indigenous Grande Ronde Basin (Catherine Creek) stock (201) using captive broodstock and conventional anadromous adults trapped in Lookingglass Creek and Catherine Creek.

The fish returning to Lookingglass Creek/Hatchery has been assigned the stock number 81, which is the main broodstock for the current program.

Juvenile spring Chinook from the Catherine Creek hatchery program were first released into Lookingglass Creek in 2001 and adult spring Chinook from Catherine Creek were first released in 2004.

1.14) Expected duration of program.

The Lookingglass Creek spring Chinook program is ongoing as part of the Lower Snake River Compensation Plan program which is Congressionally authorized to mitigate for an estimated 48% reduction in salmon and steelhead production due to development and operation of the four lower Snake River dams. This is an ongoing program and expected to continue indefinitely.

1.15) Watersheds targeted by program.

Lookingglass Creek (ODFW watershed 0800440000) and Grande Ronde River.

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

Moist Air Incubators

ODFW installed and tested a moist air incubator (MAI) at Lookingglass Hatchery in 2010. Eggs from 30 females spawned on September 2, 2010 were incubated in the MAI unit. Because of the volume of eggs, twenty one females were split and put into two egg trays and nine females' eggs were incubated in a single tray. The temperature in the MAI was set at 44° F and was verified by an independent thermometer placed inside the MAI. About a week ahead of what was expected, the eggs developed a strong eye, therefore they were shocked and picked earlier than anticipated. During incubation in the MAI, there were no obvious signs of fungus growth. The MAI operated as the manufacturer/supplier indicated that it would. Two times during incubation, about 10 gallons of water were drained out of the MAI and replaced with fresh water. There was no real reason to do this, except experiment with the MAI unit. Eye up was 93%.

Based on the results at Lookingglass, and also successful use of units at Irrigon and Wallowa hatcheries, it appears that MAI technology is a viable method of egg incubation. The advantages of using moist air incubators are that the incubators take up less floor space, use only 50 gallons of water in a re-circulating system, and can incubate eggs free of fungus eliminating the use of formalin. Using moist air incubators would allow most of the Heath style incubation system to be removed and additional fry rearing troughs to be installed increasing the rearing space for fry and reducing rearing densities.

Scientific Reviews

In 2009, two independent scientific review groups, Hatchery Scientific Review Group (HSRG) and Hatchery Review Team (HRT), assessed the Lookingglass Creek program

extensively. Their findings are summarized.

The HSRG report is available at: <http://www.hatcheryreform.us/hrp/report/appendix>.

The HSRG recommendations for Lookingglass Creek are:

1. Co-managers review existing habitat potential (productivity and capacity) as it will influence the type of program appropriate to the conditions and the contribution Lookingglass Creek can make to recovery.
2. Lookingglass Creek production be increased to 325,000 smolts with a subsequent decrease in production from Catherine Creek to 75,500 smolts. This larger program (releasing 325,000 smolts) would maintain hatchery broodstock solely from hatchery-origin returns, recover 50% of the hatchery-origin returns at the weir; and allow all additional fish (natural and hatchery origin) to spawn above the weir. In addition, the HSRG’s solution provides additional fish for harvest in the terminal area.

Response - The current program was developed in coordination with our co-managers using best available science and information. It has been agreed to for a 10 year period through the U.S. vs. Oregon 2008-2017 Management Agreement. Changes to this production program must occur through the U.S. vs. Oregon forum as specified in the U.S. vs. Oregon 2008-2017 Management Agreement.

3. Managers continue to implement their successful BKD management strategy for broodstock, which includes culling.

Response – BKD management will continue

The Hatchery Review Team (HRT) considered many benefits and risks while reviewing Lookingglass Hatchery and the Lookingglass Creek program (2009). For their complete assessment, review <http://www.fws.gov/Pacific/fisheries/Hatcheryreview/reports.html>. In brief, the HRT concluded that programmatic risks outlined were minor and their probability of occurrence was small, thus they did not warrant a proposed change to the current Lookingglass Hatchery program. The HRT recommendations and co-manager comments are included in Table 6.

Table 6. Summarized HRT recommendations for the Lookingglass Hatchery program and associated co-manager comments.

Rec.	Brief Description	Priority	Additional Costs	Comments
SC1	Restate Goals	Low	\$0	HGMP
SC2	Establish sliding scale (Table 13)	Low	\$0	<u>US v Oregon</u> issue
SC3	Program funding	Low	\$0	<u>US v Oregon</u> issue

SC4	Report eggs fertilized by jacks	Low	\$0	Ongoing (10%)
SC5	Straying	Low	\$0	Identify and preclude use
SC6	Pathogen exposure	Moderate	\$1M	Cost prohibitive
SC7	Reduce Densities	Low	\$0	Co-managers have agreed on appropriate rearing densities
SC8	Flow Indices	Low	\$0	Co-managers disagree with HRT recommendation
SC9	High water temperatures	Low	\$0	Completed: fiscally prohibitive
SC10	Medicated Feeding	Low	\$0	Ongoing discussion
SC11	Rearing at Irrigon	Moderate	\$0	Temporary, Adult ponds have been retrofitted for juvenile rearing
SC12	Raceway screens	Low	\$10K	Agree, being addressed
SC13	Turbid surface water	Moderate	\$30K	Reviewed in NEOH process, add UV bulbs and transmissibility meter – meter purchased
SC14	Fish jumping	Low	\$0	Not viewed as a problem
SC15	Re-design spawning facility	Moderate	\$75K	Agreed. Consult with engineering
SC16	Put Concrete Floor in Endemic Building	Moderate	\$12K	Agree. On LSRCP maintenance list
SC17	Lack of shade covers	Low	\$0	Low priority, complex issue
SC18	Intake water screens	Moderate/ High	\$500K	Agree. Part of re-designing intake structure
SC19	Open fish ladder, safety	Low	\$500	Plan to cover in 2010
SC20	DEQ NPDES permit expired	Low	\$0	New permit received in 2010
SC21	Work at intake, hazardous	Low	\$0	Safety equipment provided
SC22	Adult holding area fenced, fish health	Moderate	\$100K	Divider wall completed fall 2010
SC23	Water rights, measurement	Low	\$0	Ongoing with monitoring
SC24	Intake fish passage barrier	High	\$5M	Consult with engineering
SC25	Staff housing	High	\$200K	Additional housing completed in late summer 2010
SC26	Volunteer staff	Low	\$0	Low priority

SC27	Hatchery access road	Low	\$1M	Consult with engineering
SC28	Mark, tagging strategies	Low	\$0	M & E is adequate
SC29	Research data, results	Low	\$0	Ongoing
SC30	M & E data set	Moderate	\$0	Ongoing
SC31	Informational signage	Low	\$3K	Low priority
SC32	Information available to the public	Low	\$0	ODFW has a website for state operated hatcheries

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

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

- ESA Section 10 permit #1011 (expired 2002; HGMP submitted in 2002 for ESA coverage).
- NMFS 4 (d) – Section 7 consultation with USFWS
- Bull Trout Umbrella Take permit (CTUIR)
- Section 6 (4d limitation) Bull Trout Permit #TE001598

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

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

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

Snake River spring/summer Chinook salmon, specifically the Lookingglass Creek population.

Spring Chinook – The Grande Ronde Lookingglass Creek population was a spring run, and is considered extinct by the Interior Columbia Technical Recovery Team (ICTRT) as a result of adult collection of natural fish during the early years of Lookingglass Hatchery operations and continued natural spawning of Rapid River hatchery stock. It is estimated that 3,200 fish historically spawned annually in Lookingglass Creek (NPPC 2004).

Historically, spring Chinook spawned throughout the mainstem and headwater areas of the Grande Ronde Basin (Olsen et al. 1994). Currently, five core populations have been identified. Three of those populations are targeted for hatchery intervention: Catherine Creek, Lostine River, and Upper Grande Ronde River. The other two populations are managed for natural production: Minam and Wenaha Rivers. These populations may be directly or indirectly affected by the hatchery program. The other migratory ESA-listed

populations of the Grande Ronde, Snake River and the lower Columbia River basins (e.g. Chinook, coho steelhead and sockeye) may also be affected by the program fish through competitive interactions.

The 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 Lookingglass Creek spring/summer Chinook population and other populations within the MPG. All Grande Ronde/Imnaha MPG populations were assessed at high risk (>5%) of extinction in the next 100 year period. Two populations are extinct (Carmichael et al 2006; Table 7).

To achieve an ESA viable status to the Grande Ronde/Imnaha MPG, ICTRT recommends that four populations meet the viability criteria and one population meets the highly viable criteria. In addition, two of the three “Large” populations must meet viability.

Table 7. Viability status of Grande Ronde/Imnaha spring/summer Chinook major population groups.

Population	ICTRT size	Status	TRT viability	HSRG
Big Sheep	Basic	Extinct	N/A	Stabilizing
Catherine Creek	Large/ Intermediate	High Risk	Viable	Primary
Imnaha	Intermediate	High Risk	Viable	Primary
Lookingglass Creek	Basic	Extinct	N/A	Stabilizing
Lostine/Wallowa	Large	High Risk	Highly Viable	Primary
Minam	Intermediate	High risk	Viable	Primary
Upper Grande Ronde River	Large	High risk	N/A	Safety Net /Contributing
Wenaha	Intermediate	High risk	Viable	Primary
ICTRT size <ul style="list-style-type: none"> • Basic 500 • Intermediate 75 • Large 1,000 • Very Large 1,500 	TRT Viability <ul style="list-style-type: none"> • High <1% • Viable <5% Likelihood of extinction in 100 year period	HSRG criteria <ul style="list-style-type: none"> • Primary PNI 67% • Contributing PNI 52% • Stabilizing PNI no stated goals 		

For abundance and productivity measures, the Lookingglass Creek population is considered “Basic” based on historical habitat potential. A Chinook population classified as basic has a mean minimum abundance threshold criteria of 500 naturally produced spawners with a sufficient intrinsic productivity to achieve a 5% or less risk of extinction over a 100-year timeframe.

Spring Chinook life history generalizations – Historically, spring Chinook spawned throughout the mainstem and headwater areas of the Grande Ronde/Imnaha MPG (Olsen et al. 1994). Currently, eight populations have been identified. Six of those populations are targeted for hatchery intervention: Big Sheep, Catherine Creek, Imnaha, Lookingglass Creek, Lostine River, and Upper Grande Ronde River. Two of the six populations Big Sheep and Lookingglass Creek are considered extinct. The other two populations, Minam and Wenaha, are managed for natural production.

Adult spring Chinook enter the Columbia River in March through May. Movement into summer holding areas ranges from April through July. Age 4 fish typically dominate returns to the Grande Ronde Basin. Spawning occurs from early August through mid-September and generally peaks in late August. Fry emergence begins in January and extends through June. Fry expand their distribution after emergence in the spring. The extent and direction of fry movement depends on environmental conditions. A fall pre-smolt movement appears to involve a substantial portion of the population in some streams, including Catherine Creek. Juveniles rear for one year and smolt the spring of the year following emergence. Smolt migration from the basin begins in January and extends through early July (Figure 1).

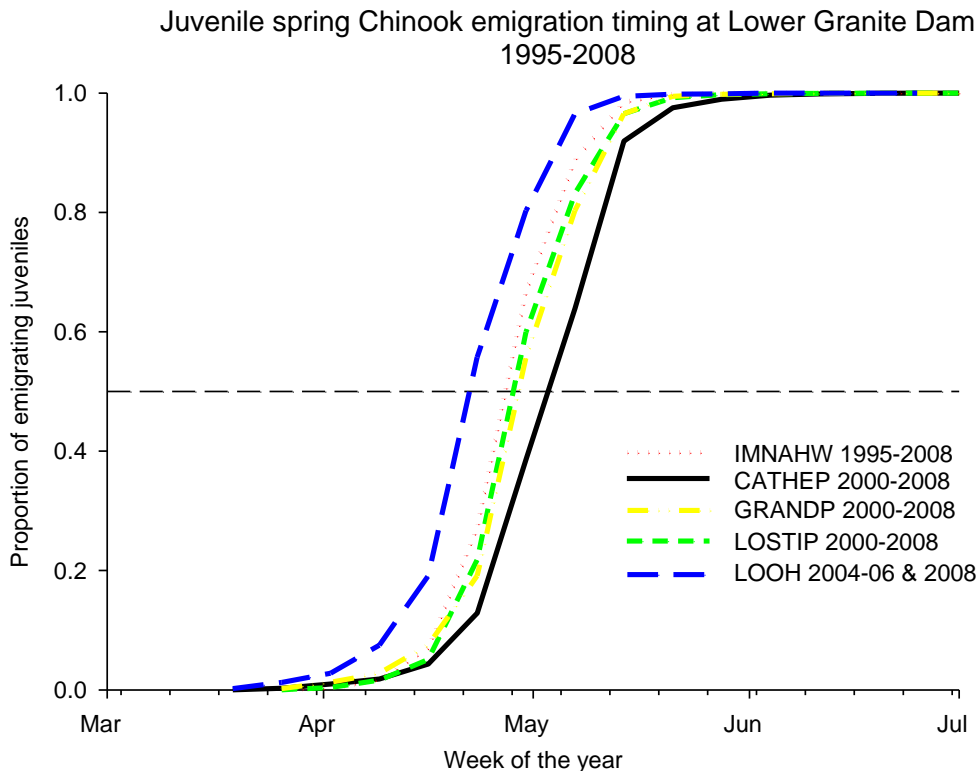


Figure 1. Grande Ronde Basin juvenile spring Chinook emigration timing at Lower Granite Dam, 1995-2008.

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

Lookingglass Creek Sp/Su Chinook HGMP

program.

The hatchery production program may incidentally or indirectly affect listed Snake River summer steelhead populations. In addition, listed Snake River spring Chinook populations from other basins, Snake River fall Chinook, and Columbia Basin bull trout may be affected due to competitive interactions for food and space. The magnitude of that affect is unknown, however, it is expected that affects will be reduced from past levels through program modifications outlined in this document.

Summer steelhead - Grande Ronde basin summer steelhead are typical of A-run steelhead from the mid-Columbia and Snake basins. Most adults returning to the Grande Ronde Basin do so after one year of ocean rearing (60%). The remainders are two-salt returns with an occasional three-salt fish. Females generally dominate with a 60/40 sex ratio on average. Returning adults range in size from 45 to 91 cm and 1.4 to 6.8 kg. Adults generally enter the Columbia River from May through August, subsequently entering the Grande Ronde River from September through April. Adults utilize accessible spawning habitat throughout the Grande Ronde Basin. Spawning is initiated in March in lower elevation streams and spring-fed tributaries and continues until early June in higher elevation “snowmelt” systems. Juveniles utilize a wide range of habitats throughout the basin, including areas adjacent to Chinook smolt release locations. Most naturally produced steelhead smolts migrate after rearing for two years. A much lower percentage migrate after one or three years. Smolt out-migration from the Grande Ronde Basin extends from late winter until late spring. Peak smolt movement is associated with increased flow events between mid-April and mid-May.

ICTRT classified population structure for summer steelhead within the Grande Ronde basin is described in Table 8.

Table 8. Intrinsic size and complexity rating for historical Snake River Steelhead ESU populations. Complexity categories: A = linear; B=dendritic. Size categories in parentheses represent core tributary production areas.

Population	Weight Area Category	Category	
		Category	#MaSA (#MiSA)
Upper Grande Ronde River	Large	B	6 (7)
Wallowa River	Intermediate	B	4 (2)
Lower Grande Ronde River	Intermediate	B	2 (5)
Joseph Creek	Basic	B	3 (3)

Fall Chinook – Fall Chinook in the lower reaches of the Grande Ronde River are considered segments of the Snake River population and exhibit similar life histories. 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. Outmigration occurs within 3-4 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 Grande Ronde River and a number of tributaries. Habitat conditions and influence of introduced brook trout vary widely across the basin and affect bull trout productivity in some areas. As a result, the basin's bull trout population(s) varies from areas of relative strength in wilderness streams, where brook trout are not currently a problem, to areas where habitat condition and/or interaction with brook trout result in substantially depressed bull trout productivity. 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 summer rearing is restricted to headwater areas by increasing water temperatures downstream.

Snake River Sockeye — No Sockeye are expected to be affected by this program. Snake River sockeye may, however, be indirectly affected by Lookingglass Creek fish through competitive interactions while both populations are in the same migration corridor.

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

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

The Grande Ronde Basin once supported large runs of Chinook salmon with estimated escapements in excess of 10,000 as recently as the late 1950s (USACOE 1975). Natural escapement declines in the Grande Ronde Basin have paralleled those of other Snake River stocks. Reduced spawner numbers combined with human manipulation of previously important spawning habitat have resulted in decreased spawning distribution and population fragmentation.

Catherine Creek and the Grande Ronde and Lostine rivers were historically three of the most productive populations in the Grande Ronde basin (Carmichael and Boyce 1986). Escapement levels in Catherine Creek and the Grande Ronde and Lostine rivers dropped to alarmingly low levels in 1994 and 1995. A total of 11, 16, and 3 redds were observed in Catherine Creek, Lostine River, and upper Grande Ronde River in 1994, respectively, and in 1995, 14, 11, and 6 redds were observed in those same streams (Table 2.2.2A). In contrast, the estimated number of redds in 1957 was 374 (not including North Fork Catherine Creek), 893 and 478 in these rivers, respectively. We are presently in an emergency situation where dramatic and unprecedented efforts are needed to prevent extinction and preserve any future options for use of natural fish for artificial propagation programs for recovery and mitigation.

The Lookingglass Creek population is a spring run and is considered extinct by the ICTRT as a result of adult collection of natural fish during the early years of Lookingglass Hatchery operations and continued natural spawning of Rapid River

Hatchery stock. Historically, it is estimated that 3,200 fish spawned annually in Lookingglass Creek (NPPC 2004).

- **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.**

Progeny to parent ratios (P:P) are available for three brood years, 2004-2006. For these three brood years, the P:P ratio for Lookingglass Creek hatchery fish averaged 3.0 versus 1.3 for natural fish (Table 9).

Table 9. Recruit:Spawner ratios for the Lookingglass Creek hatchery program and the natural spawning populations of spring/summer Chinook salmon in Lookingglass Creek (age 3 males included). Hatchery R:S ratios were calculated by dividing the total number of parents spawned in the hatchery by the total number of offspring returning to release stream. NA = not applicable.

Brood Year	Lookingglass Creek	
	Hatchery	Natural
2000 ^a	NA	NA
2001 ^b	NA	NA
2002 ^c	NA	NA
2003 ^d	0.74	NA
2004	4.0	0.41
2005 ^e	0	1.59
2006 ^f	5.0	2.0
2007 ^f		
2008 ^f		
2009 ^f		

^a The 51,864 parr released into Lookingglass creek were from excess production in the Catherine Creek Captive Broodstock program.

^b The 17,880 parr released into Lookingglass Creek were from excess production in the Catherine Creek Captive Broodstock program.

^c The 53,196 smolts released into Lookingglass Creek were from excess production in the Catherine Creek Captive Broodstock program.

^d The 98,023 smolts released into Lookingglass Creek were from excess production in the Catherine Creek Captive Broodstock program.

^e No smolts released to Lookingglass Creek

^f Incomplete brood year returns.

- **Provide the most recent 12 year (e.g. 1998-2010) annual spawning abundance estimates, or any other abundance information. Indicate the source of these data.**

The number of redds in Lookingglass Creek has increased since 1996, with a high of 341 counted in 2011 (Table 10). The population estimate has also increased, with 1,094 estimated in 2011.

Table 10. Total redd counts and estimates of age 3-5 spring/summer Chinook salmon spawning naturally in Lookingglass Creek, 1996-2011 (ODFW unpublished data). CC=Catherine Creek.

Year	Lookingglass	
	Total Redds	Pop. Est.
1996	30	96 ^a
1997	28	90 ^a
1998	5	16 ^a
1999	3	10 ^a
2000	85	272 ^a
2001	86	275 ^a
2002	18	58 ^a
2003	10	32 ^a
2004 (CC outplants)	103	181
2005 (CC outplants)	39	72
2006	56	119
2007	53	122
2008	143	269
2009	97	493
2010 (CC outplants)	259	585
2011	341	1,094

^a Rapid River returns

- Provide the most recent 12 year (e.g., 1998-2010) estimates of annual proportions of direct hatchery-origin and listed natural-origin fish on natural spawning grounds, if known.

Co-managers transitioned from using Rapid River spring Chinook stock in Lookingglass Creek to a localized Catherine Creek stock in the late 1990s. The last year of adult returns from Rapid River releases was 2003. The proportion of marked carcasses recovered during 1994 through 2008 spawning ground surveys in Lookingglass Creek is reported in Table 11. Since 2002, the percentage of hatchery origin carcasses recovered during spawning ground surveys in Lookingglass Creek has ranged from about 70-92%, with a high of 92.7% in 2011.

Data on origin of spring Chinook salmon carcasses (Rapid River stock), based on marking of hatchery fish, recovered during spawning ground surveys in the Grande Ronde River sub-basin can be found in Keniry (1999) for 1994 and 1996; Parker et al. (1995) for 1995; and Parker and Keefe (1997) for 1997.

Table 11. Origin of spring Chinook salmon carcasses, based on marking of hatchery fish, recovered during spawning ground surveys in Lookingglass Creek conducted above and below the hatchery intake weir (ODFW unpublished data) between 1994 and 2011.

Return Year	Lookingglass Creek		
	Hatchery origin	Natural origin	% Hatchery origin

Lookingglass Creek Sp/Su Chinook HGMP

1994	19	12	61.3
1995	0	4	0.0
1996	0	44	0.0
1997	2	68	2.9
1998	0	0	0.0
1999	0	1	0.0
2000	128	46	73.6
2001	83	7	92.2
2002	19	9	67.9
2003	7	2	77.8
2004 ^a	86	21	80.4
2005 ^a	31	6	83.8
2006	27	3	90.0
2007	35	6	85.4
2008	85	15	85.0
2009	50	23	68.4
2010 ^a	282	12	95.9
2011 ^b	522	33	92.7

^a Fish from Catherine Creek outplanted to Lookingglass Creek below the weir, influencing hatchery fractions.

^b Preliminary information

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 conventional and captive marked and unmarked ESA listed Chinook returning to Lookingglass Creek and potentially Catherine Creek. Adults collected are incorporated into a matrix spawning protocol to maintain genetic similarity between hatchery-origin and natural-origin populations. Most adult spawning matrices will be 2 females x 2 males, but matrices of 1 x 1, 1 x 2, 2 x 1, or 3 x 2 can be used if necessary. Adults are collected from May (as early as stream conditions allow) to September, based on a systematic approach to pass fish above the weir, outplant, or retain for broodstock based on origin, gender, and age. The approach is based on a pre-season estimate of returning adults and is modified as the run develops.

Spawning, incubation and rearing – Adult fish and jacks are killed during the spawning process at Lookingglass Hatchery. Eggs and resulting progeny are subject to mortality

during incubation and rearing due to developmental problems, disease, injury and other causes. Every effort is made in the hatchery environment to ensure maximum survival of Chinook at all life stages. There is also a limited number of fish sacrificed during fish health monitoring activities annually.

Acclimation – Lookingglass Creek production may be transferred to Irrigon for rearing in April, returned to Lookingglass Hatchery in September, and released from the adult holding ponds the following April. Incidental mortality associated with fish culture practices, the loading and unloading of fish into transport trucks and the initial stress when placed into the adult holding ponds may occur. Every effort is made at Irrigon and Lookingglass hatcheries and by the fish liberation crew to ensure the maximum survival of Chinook.

Juvenile's trapped – Wild juvenile steelhead, bull trout, and Chinook moving upstream may enter the adult trap at Lookingglass Hatchery during operation which may result in injury and/or mortality. Juveniles entering the Lookingglass Creek trap can swim through the bars and few are collected.

Wild steelhead and bull trout trapped – Wild adult steelhead and bull trout moving upstream may enter the adult trap during operation which may result in injury and/or mortality. Adult bull trout entering the Lookingglass Creek trap are enumerated, measured, and released.

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 August through September in all reaches of spawning habitat. Experienced surveyors walk in the stream, avoiding and counting redds, observing fish, and sampling 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 disturb existing redds while walking in the river.

Juvenile surveys/collections – Rotary traps are used to monitor early life history of juvenile fish. Collection and handling may result in injury, mortality or delayed mortality. Electrofishing, snorkeling and hook and line sampling may be used to monitor density, size and food habits of residual hatchery steelhead and to collect genetic samples from naturally produced steelhead. These activities, which generally occur from May through October, result in take of juvenile listed steelhead and occasionally spring Chinook and bull trout. Electrofishing efforts conform to NOAA 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 will be conducted when stream temperatures are low, so as to minimize potential for

stress and incidental mortality to listed fish. Research PIT tags around 1,000 Chinook parr in the upper reaches of the home streams of each population during the summer.

Lookingglass Hatchery intake maintenance – Natural juvenile Chinook, steelhead, and bull trout maybe encountered when performing seasonal gravel removal operations in immediate proximity to the Lookingglass facility intake. 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.

Intake Screening - New Lookingglass Hatchery screens have been added to the intake and at the head end of raceways to help prevent native fish from entering the hatchery intake water supply and comingling with hatchery fish. The screens should reduce the debris load entering the hatchery.

Some juvenile fish in the process of outmigration may go into the Lookingglass Hatchery water intake area. Travelling screens keep fish from entering water supply going to raceways; these fish are diverted and leave via a pipe about 100 m downstream of the water intake. Rarely, natural-origin fish of several species may still wind up in raceways.

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 ft³. 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.

Water Withdrawal – Water withdrawals to operate facilities, Lookingglass Hatchery in specific, may affect 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 outfall of the hatchery for 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 may be restricted to some degree; however, there is enough water to allow 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.

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

fish.

Pre-spawning mortality of Lookingglass Creek adults held at Lookingglass Hatchery and collected from the Lookingglass Creek facility since 2004 has averaged 3.62%; however, the mortality rates are not evenly distributed. The median mortality rate for the six brood years is 2.65% (Table 12). Note that no adults were collected in 2005 and 2006.

Table 12. Pre-spawning mortality for spring/summer Chinook held for broodstock at Lookingglass Hatchery, 2004-2011.

Brood Year	Lookingglass Creek		
	Adult	Mort	%
2004	118	3	2.5
2005	0	0	0
2006	0	0	0
2007	68	6	8.8
2008	152	3	2.0
2009	211	6	2.8
2010	174	7	4.0
2011	190	3	1.6

Information on survival of Lookingglass Creek stock spring Chinook from egg take to smolt is presented in Table 16.

-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).

Table 13 includes projected take for the hatchery program, includes take for program monitoring, and includes take of hatchery reared fish which as a group include progeny of listed wild fish and are therefore part of the ESU. Annual take level of Catherine Creek fish is included in the Catherine Creek HGMP (2011; Table 13).

Table 13. Estimated maximum take levels of ESA listed Lookingglass Creek spring/summer Chinook, both wild and hatchery origin, by hatchery activities.

Listed species affected: Spring/Summer Chinook		ESU/Population: Snake River		
Activity: Lookingglass Creek spring/summer Chinook hatchery program				
Location of hatchery activity: Lookingglass Creek and Snake Basin			Dates of activity: Annual	
Hatchery program operator: ODFW				
Type of Take	Annual Take of Listed Fish By Life Stage			
	<i>(Number of Fish)</i>			
	Egg/Fry	Juvenile/Smolt	Adult	Carcass

Lookingglass Creek Sp/Su Chinook HGMP

Listed species affected: Spring/Summer Chinook		ESU/Population: Snake River		
Activity: Lookingglass Creek spring/summer Chinook hatchery program				
Location of hatchery activity: Lookingglass Creek and Snake Basin			Dates of activity: Annual	
Hatchery program operator: ODFW				
Observe or harass a)	unknown	2,500	1,000	500
Collect for transport b)	357,000	250	158	500
Capture, handle, and release c)	0	2,000	1,000	0
Capture, handle, tag/mark/tissue sample, and release d)	250,000	250,000	700	0
Removal (e.g. broodstock) e)	0	0	158	0
Intentional lethal take f)	35,000	480	158	0
Unintentional lethal take g)	52,000	20,000	25	0
Other Take (specify) h)	0	0	0	0

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

- 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.

When water temperature exceeds 18.3° C daily maximum, fish will not be handled at the Lookingglass Weir to minimize stress and take levels. At higher environmental temperature, fish will be allowed free passage without handling. It is expected that as water temperature rises, work schedules will be adjusted to conduct fish handling only while water temperatures are cool enough for handling the listed fish. It is, therefore, expected that the take level shall not exceed the projected goal.

SECTION 3. RELATIONSHIP OF PROGRAM TO OTHER MANAGEMENT OBJECTIVES

3.1) Describe alignment of the hatchery program with any ESU-wide hatchery plan (e.g., Hood Canal Summer Chum Conservation Initiative) or other regionally accepted

Lookingglass Creek Sp/Su Chinook HGMP

policies (e.g., the NWPPC *Annual Production Review Report and Recommendations* - NWPPC document 99-15). Explain any proposed deviations from the plan or policies.

The proposed program outlined in this HGMP is consistent with the NWPPC Annual Production Review (Report and Recommendations), draft Snake River recovery plan, ESA permits, and addresses issues of concern outlined in the NOAA Hatchery Biological Opinions (1999, 2004).

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.
- *US vs Oregon* - The hatchery program outlined within this HGMP is consistent with the 2008-2017 *United States v. Oregon Management Agreement*.
- *Lookingglass Creek Spring Chinook Management Plan* – The hatchery program outlined within this HGMP is consistent with production levels and management agreed to by co-managers in the Lookingglass Spring Chinook Management Plan (January 2011).
- *Annual Operation Plan (AOP 2011 LSRCP)* - The program is consistent with co-manager agreements outlined in annual operations plan.
- *Grande Ronde Spring Chinook Management Plan* - The program is consistent with production levels agreed to by co-managers.
- *2008 and 2010 Supplemental FCRPS Section 7 ESA Consultation Biological Opinion* – The program is consistent with the 2008 and 2010 Biological Opinion, including but not limited to RPAs 39-42.

3.3) Relationship to harvest objectives.

Fishery co-managers agree with adoption of the Lookingglass Creek Spring Chinook Management Plan that states tributary harvest is a primary objective of the current hatchery production program. In June 2011, the fishery co-managers reached agreement on fishery management objectives now documented in the ODFW Grande Ronde Spring Chinook Fishery Management and Evaluation Plan (June 2011) and Confederated Tribes of the Umatilla Indian Reservation Tribal Resource Management Plan (June 2011).

3.3.1) Describe fisheries benefiting from the program, and indicate harvest levels and rates for program-origin fish for the last twelve years (1997-08), if available.

A sport Chinook fishery was implemented in Lookingglass Creek in 2011 per the fishery plan referenced above. Total recreational fishery impact on adult Chinook was estimated at 144 (141 marked and 3 unmarked; Table 14). We estimated that Chinook anglers

caught and released 60 bull trout.

Table 14. Estimates of angler effort, catch, and harvest during the Lookingglass Creek Chinook salmon fishery, May 28-July 15, 2011. Due to high flows and low angler effort, creel surveys were not initiated until June 9. Catch before June 9 was assumed to be zero.

Fishery Parameter	Estimate
Angler Hours	3,652
Marked Adult Chinook Harvested	141
Marked Jacks Harvested	211
Unmarked Adults Released	38
Unmarked Jacks Released	42
Bull Trout Released	60

Recreational angling for Chinook salmon was also allowed on Lookingglass Creek from 26 May through 1 July 2001, and is described in detail by Keniry et al. (2004). Briefly, an intensive creel survey was conducted to monitor angling effort, catch rates and impacts on non-target stocks and species. ODFW conducted 1,606 angler interviews and estimated that 741 Chinook salmon were caught and 541 kept by anglers. Catch rates were good throughout the season with a mean catch rate of 12.0 and 12.3 h/fish in May and June, respectively, and 8.7 h/fish on 1 July. Tribal harvest by the Confederated Tribes of the Umatilla Indian Reservation and Nez Perce Tribe was not monitored during ODFW's survey.

Nez Perce treaty harvest in Lookingglass Creek is reported in Long Term Nez Perce Harvest Plan For Snake River spring/Summer Chinook Salmon in the Imnaha and Grande Ronde Subbasins of Northeast Oregon (October 2011) and presented in Table 15.

Table 15. Nez Perce treaty harvest in the Grande Ronde subbasin, 2000-2009. 2010 data from preliminary review of 2010 Nez Perce Treaty Fishery Harvest in Snake Basin.

Year	Lostine River		Lookingglass Creek*	
	Hatchery Origin	Natural Origin	Hatchery Origin	Natural Origin
2000	0	0	23	0
2001	0	0	133	0
2002	0	0	35	0
2003	0	0	Na	Na
2004	0	0	Na	Na
2005	20	0	Na	Na
2006	5	0	Na	Na
2007	0	0	Na	Na
2008	55	0	8	0
2009	229	37	Na	Na

2010	314	7	126	7
*"Na" indicates that a fishery may have occurred, but no catch data are available.				

Fisheries that benefit from the hatchery fish produced by this program occur mainly in the mainstem Columbia River and the Grande Ronde 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 Lookingglass Creek hatchery program is as follows:

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 River 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. v. Oregon. The 2008-2017 U.S. v. Oregon Management Agreement requires implementing 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 – Fishing occurs in the Snake River and the Grande Ronde basins for spring/summer Chinook. Annual fishery impact rates will be set pre-season consistent with fishery management protocol developed within FEMPs and TRMPs and 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 is then allocated by the tribal and state managers. Co-managers report catch statistics in season and all fishing stops when the allowable impact for the year is met.

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 Grande Ronde Basin. Loss of channel diversity, sedimentation, reduced stream flows, habitat constriction due to effects of irrigation withdrawal, water temperature and fragmentation of habitat all affect productivity of natural Chinook populations within the watershed. State programs that are in place through the Department of Environmental Quality, Department of Forestry and Division of State Lands along with the federal Clean Water Act and Corps of Engineers 404 regulations provide standards for activities on private land that might otherwise contribute to the problems listed above. Activities on public lands or those that are federally funded must additionally meet Endangered Species Act listed species protection criteria developed through consultation with US Fish and Wildlife Service and National Marine Fisheries Service as well as National Environmental Policy Act (NEPA) review.

These habitat protection programs in conjunction with ongoing private and publicly funded restoration efforts have resulted in an improvement in Chinook and steelhead habitat in many Grande Ronde Basin tributaries. Most watershed restoration/improvement projects are funded through the Grande Ronde Model Watershed Program, Oregon Watershed Enhancement Board, Bonneville Power Administration funded Northwest Power Conservation Council's Fish and Wildlife Program, the Columbia Basin Fish Accords, Mitchell Act Program and Natural Resource Conservation Service's (NRCS) Conservation Reserve Enhancement Program (CREP). Efforts include fencing streamside corridors to promote riparian vegetative recovery, active restoration including channel reconfiguration, improved fish passage at road crossings and diversions, reduced 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 wild spring/summer Chinook.

3.5) Ecological interactions.

(1) Species that could negatively impact program:

There is potential for predation by other salmonids, especially by bull trout on hatchery-produced Chinook within the basin. While migrating downstream towards the ocean the program fish may be subject to predation and negatively impacted by the following species:

- Avian predators, such as great blue herons, Caspian terns, cormorants, and gulls;
- Mammalian predators such as river otters, harbor seals, or sea lions;
- Introduced fish species such as American shad, walleye, smallmouth bass, and channel catfish;
- Northern pikeminnow;
- Out-of-basin hatchery salmonid releases;
- Other unknown aquatic local or non-local animals.

The majority of the preceding species can be characterized as predators of juvenile salmonids, or competitors which may negatively affect the Lookingglass Creek's Chinook juvenile survival after release. In recent years, Caspian terns (*Sterna caspia*) have colonized the Columbia River estuary; the colony currently represents the largest in North America. Recent estimates of annual Caspian tern predation on salmonid smolts have been as high as about 25 million (Roby et al. 1998). Caspian tern predation is highest on large smolts, such as steelhead or coho that spend 1-2 years rearing in freshwater. Predation is lower on smaller, ocean-type salmonids such as fall Chinook and chum salmon that emigrate as sub-yearlings. Northern pikeminnow (*Ptychocheilus oregonensis*) have been estimated to annually consume millions of juvenile salmonids in the lower Columbia River (Ward et al. 1995). Most northern pikeminnow predation is thought to occur downstream of dams. Walleye (*Stizostedium vitreum*), smallmouth bass (*Micropterus dolomeiui*), and channel catfish (*Ictalurus punctatus*) have been estimated to consume substantial numbers of emigrating juvenile salmonids (Zimmerman 1999). The impacts from these species are thought to be highest around dams and throughout impounded reaches of the Columbia River (Zimmerman and Parker 1995). Like pikeminnow, their abundance in the Columbia River estuary is thought to be low; thus, their predation effects in the lower Columbia River and the estuary should be highest near Bonneville Dam and progressively decrease with distance downstream.

River otters (*Lutra canadensis*) may represent a substantial predation source on juvenile salmonids. Harbor seals (*Phoca vitulina*), Steller sea lions (*Eumetopias jubatus*), and California sea lions (*Zalophus californianus*) are commonly observed in the Columbia River estuary. Seals and sea lions prey on adult salmonids, although diet studies indicate that other fish species generally comprise the majority of their food (NMFS 1999). These mammals are often attracted to concentrated fishing effort and can be troublesome to both sport and commercial fishers by taking hooked or net-caught fish before they can be landed.

American shad (*Alosa sapidissima*) and large out-of-basin hatchery salmonid releases represent potential competitors of juvenile Lookingglass hatchery-produced Chinook and may decrease juvenile survival through density dependent competition effects. In the lower Columbia River and estuary, juvenile American shad were described as year-round residents in all areas of the estuary (Bottom et al. 1984). Multiple studies have found overlap in both habitat use and diet items in juvenile American shad and both sub-yearling and yearling salmonids (McCabe et al. 1983, Bottom et al. 1984), suggesting competition for food and space. Additionally, other hatchery fish may be a source of

competition for Lookingglass Hatchery spring/summer Chinook. Food availability may be negatively affected by the temporal and spatial overlap of juvenile salmonids from different locations. Competition for prey may develop when large releases of hatchery salmonids enter the estuary (Bisbal and McConnaha 1998).

(2) Species that could be negatively impacted by program:

The Snake River and Grande Ronde River Chinook and steelhead, and the Lower Columbia River Chinook, chum, coho, and steelhead populations may be negatively impacted by program fish due to predation and the competitive interactions for food and space.

Predation – Although there are possibilities of predation by program fish on other listed salmonids, little evidence exists of such predation by hatchery released spring Chinook on other salmonids. Hatchery spring Chinook smolts are programmed for release in Lookingglass Creek 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 and limit interaction with other species in the river. The small size of hatchery migrants, rapid migration from Lookingglass Creek, 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 Grande Ronde and Columbia basins.

Competition – Hatchery Chinook smolts have the potential to compete with naturally produced Chinook, steelhead and bull trout juveniles for food, space, and habitat. If significant interaction does occur in Lookingglass Creek, 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 tributary 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.

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 to or slightly larger than natural Chinook smolts (20 fish per pound) and may 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 may 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 Catherine Creek program are reared at Lookingglass Hatchery, 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 become more prevalent at Lookingglass Hatchery in recent years. 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 an 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 (there are occasional disease problems) demonstrated good health when reared at Lookingglass Hatchery, which indicates potential for minimal to low level transmission of any agents they harbor to natural populations. Documentation of fish health status of Catherine Creek and Lookingglass 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; (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). The prevalence of BKD in hatchery brood adults and wild spawners is similar and low (<1.0%).

Incidental Take at Trapping Facilities – Operation of the Lookingglass Hatchery and Catherine Creek 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. When 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.

Genetic Introgression - Genetic introgression may occur if hatchery adults interbreed with naturally-produced Chinook within the basin, and such interbreeding may degrade the genetic quality of wild population. However, this is an integrated recovery program and hatchery fish are intended to spawn in the wild or genetically integrated with the targeted natural population to enhance the recovery effort. Also, the hatchery Chinook (stock 81) is indigenous to the Grande Ronde Basin and is expected to produce offspring that would be genetically similar to wild population within the basin.

Bull trout have been captured at the Lookingglass Hatchery and Catherine Creek 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 two hour retention time, based on a continuous inflow of 1500 gpm, and has an active water volume above the sludge reservoir of 27,000 ft³. 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 affect 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 may be restricted to some degree; however, there is enough water to allow 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.

(3) *Species that could positively impact program:*

There are no species that are known to positively impact the program. However, stream

enrichment by naturally spawned salmonid carcasses in Lookingglass Creek may provide benefits to the program fish with natural food availability.

(4) *Species that could be positively impacted by program:*

Any freshwater or marine species that depend on salmonids for food and nutrients may benefit from this program and thus the program fish may play a role in the population dynamics of predator-prey relationships and community ecology during low productivity and shifting climatic cycles. Adult carcasses generated through this program may improve the natural productivity of the freshwater ecosystems and benefit the naturally-produced species within the basin.

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.

Lookingglass Hatchery - The main water source for Lookingglass Hatchery is Lookingglass Creek (72 cfs water right). Water flow to the hatchery is equal to the water rights and are available year round but are not needed at all the times. Water temperature of Lookingglass Creek fluctuates daily and seasonally with mean daily temperature ranging between 1° C and 16° C (between winter and summer months). Due to freezing temperature in winter months continuous supply from the creek becomes problematic. However, the facility has additional water supply from a well that is capable of pumping up to 5 cfs with a year round constant temperature of ~14.5° C. The well water is used to temper creek water in an attempt to reduce water intake from the creek and prevent the raceways from filling with slush ice in winter months. High spring run-off may create problems with turbid water and sediment deposition in egg incubation trays, early rearing troughs, large raceways, and associated water delivery pipes.

Irrigon Hatchery –The Irrigon Hatchery water supply is provided from two wells that can deliver a total of approximately 21,000 gpm. Water rights and design capacity is about 25,000 gpm. The 21,000 gpm is available year round with actual low water use occurring in June when only 9,600 gpm is needed. Water temperature is almost constant year round (~14° C). Water flows from an upper series of raceways and is re-used in the lower series prior to discharge.

Catherine Creek Weir - The main water source for the Catherine Creek weir is Catherine Creek. Water temperature fluctuates daily and seasonally with mean temperature ranging between 1° C and 17° C.

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.

Lookingglass Hatchery - Intake screens were replaced at Lookingglass Hatchery in 1999. Current evaluations suggest improvements to the sweeping velocity across the intake screen are necessary. The potential for entrapment of listed fish exists at the Lookingglass Hatchery. Routine maintenance on the traveling intake screens has not prevented fish from entrainment into the main hatchery. Head screens were installed in the Lookingglass hatchery raceways in 2009 to prevent the transfer of Lookingglass Creek fish to Catherine Creek and other watersheds. The hatchery is operated under the NPDES general permit 300J to comply with the effluent water quality standards of Oregon.

Irrigon Hatchery - Fry/juveniles of program fish will be reared at Irrigon Hatchery. Water intake screening at Irrigon Hatchery is not a necessary as all supply water comes from the wells. The facility is operated under the NPDES general permit 300J to comply with the effluent water quality standards.

Catherine Creek - A NOAA approved screened intake box at Catherine Creek is used.

SECTION 5. FACILITIES**5.1) Broodstock collection facilities (or methods).**

Lookingglass Hatchery – The adult collection facility is located on Lookingglass Creek at Rm 2. Two adult traps can be operated, however only the upper trap is currently used. The upper trap, operated by the ODFW Lookingglass Hatchery staff, is located at the facility water intake. A block weir directs fish into the ladder and through a fyke trap into a holding area. Fish are handled daily. Lookingglass Hatchery has five permanent residents to provide facility security.

Catherine Creek Weir - The Catherine Creek weir consists of one temporary travel trailer which houses personnel 24 hours a day during the trapping season. Facility security is provided by the occupant of the trailer. The adult trap consists of a hydraulic weir that is attached at the bottom sill of a full channel-width pool and chute type ladder. Adults are collected by directing fish into an off channel ladder leading to a trapping and holding area of 825 ft³ (25'x 6' x 5.5'). The trap is covered with aluminum grating and is fully lockable. A maximum of 82 adults can be held for 48 hours. Adults handled for transport are transferred using a water-filled tube or elevator system. Trapped adults are passed above the weir or transported to Lookingglass Hatchery within 48 hours of collection.

Collections

Lookingglass Creek – The first goal was to develop a broodstock from known Catherine Creek origin fish. All Lookingglass Creek adults arriving at the Lookingglass Hatchery

intake weir are passed above the weir or kept for brood based on estimated escapement to the mouth of Lookingglass Creek (Table 2). Adults arriving at the weir that are identifiable as Upper Grande Ronde fish will be hauled to the Grande Ronde River. Catherine Creek adults may be retained if needed for broodstock or spawning escapement, or recycled into lower Lookingglass Creek. Unmarked Chinook will be held for broodstock or passed above the weir.

Catherine Creek –The Catherine Creek spring Chinook program uses the endemic population for hatchery broodstock. Captive Broodstock progeny adults (F 1) may be used for Lookingglass Creek production.

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

Adults are transported from the Lookingglass trap to the hatchery adult holding pond in a 100 gallon tote equipped with a lid and supplemental oxygen.

Adults are transported by CTUIR staff from Catherine Creek weir within 96 hours or less after collection to Lookingglass Hatchery in one of three insulated containers: 550-gallon, 400-gallon, and 250-gallon tanks. Tanks are equipped with supplemental oxygen, aeration, and alarms.

5.3) Broodstock holding and spawning facilities.

Conventional Broodstock - Lookingglass Hatchery consists of one hatchery building complex (11,588 ft²). The complex includes an office, spawning room, incubation and rearing room, cool fish feed storage area, shop, lab, visitor center, and dormitory. The spawning room consists of an anesthetizing tank, brail, spawning table, fish health and fish research stations, and adult return tubes to the adult holding ponds.

Adult facilities consist of two adult concrete holding ponds (4,560 ft³), each partitioned into two ponds, three adult circular holding tanks 1,100 ft.³ (20'x 4'), and three small circular tanks (6' x 3'). Lookingglass Creek adults can be held in two types of containers: Linear flow raceway 3,200 ft.³ (10x80x4) with holding capacity of 800 fish (1 adult/8 ft³), or one of three circular tanks each 1,100 ft³ (20'x4') with a holding capacity of 137 fish (1 adult/8 ft³). Typically, the Lookingglass spring Chinook broodstock are held in a single pass concrete raceway.

5.4) Incubation facilities.

Incubation of eggs for the program will occur at Lookingglass Hatchery. Lookingglass Hatchery contains 360 incubation trays. Approximately 150 gpm of chilled well water is available for incubation and early rearing. Currently, eggs are incubated to eyed stage on chilled well water and then transferred to UV treated water system for hatching, button-up, and early rearing. Lookingglass Hatchery conducted an experimental use of Moist Air Egg Incubators to incubate a portion of the BY 2010 egg take. Results of this

experiment are discussed in Section 1.16. Based on the results at Lookingglass, and also successful use of units at Irrigon and Wallowa hatcheries, it appears that MAI technology is a viable method of egg incubation.

Because of the encouraging results of Moist Air Incubators, Lookingglass Hatchery is phasing-in the use of moist air incubators for incubation to the eyed stage and utilizing hatch boxes located inside the early rearing troughs for hatching. The intent is to reduce the demand for chillers and eliminate some of the heath stacks. This will result in more floor space to add additional early rearing troughs to lower early rearing densities.

Lookingglass Creek stock will be incubated at Lookingglass Hatchery using a combination of chilled and un-chilled well water, UV treated ($>60,000$ uw/cm²/sec) creek water and moist air incubator. A Moist Air Incubator will be used on a cross section of Lookingglass Creek adult's eggs. Eggs from approximately 30 females will be used. Additional moist air incubators will be acquired with the capacity to incubate approximately 500,000 eggs.

5.5) Rearing facilities.

Lookingglass Hatchery – There are 30 Deep Canadian troughs for early rearing with a capacity of 200 to 250 pounds (117 ft³) of fish each. Lookingglass stock fry will be loaded at 30,000 to 50,000 per trough. The outside rearing containers include 18 raceways with rearing volume of 3,000 ft³ (10'x100'x3'), two adult holding raceways of 3,200 ft³ (10'x 80'x 4') divided into two halves by a concrete wall installed down the center of the adult holding pond, and three adult circular holding tanks 1,100 ft³ (20'x4'). Final rearing is in 18 concrete raceways (4,000 ft³) with 3,000 ft³ cubic feet of rearing space. The adult holding ponds serve a dual purpose of adult holding and juvenile final rearing. Final rearing density indices range from 0.17 to 0.24.

Irrigon Hatchery - The main hatchery building includes 68 6' diameter x 2.42' depth circular fiberglass tanks. The outside concrete raceways used for rearing include 32 raceways which are 100'x20'x5' with a capacity (at 3.5' water depth) of 7,000 cubic feet per pond. Two banks of raceways exist, 16 upper and 16 lower raceways in series. Water flows from the upper series of raceways and is re-used in the lower series prior to discharge.

Up to 250,000 Lookingglass Creek fry are transferred to Irrigon Hatchery in April and returned to a Lookingglass Hatchery adult holding ponds in late September.

5.6) Acclimation/release facilities.

Lookingglass Hatchery — Lookingglass Hatchery fry will be transferred outside in April or early May. Up to 250,000 fry will be transferred to Irrigon in April and returned to Lookingglass in late September. Chinook smolts released into Lookingglass Creek are reared in one or more adult holding ponds and transferred to empty production raceways

prior to release as smolts. No additional in-stream acclimation takes place for the program fish.

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

Due to freezing temperatures in winter months icing events and blockage at water intake may occur at Lookingglass Hatchery. The following three scenarios can cause ice buildup and blockage of the intake:

- A 1 to 3 week period brought on by sub-zero air temperatures.
- A 1 to 3 week period of sub-zero temperatures followed by heavy snow resulting in slush ice.
- Quick warming temperature resulting in blocks of ice breaking loose from Lookingglass Creek and lodging against the intake screens.

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 pond in the same building as the Lostine fish. The maintenance stopped flow into the circular pond and consequently the fish died of oxygen depletion before water flow could be returned. No Lostine stock adult mortality occurred during this event.

On June 3 2010, heavy rains that had persisted for several days caused elevated flows in Lookingglass Creek. The creek water was a muddy due to high debris load, and looked very turbid. Water flows in the creek were high enough that creek water flow was going over the top of screens in place on the outside of the hatchery water intake. The screens are the first line of defense in keeping debris out. The debris coming over the top penetrated the second set of screens which are traveling water screens and traveled into and through the hatchery water supply line. Water from this supply line was diverted to the hatchery's UV treatment system for UV disinfection before the water was distributed throughout early rearing troughs inside the hatchery building. The UV treatment system has a third 40 micron drum filter with a water spray system to spray debris and small matter off into a waste channel and drain. The spray bar pump for the spray bar system is supplied water from the domestic well located at the hatchery. Coincidental to the environmental condition of Lookingglass Creek, construction of two additional residences by private contractors was ongoing. The private contractors dug through an underground domestic water line and in their efforts to shut off the water which was rapidly leaking out of the system, the private contractors turned off the domestic well and thereby turned off the water supply to the spray bar pump. There was no backup system in place for an event like this. The water line was repaired after a few hours; however the contractors were unable to re-start the domestic well and had to wait until the next day before a professional could address the water well situation. Lookingglass Hatchery staff monitored the UV system and at quitting time, the lack of water to the spray bar pump did not seem to be having any adverse effect on the UV system or its function. However, during the night, the drum filter clogged with debris and without a spray bar pump to

spray the debris to the waste channel, the debris passed through the drum filter and clogged a screen which provides protection to the UV lamps in the UV system. When this screen clogged, water flow was shut off to the rearing containers in the hatchery building resulting in oxygen deprivation and the suffocation of 496,000 fry. The UV system had no alarm system and therefore the loss was not noticed until the next morning. Since the loss occurred, new alarm systems monitoring water depth in the UV treatment have been installed and the management approach for operation of the UV system was modified.

Predation – Due to worn out netting at Irrigon Hatchery, annual bird predation was estimated at 10-15% per pond in 2010 and 2011. The majority of predation occurred in March – July, while young were nesting. New netting was acquired in July 2011, and installation has been completed.

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

Lookingglass Hatchery

Lookingglass Hatchery is staffed full time and equipped with various water alarm systems to help prevent catastrophic fish loss resulting from water delivery failure. The intake well (TW2) is operated for icing emergencies. There is a backup diesel motor for TW2. There are low water alarms on all raceways and circulars. Annual removal of gravel deposition near the intake and screen maintenance occurs.

- Lookingglass Hatchery assigns one person to perform on call duty 24/7 to answer and respond to alarm and emergency situations. The hatchery is equipped with water alarm systems to help prevent catastrophic fish loss resulting from water delivery failure. New alarms have been added at critical water monitoring points in the water delivery system particularly the UV system, since the losses in 2010.
- Use UV efficiency test results in combination with staff judgment regarding environmental conditions of Lookingglass Creek to decide when to by-pass the UV treatment and filtration system.
- Operate intake well (Tempering Well 2) for icing emergencies at intake
- Maintain back-up diesel motor for Tempering Well 2
- Low water alarms
- Monitor facilities operation during high flow events
- Maintain screens in working order
- Keep trap and ladder area free of debris
- Annual removal of gravel deposition near the intake

Irrigon Hatchery

Irrigon Hatchery is staffed full time and equipped with various water alarm systems to

help prevent catastrophic fish loss resulting from water delivery failure. The facility alarm system is antiquated, however, and ODFW is in the process of updating the system.

The Irrigon Hatchery rearing water supply system consists of five well stations that have a total of seventeen pumps. In the event of a power failure, well stations #1, #2, #3 and the hatchery building each have a diesel generator for backup power. Well stations #4 and #5 share a single generator. All of the well station generators have automatic transfer switches to start them immediately and supply emergency power when the commercial power fails.

In the event of a single pump failure, the hatchery has enough reserve pumping capacity that it would not cause any significant loss of water to the hatchery building or the rearing ponds.

The hatchery building and incubation rooms have an automatic system that will transfer the water supply from the chiller booster pumps to direct gravity feed from the aeration building in case of a booster pump or power failure. The chiller room has a total of three booster pumps. The chillers only require two pumps to operate allowing the third pump to act as a backup in case of an emergency.

Whereas the Irrigon Hatchery uses only ground water sources for rearing, there would be no danger of flooding at the facility.

The Irrigon Hatchery water supply alarm system has annunciation points for the following locations and problems:

- Well station generators - running and trouble
- Well station pumps and motors - failure
- Aeration building - low water level
- Thirty two individual rearing ponds - low water level
- Chillers and booster pumps - failure
- Hatchery building and incubation rooms - low water pressure

During an alarm event, a siren sounds on the roof of the hatchery building and is acknowledged on a display panel within the hatchery building. A new Zetron hand held radio system that will also announce the alarms is currently on order and should be in operation by the end of December 2011.

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.

Lookingglass Creek Sp/Su Chinook HGMP

Releases up to BY 2001 were from Rapid River/Carson out-of-basin stocks. The last marked adults from these releases returned in 2002. Unmarked adults, considered naturalized from Rapid River/Carson stocks, continued to return through 2008 and were phased out of the program and replaced with Catherine Creek stock using surplus production from the Captive Broodstock Program. Broodstock for the Lookingglass Creek program are collected from Catherine Creek adults that returned to Lookingglass Hatchery and Catherine Creek weir and originated from Captive Broodstock produced smolts. The first returns (jack) occurred in 2003 from parr released in 2001 (BY 2000). Adults will be trapped in the upper Lookingglass Hatchery trap. Adults were passed above the weir beginning in 2004.

6.2) Supporting information.

6.2.1) History.

The Grande Ronde Basin LSRCP spring Chinook salmon program was established in the late 1970's in response to the severe declines that occurred in the mid-1970s and the depressed status of all populations in the basin. Annual adult mitigation, broodyear specific smolt-to-adult return and total survival rates, and annual smolt production goals were established to compensate for the estimated annual loss of 48% of the basin adult production.

During the construction phase of Lookingglass Hatchery in the late 1970s, it was thought there were too few natural fish returning to Lookingglass Creek to develop adequate broodstock in a short time frame. ODFW decided that broodstock development and smolt production goals could be more quickly achieved by importing hatchery stock from outside the basin. In 1978, the first eggs were taken from Rapid River stock (Idaho) and smolts were released into Lookingglass Creek in 1980. Due to egg availability and disease concerns, Carson stock began to replace the Rapid River stock in the mid-1980s. However, Rapid River stock was again imported throughout the late 1980s and early 1990s (Lower Snake River Compensation Plan Status Review Symposium 1998).

In the early 1990s, two major policy rulings influenced the Grande Ronde Basin spring Chinook salmon hatchery program. In 1990, ODFW adopted the Wild Fish Management Policy, which established guidelines for the maximum acceptable level of non-local origin hatchery fish that would spawn in nature with local populations. In 1992, naturally produced Grande Ronde Basin spring Chinook were listed as threatened by the National Marine Fisheries Service (NMFS) under the ESA. The existing hatchery operations were inconsistent with conservation and recovery opinions.

In 1995, co-managers made a decision to use native stock and shift the focus of the program from mitigation to conservation. The decision was a result of a number of factors including: increased emphasis on natural production and native stock recovery; consultations and requirements resulting from Endangered Species Act listing of Grande

Ronde Chinook populations as endangered; a lack of success in using non-local stocks for supplementing Grande Ronde Chinook populations; preferred strategies for use of artificial propagation identified in the NFMS draft recovery plan and recommendations of an Independent Scientific panel (Currens et al. 1996), which was convened under the U.S. v. Oregon dispute resolution process.

Currens et al. (1996) indicated that there remained significant genetic differentiation among natural populations and between hatchery populations and the natural populations, even though significant outplanting and straying of non-local hatchery fish had occurred. Other assessments have also identified significant genetic differentiation between hatchery and natural populations and among the Minam, Wenaha, Grande Ronde, Lostine Rivers and Catherine Creek natural spawners (Currens et al. 1996; Waples et al. 1993).

Due to the very low abundance of natural origin fish remaining in Grande Ronde populations and given the uncertainties of using artificial production to increase natural production, two approaches to hatchery supplementation were implemented using endemic stocks: Captive Broodstock and Conventional Broodstock.

The intent of the Captive Broodstock program is to maintain natural escapement above a minimum threshold to prevent extinction. As natural production and escapement increases, a more traditional or conventional approach to supplementation can be implemented to achieve LSRCP objectives.

The *Captive Broodstock* program was initiated because Catherine Creek, Lostine River, and Upper Grande Ronde River populations were below viable population thresholds with spawning escapement below 50 fish during the mid-1990s (LSRCP Symposium, 1998). The Catherine Creek spring Chinook hatchery program was initiated with the collection of wild parr for the Captive Broodstock Program in 1995.

Catherine Creek captive broodstock program adults served as the only source of Catherine Creek broodstock for the 1998-2000 spawn years. From 2001-2004, captive broodstock adults and natural-origin adults collected in Catherine Creek were the broodstock sources. Conventional hatchery produced adults, captive broodstock, and natural-origin adults all contributed to Catherine Creek hatchery production for 2005-2009. Conventional hatchery adults and natural adults are spawned together and captive broodstock adults are always spawned separately. Conventional and captive offspring are reared separately and uniquely marked to allow identification at the adult stage.

For a minimum of ten years to evaluate the efficacy of the program, juveniles were reared to near smolt stage at Lookingglass Fish Hatchery, a portion of the smolts transported to Bonneville Fish Hatchery (BOH), and the remaining smolts transported to NMFS Manchester Research Station (MRS), where they were reared to maturity. Maturing adults were transported from MRS to BOH and all fish spawned at BOH. Captive broodstock progeny were incubated to eyed stage at Oxbow Hatchery then transported to LGFH for final incubation and rearing to the smolt stage. Resulting smolts were released

into Catherine Creek.

Catherine Creek stock captive broodstock progeny were released into Lookingglass Creek in the fall of 2001 and spring 2002. Co-managers reached agreement in 2002 on the comprehensive management plan for Grande Ronde Basin spring Chinook salmon. This agreement includes the use of F1 captive broodstock progeny from Catherine Creek stock in Lookingglass Creek to reestablish a naturally reproducing population.

The Captive Broodstock Program began with a goal of 150 Catherine Creek adults consistently returning to the program stream. Catherine Creek has had at least 150 adults (range 229-1,553) returning to the mouth each year since 2001. Therefore, brood year 2005 was the last cohort collected and the last salmon from that cohort were spawned in 2010.

The Conventional Broodstock program was initiated in 2004. Spawning data is summarized in Table 16. Broodstock for the program will be collected from returns to either the Lookingglass Hatchery weir or the Catherine Creek weir. Either conventional or captive hatchery adults may be used for brood.

Table 16. Lookingglass spring/summer Chinook salmon spawning data for 2004 - 2011 brood 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 Poned (1,000's)	Smolts releases (1,000's)
2004	56	53	--	--	0.0%	0.95	2,867	172	146	150
2005*	--	--	--	--	--	--	--	--	--	--
2006*	--	--	--	--	--	--	--	--	--	--
2007	41	23	--	--	0.0%	0.56	2,997	68	51	N/A
2008	128	76	24	--	12%	0.50	3,768	286	N/A	N/A
2009	8	7	15	19	56%	0.88	3,909	101	99	103
2010	50	55	26	20	30%	0.98	4,002	300	255	N/A
2011	41	50	33	29	68%	1.06	N/A	N/A	N/A	N/A

* Years 2005 and 2006, all fish released to spawn naturally.

6.2.2) Annual size.

The goal for Lookingglass Creek spring/summer Chinook program is to release 250,000 smolts annually into Lookingglass Creek. To produce 250,000 smolts annually about, 158 adults (1:1 sex ratio) will be required in each brood year. Actual collection goals are established each year through development of the annual operation plan. The number of males and females of both marked and unmarked fish spawned in the past are reported in Table 16.

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

The numbers of natural/wild fish used in the past as broodstock are reported in Table 16. The proportion of naturally-produced fish to hatchery-produced fish used for broodstock is directed by guidelines outlined in Section 5.1, Table 3 (Section 1.11.1). The proposed number of natural and hatchery-origin adults for broodstock is 158 adults (47 natural-origin and 111 hatchery-origin).

6.2.4) Genetic or ecological differences.

There is currently no information about genetic and ecological differences between the currently used hatchery stocks and wild stocks. Annually, broodstock composition incorporates locally adapted naturally produced fish that should minimize the genetic and ecological differences between the two populations.

6.2.5) Reasons for choosing.

The chosen broodstocks are indigenous to the Grande Ronde Basin and it is expected that the offspring will have better adaptation to Lookingglass Creek. Fish are collected at tributary weirs and from natural production areas in two target tributaries (Lookingglass and Catherine creeks). Therefore, broodstock sources incorporate naturally-produced fish in order to maintain local adaptation and wild type characteristics.

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.

As the current program is designed for Chinook re-introduction/recovery, it is necessary that locally adapted natural fish be incorporated into broodstock each year. However, based on the projected run size of natural fish, a sliding scale shall be followed to determine the number of listed natural fish to be selected for brood so that the continued existence of listed natural fish is not jeopardized due to brood selection (see Section 1.11.1, Table 3). Conventional adult broodstock is selected systematically from across the run time as long as the weirs are operational. Pass/keep ratio varies annually depending on return projections, and is adjusted in-season to ensure representation from across the run as described in Table 3. As described in Section 1.7 (recovery goals, strategies, and actions), the long-term intent for this hatchery program is to assess the feasibility or re-establishing a natural population and using findings from this evaluation to develop a long-term strategy for how this population will aid in the recovery of this MPG.

SECTION 7. BROODSTOCK COLLECTION

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

Conventional broodstock adults are collected for the Lookingglass program.

7.2) Collection or sampling design.

All adults that enter the Lookingglass Creek trap are sorted by origin (marked conventional or unmarked), gender, and age. Fish are retained for broodstock, out-planted, released above the weir, provided to food banks, or provided to tribes for ceremonial and subsistence use. Ratios vary annually depending on escapement estimates and the guidelines outlined in Table 3 and the Lookingglass Creek Spring Chinook Management Plan or AOP. Adults are selected randomly from the available fish for use as broodstock. Fish not retained for broodstock are marked with an opercle punch and released above the weir. Hatchery jacks may be placed above the weir, and in combination with wild jacks, comprise up to 10% of the total males passed. Surplus hatchery jacks may also be released downstream to be recycled through fisheries when they occur. Trap efficiency varies by year. Dates of Lookingglass Hatchery weir operation and spring Chinook collection and spawning dates are included in Table 17. Information on Catherine Creek weir operation dates and Catherine Creek spring Chinook collection and spawning dates is located in Table 17, Section 7.2, of the Catherine Creek spring/summer Chinook HGMP (2011).

Table 17. Dates of Lookingglass Hatchery weir operation, spring/summer Chinook salmon collection, and spawning dates from 1994 to 2011.

Run Year	Operation of Lookingglass weirs		Collection at Lookingglass		Spawning at Lookingglass Hatchery	
	Beginning	Ending	Beginning	Ending	Beginning	Ending
1994	24-May	21-Sep	2-Jun	8-Sep	24-Aug	21-Sep
1995	26-Apr	21-Sep	2-Jun	31-Aug	24-Aug	21-Sep
1996	1-May	10-Sep	22-May	5-Sep	20-Aug	26-Sep
1997	28-Apr	15-Sep	5-Jun	15-Sep	*	*
1998	1-Apr	30-Sep	2-Jun	3-Sep	**	**
1999	16-Jun	9-Sep	16-Jun	9-Sep	**	**
2000	19-May	1-Sep	22-May	1-Sep	***	***
2001	9-May	15-Sep	9-May	10-Sep	***	***
2002	21-Mar	3-Oct	5-Jun	21-Aug	***	***
2003	7-Mar	18-Sep	21-May	4-Sep		
2004	2-Mar	1-Oct	28-May	14-Sep	26-Aug	13-Sep
2005	22-Feb	12-Sep	30-May	7-Sep	~	~
2006	13-Mar	15-Sep	6-Jun	28-Aug	~	~
2007	27-Mar	17-Sep	12-May	3-Sep	29-Aug	11-Sep
2008	1-Mar	8-Sep	7-Jun	4-Sep	13-Aug	8-Sep
2009	4-Mar	11-Sep	5-Jun	10-Sep	20-Aug	10-Sep
2010	1-Mar	10-Sep	14-May	3-Sep	12-Aug	9-Sep
2011	28-Feb	12-Sep	1-Jun	9-Sep	18-Aug	8-Sep

Notes: Rapid River/Carson stock only. Composite stock phased out with last spawning in 1999.
 *Spawned at Wallowa Hatchery
 **Spawned at South Fork Walla Walla and Lyons Ferry
 ***Adults returned to Lookingglass Creek
 ~ All fish released to spawn naturally.

7.3) Identity.

Naturally-produced fish are identified based on lack of marks or tags. All smolts that will be released into Lookingglass Creek from conventional broodstock will be marked with an adipose fin clip with a representative coded wire tag groups. All captive brood releases will be 100% adipose clipped and coded wire tagged.

7.4) Proposed number to be collected:

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

Collection is not expected to exceed 158 adults (79 males and 79 females).

7.4.2) Broodstock collection levels for the last five years, 2003-08:

Broodstock collection levels, egg take, and juvenile production of spring/summer Chinook at Lookingglass Hatchery is included in Table 18.

Table 18. Broodstock collection levels, egg take, and juvenile production of spring/summer Chinook (Stock 81) at Lookingglass Hatchery, 2004 - 2011.

Year	Adult Females	Adult Males	Jacks	Green Eggs	Juveniles
2004	59	65	4		149,857
2005	0	0	0		0
2006	0	0	0		0
2007	25	16	27		
2008	77	60	3		
2009	26	23	27		101,637
2010	75	76	8		300,180
2011	79	70	7		318,779

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

Lookingglass Creek Sp/Su Chinook HGMP

- Adults are passed upstream consistent with the adult sliding scale guidelines outlined in Section 5.1. Jacks are distributed to local food banks when possible or recycled downstream of the trap for fisheries. Hatchery adults are outplanted in designated areas (Lookingglass Creek Spring Chinook Management Plan 2011).
- Surplus adults and jacks are given to the Tribes for ceremonial and subsistence purposes
- Used for nutrient enhancement (hatchery origin jacks)

7.6) Fish transportation and holding methods.

During Lookingglass fish trap operations, fish are sorted (released above the weir or kept for broodstock) daily. Fish may be held in the trap for a maximum of 48 hours. Adults are transported from the Lookingglass trap to the hatchery adult holding pond in a 100 gallon tote equipped with a lid and supplemental oxygen.

Adults may be anesthetized with MS 222 prior to biological sampling and antibiotic injections.

Adults are transported by CTUIR staff from Catherine Creek weir within 96 hours or less after collection to Lookingglass Hatchery in one of three insulated containers: 550-gallon, 400-gallon, and 250-gallon tanks. Tanks are equipped with supplemental oxygen, aeration, and alarms.

7.7) Describe fish health maintenance and sanitation procedures applied.

Collection - Adults retained for broodstock are injected with oxytetracycline (10 mg/kg) and erythromycin (Erythro-100 @ 20 mg/kg) at the Lookingglass Creek trap.

Holding - At Lookingglass Hatchery, formalin is dripped into the inflowing water to achieve a concentration of 167 ppm. The treatment is applied for a minimum of three days per week for one hour to control fungus and parasites. Frequency of treatment is adjusted on an as needed basis.

Spawning - All hatchery-spawned females are screened for *R. salmoninarum* using enzyme-linked immunosorbent assay (ELISA). A minimum of 20 pre-spawning mortality adults (if available) are examined for systemic bacteria and BKD. A minimum of 60 spawned fish are sampled for culturable viruses using ovarian fluid and caeca/kidney/spleen sample pools of up to 5 fish.

Progeny - Eggs are water hardened in 100 ppm iodophor solution for a minimum of 15 minutes to control vertical transmission of pathogens including IHNV and *R. salmoninarum* (BKD). Bacterial Kidney Disease (BKD) is of special management concern with the Lookingglass Creek spring Chinook program. Adults from this program released above the hatchery can release pathogens that enter the facility water supply,

potentially jeopardizing production for multiple programs. Due to this disease concern, eggs for the Lookingglass Creek program will be culled at a more restrictive level than that agreed upon in the Grande Ronde Spring Chinook Hatchery Management Plan. Eggs from individual females will be incubated separately and those with an ELISA value of 0.20 or higher will be culled from the program and destroyed per the 2011 Lookingglass Creek Spring Chinook Management Plan.

The level of infection in eggs is categorized by the following ELISA value reading:

- ≤ 0.199 = Low
- $0.2 - 0.399$ = Moderate
- $0.4 - 0.799$ = High
- ≥ 0.800 = Clinical

Progeny receive a minimum of one 28 day erythromycin (Aquamycin) feed treatments (INAD 110RLOSCS1) to control BKD.

Disease outbreaks are treated on a case-by-case basis. Therapies and remedial measures are based on conventional and available treatments, new information, and innovation. Warm water therapy can be used if EIBS becomes a problem. It would be used, based on priorities of stocks and raceways affected, after consultation with appropriate entities. Formalin treatments, at the recommendation of Fish Health Services, can be implemented for parasitic infestations.

Disinfections and sanitation guidelines for Lookingglass Hatchery are outlined in Table 19.

Table 19. Recommended disinfectants, concentrations, and treatment duration at Lookingglass Hatchery. Disinfecting and disinfected water are disposed of as per labeling requirements.

Disinfectant	Application	Concentration	Time	Comment
Iodophor	Nets, gear and equipment, clipping & tagging van, PIT tag stations, large tub disinfectant containers, spawning colanders and buckets, lib truck, footbaths, floors	100 ppm Note: to make 100 ppm solution mix 6.7 oz of jug strength iodophor to 5 gallons H ₂ O 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
Iodophor	Water hardening eggs	100 ppm	Minimum 15 minutes	This is the statewide general practice
Iodophor	Egg transfers-disinfection at	100 ppm	10 minutes	

	receiving stations			
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	Footbaths, nets, boots, and gear			As per label instructions
Chlorine or Aqueous solution as sodium hypochlorite (Household Bleach)	Lib truck tanks Raceway disinfection	100 ppm 100 ppm	10 min.	Organic matter binds and neutralizes Left to dry and breakdown in sun. Make sure no bleach enters effluent

7.8) Disposition of carcasses.

Spawned carcasses are disposed of in the hatchery landfill. Carcasses may be screened for pathogens BKD, IHN, and *M. cerebralis*. Surplus carcasses may be used for nutrient enrichment consistent with MOA between ODFW and DEQ.

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.

- Broodstock will be collected throughout the run so that any particular segment of the run is not seriously affected.
- Only a portion of the adult collections will be used for broodstock and the remaining fish will be released upstream without harm for natural spawning so that continued existence of the natural run is not jeopardized.
- The risk of fish disease amplification or transmission will be minimized by consulting with the Fish Health Specialist 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 based on ELISA values.
- Brood collection will be stopped during higher temperatures to minimize stress and/or adult mortality, as suggested in the AOP (2011).
- Adults arriving at the weir that are identifiable as Upper Grande Ronde will be hauled to the Upper Grande Ronde River. Other identifiable strays will be removed and not spawned.
- Conventional and captive brood releases will be 100% adipose clipped.

SECTION 8. MATING

Lookingglass Creek Sp/Su Chinook HGMP

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

8.1) Selection method.

Conventional Broodstock - Adults are collected daily throughout the operation of the weir. From the collected fish, a predetermined number of adults by age, sex, and origin, are selected systematically. Ripe females are selected randomly for spawning on a specific spawning day.

8.2) Males.

Conventional Broodstock - The majority of fertilization occurs with age-four and age-five males. Three-year-old males (jacks) are also included in the gene pool. When an abundant number of jacks are collected, typically hatchery origin, milt is used to fertilize a maximum of 10% of the available eggs. Starting in 2010, a target of at least 30% of the eggs will be fertilized with larger (>80 cm) and presumably 5 year old males. Large males may be spawned up to 3 times. Frequently, natural origin males are used multiple times to increase their contribution.

8.3) Fertilization.

Conventional Broodstock – Matrix or factorial spawning is used. Most adult spawning matrices will be 2 females x 2 males, but matrices of 1 x 1, 1 x 2, 2 x 1, or 3 x 2 can be used if necessary. Therefore, each matrix generates two to nine family pairs. The goal is that 30% of the progeny is produced from natural-origin adults.

Target gender ratio for this program is a 1:1 male-to-female adult spawning ratio; however, natural origin males will be prioritized if male numbers are low.

8.4) Cryopreserved gametes.

Conventional Broodstock - Cryopreserved milt/gametes have been collected and maintained by the Nez Perce Tribe at the University of Idaho and Washington State University. From 2000 through 2008, milt from Catherine Creek conventional broodstock was collected and cryopreserved. No gametes from Lookingglass stock fish have been cryopreserved. The collection of milt/gametes for the cryopreservation program ended in 2008.

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. Refer to Section 7 for fish health and sanitation procedures.

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.

There is no current goal; however, an estimate of 75% 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.

Conventional Broodstock –

Adult collections and spawning has occurred from 2004-2011 (Table 20). In 2004, we started using an egg counter to determine fecundity and survival.

Table 20. Egg take, survival of green eggs to eyed stage and eyed-eggs to ponding for spring/summer Chinook (stock 81) at Lookingglass Hatchery, 2004-2011.

Year	Egg Take Estimated	Egg Loss		% Survival to Eyed Stage	Fry Loss		% Survival to Ponding
		Total	% Loss		Total	% Loss	
2004	172,476	26,126	15.1	84.9	601	0.4	84.5
2005	None	0	0.0	0.0	0	0.0	0.0
2006	None	0	0.0	0.0	0	0.0	0.0
2007	68,055	15,722	23.1	76.9	1,516	2.9	74.7
2008	286,383	22,854	8.0	92.0	2,870	1.1	91.0
2009	101,637	2,704	2.7	97.3	514	0.5	96.8
2010	300,180	42,202	14.1	85.9	1,190	0.5	85.5
2011	318,000	26,760	8.4	91.6	n/a	n/a	n/a

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

Every attempt will be made to adhere to the production goals. However, surplus production may occur due to higher than anticipated fecundities or survival rates. Any production above the identified goals will be reared to full term yearling smolts if hatchery space is available. If space is not available, surplus production will be

outplanted as fry or fingerlings in the fall into lower Lookingglass Creek. These fish would be 100% marked to indicate hatchery origin.

9.1.3) Loading densities applied during incubation.

Conventional Broodstock - Eggs are incubated in vertical Heath trays. Each female's eggs will be incubated in one tray until disease screening profiles results are completed. Eggs may be combined after fecundity estimates are completed. After BKD ELISA values are known, eggs are recounted and 5,000 eggs are loaded into each tray. Flows are regulated at 5 to 6 gpm per vertical stack. Lookingglass Hatchery experimented with Moist Air Egg Incubators in 2010. Moist air incubators are being considered for future egg incubation where approximately 1,400-2,000 eggs will be loaded in each 1.2 liter container.

9.1.4) Incubation conditions.

Conventional Broodstock - Eggs are incubated on UV treated Lookingglass Creek water supplemented with artificially chilled well water until the ambient water temperature of Lookingglass Creek cools, historically around the 3rd week of September. After Lookingglass Creek temperatures cool, only UV treated creek water is used to incubate eggs. However, eggs from late spawning conventional and captive brood can be incubated in creek water supplemented with pathogen free well water. The well water is 14° C and is used to temper the cold creek water temperatures common in winter, to accelerate growth and development.

Water temperature is monitored using thermometers and recorded daily in the morning and afternoon to determine thermal units (TUs). Daily thermal units are used to calculate celsius thermal units (CTUs) to determine developmental stages in incubating eggs. Eggs are picked at approximately 325-350 CTU's (585 - 630 FTU's). Fry are visually inspected to determine if they are buttoned up prior to ponding and feeding. At approximately 1,000 CTU's (1,800 FTU's) feed is presented to the swim-up fry.

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. After eyeing, dead eggs and fry are handpicked and enumerated, and data are recorded in the HMIS system.

If moist air incubators are deployed, upwelling incubators or hatching boxes will be used, located inside the early rearing trough.

All eggs for Lookingglass Creek stock are incubated at Lookingglass Hatchery.

9.1.5) Ponding.

Fry are ponded in double deep troughs at approximately 50,000 fish per container.

Conventional Broodstock - Fry are ready to pond at about 1,000 CTUs (1,800 FTUs). Fry weight at ponding is estimated at approximately 0.4 grams each or 1,200-1,300 fish per pound.

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. After eyeing, dead eggs and fry are hand-picked and enumerated. Inventory data are recorded in the HMIS system.

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 incubated at Lookingglass Hatchery on pathogen-free UV treated creek water, or pumped well water. Eggs are fertilized at the hatchery and water hardened in 100 ppm iodophor for a minimum of 45 minutes to one hour.

Water supply to incubation units is monitored by high/low level water alarms. Incubation water temperature is monitored twice daily.

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 (1999-2010), or for years dependable data are available.

Conventional Broodstock - Survival data is categorized below and production projections are modeled using 75% survival of green eggs to smolt.

- Green egg to eyed-egg: 90%
- Eyed-egg to swim-up fry: 91%
- Swim-up fry to fingerling (marking): 93%
- Fingerling to smolt (marking to release): 99%

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

Lookingglass Hatchery

Up to 250,000 Lookingglass Creek fry are transferred to Irrigon Hatchery in April and returned to a Lookingglass Hatchery adult holding pond in late September. The target goal of 250,000 for release results in a loading density of 62,500 smolts per adult pond and a density of .22 lbs/ft³.

Irrigon Hatchery

Maximum density for one pond is ten thousand pounds, or 1.3 lbs/ft³. Three ponds were used in 2010-2011. The heaviest density was 3,400 pounds, or .45 lbs/ft³.

9.2.3) Fish rearing conditions.

Lookingglass Hatchery - Fish are reared in UV treated creek and pathogen free well water (5° C to 10° C) from late-January to April. Flows are set to maintain acceptable flow indices; however the UV system limits flow capacity to a maximum of 50 gpm per trough. Troughs are cleaned and mortalities removed regularly.

Lookingglass Creek juveniles are transferred to Irrigon Hatchery in late April for further rearing and marking before they are returned to Lookingglass Hatchery in late September or early October, for final rearing and release into Lookingglass Creek in the following year.

Irrigon Hatchery - Fish are reared in well water (seasonal temperature variations 50°F to 62°F). Dissolved oxygen levels are monitored during peak production and maintained above 6 ppm. Raceways are cleaned weekly and mortalities are picked daily.

Lookingglass Hatchery (final rearing) – Lookingglass Creek fish are returned to Lookingglass Hatchery in late September or early October, and transferred to outside adult holding ponds. Adult holding ponds are cleaned weekly and mortalities picked daily. Fish remain in the adult holding ponds until March and April of the following year, when they are released directly into Lookingglass Creek. Water temperature varies seasonally from 0.5° C to 20° C.

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

Fish growth information by month, from initial ponding to release, for Lookingglass Creek Conventional progeny at Lookingglass Hatchery, averaged for Brood Year 2007 and Brood Year 2009 is presented in Table 21.

Table 21. Monthly weights (fish/lb) of Lookingglass Creek spring/summer Chinook (stock 81) juveniles at Lookingglass Hatchery averaged for Brood Years 2007 and 2009.

Month	Weight (g)	Fish/Pound
January		Not Poned
February	0.55	899
March	1.00	460
April	2.04	223
May	2.61	174
June	4.54	100
July	6.73	68
Aug	10.55	44
Sept	13.07	35

Oct	14.93	31
Nov	15.67	29
Dec	16.24	28
Jan	17.14	26
Feb	19.33	24
Mar	25.00	19
Apr	22.70	20

Fish growth information by month from initial ponding to release for Brood Year 2008 Lookingglass Creek Conventional progeny reared at Irrigon Hatchery is presented in Table 22.

Table 22. Monthly weights (fish/lb) of Lookingglass Creek spring/summer Chinook (stock 81) juveniles at Irrigon Hatchery for Brood Year 2008.

Month	Weight (g)	Fish/Pound
April	1.82	250
May	3.78	120
June	5.68	80
July	15.13	30
August	16.81	27
September	19.74	23

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

The specific growth rate was calculated from the growth modeled in Table 21. The highest growth rates occurred in February and March with the lowest growth rates in December and January. Growth rates declined August through October with decreasing water temperatures and photoperiod (Figure 2). Fish appear to lose weight in November with little weight gain in December and January. Winter time cold water and icing conditions greatly reduce feed levels.

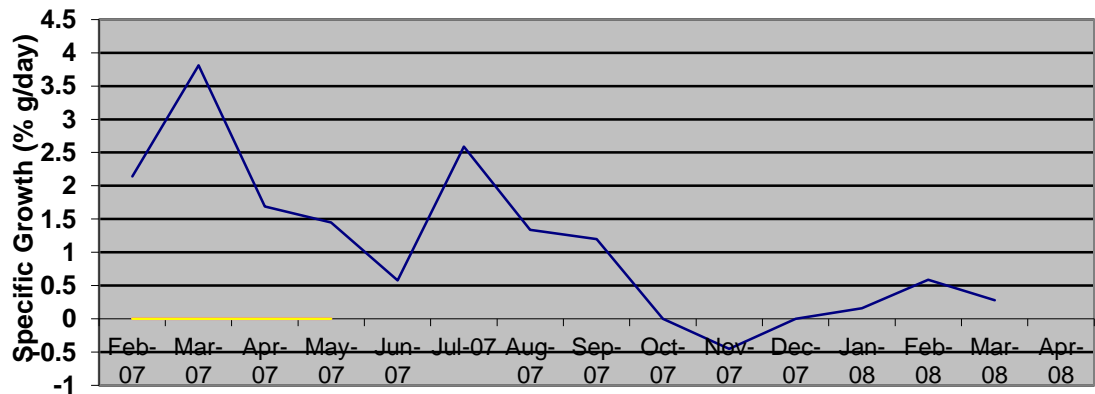


Figure 2. Calculated growth rates for BY07 Chinook stocks at Lookingglass Hatchery.

No hepatosomatic index (liver weight/body weight) and body moisture content was collected to estimate body fat concentration during rearing.

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 Hatchery, fish have been fed BioOregon's Bio-diet starter and Bio Diet fry feeds. The feed is distributed to the raceways with air blower feeders and by hand during periods of cold temperatures. One 28-day erythromycin medicated feed treatment is given using Bio-Oregon feed at a target body weight of 1.9%.

Feed rate:

- Start 5.0% body weight/day
- November through January fish are fed intermittently at "maintenance" ration 0.1-0.2%.
- Final rearing 0.1-0.2% body weight/day

Overall food conversions are 1.1-1.3.

At Irrigon Hatchery, fish have been fed Bio Diet Dry Feeds. Feed is distributed to the raceways via LinTec feeders. One 28-day erythromycin feed treatment is given using Bio-Oregon feed at a target body weight of 1.9%.

Feed rate:

- Feed rates are started at 5.0% body weight/day
- The feed rate ranges from 0.3-0.4% body weight/day while the fish are being reared at Irrigon Hatchery.

The average conversion rate for Lookingglass Creek spring Chinook (By 2008-2010) reared at Irrigon Hatchery is 0.89.

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

At Lookingglass and Irrigon hatcheries, monthly sample of about 10 (or available) moribund and/or dead fish will be examined for *R. salmoninarum* (BKD) and systemic bacteria. Tissues (gill/kidney/spleen) will be assayed for culturable viruses from a sub-sample of fish. Every other month, 5 grab-sampled fish per stock will be examined and any moribund fish (monthly) for erythrocytic inclusion body syndrome (EIBS) using blood smears and hematocrits. Gill and skin wet mounts will be examined 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, smears will be made from the gills on agar medium.

BKD – One 28-day therapeutic erythromycin (Aquamycin) medicated feed treatment is scheduled. All fish receive a medicated feed treatment in July or August.

EIBS - There is no prophylaxis for EIBS except avoidance of the infectious agent. Bacterial coldwater disease is the most common secondary infection. Oxytetracycline or Aquaflor prophylaxis will likely be implemented based on the sensitive nature of this stock if conditions warrant its use.

Fungus - Formalin treatments are given for one-hour treatment for two consecutive days after fin clipping operations, PIT-tagging and VIE marking. Following Fish Health Services recommendations, formalin treatments can be implemented for parasitic infestations or other external fungus problems.

Disease Outbreak Treatment Plan - Disease outbreaks are treated on a case-by-case basis. Therapies and remedial 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 co-managers and fish pathologists.

Disease history of Lookingglass Creek adults and progeny since 2003 is included in Table 23.

Table 23. Disease history (2003 to present) of Lookingglass Creek adults and progeny^a. This table includes information from brood years 2004, 2007 and 2008-2010.

Disease or Organism	Life stage	
	Adults	Progeny
IHN Virus	Yes	Yes
EIBS Virus	No	No

<i>Aeromonas salmonicida</i>	No	No
<i>Aeromonas/Pseudomonas</i>	Yes	Yes
<i>Flavobacterium psychrophilum</i>	No	Yes
<i>Fl. columnare</i>	No	No
<i>Renibacterium salmoninarum</i>	Yes	Yes
<i>Yersinia ruckeri</i>	Yes	No
<i>Carnobacterium sp</i>	No	No
<i>Ichthyobodo</i>	No	Yes
<i>Gyrodactylus</i>	No	No
<i>Ichthyophthirius multifiliis</i>	No	Yes
<i>Epistylis</i>	No	Yes
<i>Ambiphrya (Scyphidia)</i>	No	Yes
Trichodinids	No	No
Gill Copepods	Yes	No
Coagulated Yolk Disease	No	Yes
External Fungi	Yes	Yes
Internal Fungi	No	Yes
<i>Myxobolus cerebralis</i>	No	No
<i>Ceratomyxa shasta</i>	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.

Note: The Lookingglass Creek stock Fish Health Monitoring Plan is explained in the Lower Snake Annual Operation Plan document developed annually by the co-managers in this program.

Refer to Section 7.7 for fish health and sanitation procedures.

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

Smoltification stage is determined by age, size, behavior, and physical appearance of fish. No gill ATPase enzyme activities is measured.

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

Traditional hatchery rearing methods are applied at both Lookingglass and Irrigon hatcheries. After eggs are eyed, fish are reared on natural water temperatures and photoperiods. Daily feed rations are primarily distributed with automatic feeders to limit human interaction.

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.

The incorporation of natural fish into production is intended to reduce the long-term impacts of domestication. Fish health condition is regularly monitored in each month and prior to release to minimize disease transmission to natural fish. Only certified fish are

released into the water body. Also see Section 7.7 for fish health management and sanitation practices. Ponds are cleaned and mortalities are removed regularly. Fish are released at full smoltification stage for quick outmigration to the ocean, to minimize competitive interactions with listed natural species throughout the migration corridors. Fish are released to coincide with natural fish emigration timing so that the behavioral and life history characteristics of hatchery fish become more similar to those of naturally-produced fish.

SECTION 10. RELEASE

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

Refer to Lookingglass Creek Spring Chinook Management Plan (2011).

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

Fish production surplus to program goals and rearing space at Lookingglass Hatchery can be outplanted at various age class stages. Production releases target smolt age class.

Fish production for Lookingglass Creek is comprised of surplus Captive Broodstock from Catherine Creek and conventional production from adults trapped on Lookingglass Creek and/or Catherine Creek. Up to 250,000 smolts can be released if rearing space for full term smolts is available at Lookingglass Hatchery. Planned releases are described in Table 24.

Table 24. Planned releases numbers for Lookingglass Creek spring/summer production.

Age Class	Maximum Number	Size (fpp)	Release Date	Location
Eggs	-	-	-	-
Unfed Fry	-	-	-	-
Fry	-	-	-	-
Fingerling	-	-	-	-
Yearling	250,000	17- 20	April	Lookingglass Cr.

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

Stream, river, or watercourse: Lookingglass Creek (HUC-17060104)

Release point: River Mile 2.2

Major watershed: Grande Ronde

Basin or Region: Snake River

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

Table 25. Summary of spring/summer Chinook releases by stock, number and size in Lookingglass Creek and surrounding tributaries, 1987-2011. Note: Fish have been 100% marked since BY1990 released in 1992.

Release year	Stock	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Parr	Avg size	Smolts	Avg size
1987	RR/ Carson					338,318	27.93	558,157	11.1
1988	RR					312,954	24.3	345,943	13.5
1989	RR					126,700	36.2	417,354	15.2
1990	RR							619,630	15.8
1991	RR					17,404	60.6	836,304	18.4
1992	RR							950,868	17.1
1993 (100% marking)	RR							448,291	20.0
1994	RR							764,183	18.9
1995	RR							658,230	21.9
1996	RR					30,880 ^a	151.5	139,112	20.0
1997	RR					7,230	176.3	153,478	18.9
1998	RR					98	54.8	295,559	24.1
1999	RR					57,290	127.3	312,145	21.6
2000	RR					24,201	71.4		
2001	CC- Captive Brood					51,864	24.5		
2002	CC- Captive Brood					17,880	55.9		
2003	None								
2004	CC- Captive Brood							53,333	21.2

Release year	Stock	Eggs/ Unfed Fry	Avg size	Fry	Avg size	Parr	Avg size	Smolts	Avg size
2005	LG & CC- Captive Brood					25,712	38.5	98,023	20.1
2006	LG							124,145	25.5
2007	None								
2008	CC- Captive Brood							43,218	19.5
2009	LG & CC- Captive Brood							150,477	20.3
2010	LG							262,911	18.3
2011	LG							102,828	20
Average						61,553		337,069	

^a From total, 9,657 fish were released in Little Lookingglass Creek

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

Lookingglass Creek program smolts are released from Lookingglass Hatchery in late March to mid-April to mimic natural fish emigration timing and reduce the natural and hatchery fish interactions in freshwater. The screens will be pulled allowing fish to leave for 14 days. On day 15, the remaining fish will be forced out. Lookingglass Creek stock releases from 2002-2011 are included in Table 26. Catherine Creek captive stock releases into Lookingglass Creek are included in Table 27.

Fish Health will coordinate with hatchery staff to conduct a pre-release health exam.

Table 26. Summary of Lookingglass Creek stock release dates into Lookingglass Creek, 2002-2011.

Release Year	Volitional Release	Forced release
2002	None	None
2003	None	None
2004	None	None
2005	March 18	April 8
2006	March 17	April 5

2007	None	None
2008	April 1	April 14
2009	April 1	April 14
2010	April 1	April 14
2011	April 1	April 14

Table 27. Summary of Catherine Creek captive stock, CQ 201F release dates into Lookingglass Creek, 2002-2011.

Release Year	Volitional Release	Forced release
2002	None	None
2003	None	None
2004	March 19	April 8
2005	March 18	April 8
2006	March 17	April 5
2007	None	None
2008	April 1	April 14
2009	None	None
2010	None	None
2011	None	None

10.5) Fish transportation procedures, if applicable.

Not applicable as smolts are released directly from the Lookingglass Hatchery raceways into Lookingglass Creek.

10.6) Acclimation procedures.

Not applicable as acclimation occurs in the production raceways.

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

Per Attachment C of the 2008-2017 United States vs. Oregon Management Agreement, 100% of conventional brood releases are marked with an adipose fin clip. A represented group of at least 62,500 is imbedded with a coded wire tag (CWT).

A portion of all releases is PIT tagged to evaluate out migration performance and survival.

Captive brood releases are 100% adipose clipped and CWT.

10.8) Disposition plans for fish identified at the time of release as surplus to

programmed or approved levels.

Any production above the identified goals will be reared to full term yearling smolts if hatchery space is available. If space is not available, surplus production will be outplanted as fry or fingerlings in the fall into lower Lookingglass Creek.

10.9) Fish health certification procedures applied pre-release.

Pre-transfer from Irrigon to Lookingglass Hatchery, monthly fish health inspections are conducted.

Fish health is inspected by professional fish health specialist prior to release, and only certified fish are released into Lookingglass Creek. Usually 60 normal appearing smolts are grab sampled for fish health inspection at Lookingglass Hatchery prior to release. Pre-release grab-sampled numbers may vary depending on the disease history and number of fish for a given brood year. Individual fish are examined for *R. salmoninarum* by ELISA. Five grab-sampled fish per raceway are tested for EIBS. In addition, a target of 10 moribund and/or dead fish will be tested for *R. salmoninarum* by ELISA and systemic bacteria. A subsample of mortalities will be tested for virus. Gill/kidney/spleen from grab-sampled fish are examined in 3-fish sample pools and assayed for viruses. Wet mounts of skin and gill tissue from a minimum of five live fish are examined by microscopy. At a minimum, a target of 10 (or available) moribund and/or dead fish will be sampled for *R. salmoninarum* (BKD) and systemic bacteria. A subsample of these fish will be tested for viruses.

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

The Lookingglass Hatchery manager has the authority to release fish early in an emergency due to adverse environmental conditions. Section (5.7.2) describes winter icing conditions that can result in the intake becoming blocked to inflowing water.

In the event of an emergency release, the Hatchery Manager will notify their immediate supervisor, ODFW Regional 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 released volitionally in late March to mid-April from the hatchery raceways directly into Lookingglass Creek. Any fish remaining after the volitional release are forced released. Releases coincide with warming water temperature and increasing river flow. The intent is to reduce the time fish reside in freshwater, thereby 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 retention rate
 - *(Indicators: 1a, 1b, 2b, 3a, 4a, 4b, 7a, 26a)*
- Analyze marked fish recovery data collected by others from Columbia River, Snake River and other fisheries to determine harvest numbers and rate
 - *(Indicators: 1a, 1b, 2b, 3a, 25a, 25b, 26a)*
- Conduct statistically valid creel studies in the system to determine effort and harvest of hatchery fish and incidental handling rate for other fish
 - *(Indicators: 2a, 3a, 3b, 4a, 5a, 25a, 25b)*
- Monitor smolt release size, numbers, timing, location and smolt movement
 - *(Indicators: 7a, 14b, 17a, 22a, 22b, 22c, 24a, 25a, 25b)*
- Monitor adult collection, numbers, status and disposition
 - *(Indicators: 2b, 3a, 11a, 11b, 11c, 14a, 15a, 15b, 16a, 16b, 17b, 19a, 20a, 20b, 20c, 20d, 25a, 25b)*
- Monitor survival, growth and performance of hatchery fish in the hatchery and in nature
 - *(Indicators: 6a, 25a, 25b)*
- Determine proportion of hatchery adults in key natural spawning areas and population as a whole via adult mortality recoveries or other methods
 - *(Indicators: 19a, 25a, 25b)*
- Develop genetic profiles for hatchery and natural Chinook populations in the basin and conduct regular monitoring
 - *(Indicators: 18a, 20c, 25a, 25b)*
- 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, 17b, 19a, 20b, 21a, 21b, 25a, 25b)*
- Develop and implement evaluation plans and report findings consistent with needs of the program for adaptive management
 - *(Indicators: 25a, 25b)*
- Monitor discharge water quality and water withdrawals and report annually on compliance with related permits.
 - *(Indicators: 12a, 23a, 23b, 23c, 23d)*
- Monitor health of adult and juvenile Chinook associated with hatchery production.
 - *(Indicators: 8a, 8b, 9a, 9b, 9c, 11b)*

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). Additional data collection and analyses is being conducted by the CTUIR to evaluate this program. Information on this evaluation is included in the study plan Statement of Work (Boe et al. 2011). The key information pieces are:

1. A time series of wild and hatchery spawner escapement estimates for the entire Lookingglass Creek 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).

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, funding to monitor potential hatchery/wild interaction, hatchery-origin contribution, and genetic monitoring will require commitment of additional resources. Given the questions, uncertainties and concerns associated with the potential influence of hatchery supplementation on natural populations, it is imperative that we examine potential methodologies for eliminating or minimizing and managing those effects. Our desire is to find ways to improve the hatchery program and our ability to manage it.

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 are followed in all sampling activities.
- Experienced surveyors are utilized to conduct spawning surveys. Surveyors will walk in the stream, crossing when necessary, avoiding and counting redds and observing fish.

- Experienced fish culturists and pathologists perform activities associated with fish production and fish health issues within the hatcheries.
- Experienced fish culturists stay on-call to respond to emergency alarms 24 hours per day 7 days per week.

SECTION 12. RESEARCH

12.1) Objective or purpose.

Research, monitoring and evaluation have been an integral part of this program since its inception. The purpose of all past, present and planned research is to find ways to improve this and other hatchery programs. The focus of these investigations is to improve our ability to produce hatchery-reared salmon and that those salmon have behavioral and life history characteristics that are more similar to those of natural salmon. For example, we hope to develop strategies to improve in-hatchery growth and survival, smolt-to-adult survival and age composition of returning adults, as well as methods to prevent and treat diseases.

In these studies, we monitor specific parameters, e.g., growth, health and survival in both the hatchery and in nature and compare those parameters with those of natural salmon. We have conducted experiments to improve the effectiveness of hatchery rearing, including examining the effect of exercise on smolt physiology and subsequent survival to maturation. We have also examined the effectiveness of different rearing densities and sizes at release. Future research is being developed to examine methods for increasing survival to adulthood and program efficiency and reducing the rate of jacking in hatchery salmon (by examining the genetic and environmental relationships to age at maturity).

At Irrigon, all Lookingglass Creek fish are marked differentially by raceway and a portion of fish from each raceway is PIT-tagged to monitor outmigration characteristics and survival.

Collaboration between ODFW and CTUIR is necessary to evaluate this Conventional Hatchery Program. We have been and will continue to monitor the production and life history characteristics of naturally-produced fish. The Conventional Hatchery fish are compared with natural fish: size, age, fecundity and time of maturation of adults, as well as fertility, egg size, and health, growth and survival of the F₁ generation are some of the variables compared. We can also use genetic parental analyses to compare spawning success (production of an F₂ generation) in nature between fish reared in nature vs. those reared to smolt stage in a hatchery.

In addition to research directly related to hatchery performance that is a primary focus of ODFW, the CTUIR are investigating the reintroduction of natural production above the Lookingglass Hatchery weir. Sampling activities are detailed in the 2011-2012 LSRCP

Statement of Work (Boe et al. 2011).

The CTUIR is also using the adult trap and a rotary screw trap to collect life history and abundance data on natural steelhead to use in management and recovery planning. Funding for this work is transitioning to BPA (Project 2007-083-00)

12.2) Cooperating and funding agencies.

- Lower Snake River Compensation Program
- Confederated Tribes of the Umatilla Indian Reservation
- Bonneville Power Administration
- NOAA Fisheries

12.3) Principle investigator or project supervisor and staff.

ODFW

Richard W. Carmichael

Timothy Hoffnagle

Joseph Feldhaus

Debra Eddy

Sally Gee

Shelby Warren

CTUIR

Gary James

Steve Boe

Carrie Crump

Aaron Bliesner

Gene Shippentower

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.

Conventional Hatchery Program

1. Monitoring hatchery/wild ratios in natural spawning streams - Adult spring/summer Chinook are captured and enumerated at the existing facilities: Catherine Creek and Lookingglass Creek. See section 2.2.3.

2. Spawning surveys – In addition to adult trapping, density and hatchery/wild ratio of spawners in natural spawning areas is monitored via direct observation, redd counts and carcass recoveries on the spawning grounds. See section 2.2.3.

Reintroduction of Spring Chinook Salmon above the Lookingglass Hatchery Weir
Evaluation (Boe et al. 2011)

1. Adult trapping - See sections 12.5 and 2.2.3.
2. Spawning ground surveys - See sections 12.5 and 2.2.3
3. Rotary screw trapping - See Statement of Work
4. Parr sampling - See Statement of Work
5. Parr PIT-tagging - See Statement of Work
6. Genetics sampling - See Statement of Work

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.

Conventional Broodstock - Handling of fish will include enumeration, measurement, gender identification, mark identification and release at the site of capture. If handling involves more than determining species and enumeration e.g., measurement, marking or tissue sampling, fish are anesthetized with MS-222 before the procedure and allowed to fully recover before release. If fish are to be immediately released back into a fishery, then no MS-222 is used.

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

Monitoring and evaluation will involve take of all types (Table 13). Injury due to capture, marking and tissue sampling is inevitable. Hooking wounds, electrofishing injury and other physical damage is 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, accounts for the lethal take estimates that may 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 1).

See Table 13.

CTUIR anticipated take as a result of its monitoring and evaluation activities for spring Chinook salmon and summer steelhead in Lookingglass Creek is included in Table 28.

Table 28. Anticipated take of listed species in 2012 as the result of monitoring and evaluation activities conducted by the CTUIR for spring Chinook salmon and summer steelhead in Lookingglass Creek, Oregon.

Start Date	End Date	Species	Life Stage	Production	Take Action	Capture Method	Intrusive Method	Expected Take	Indirect Mortality
1/1/12	12/31/12	Bull trout	Juvenile	Natural	Capture/Handle/Release	Rotary Screw Trap		500	5
1/1/12	12/31/12	Bull trout	Adult	Natural	Capture/Handle/Release	Rotary Screw Trap		25	1
1/1/12	12/31/12	Summer steelhead	Juvenile	Natural	Capture/Mark, Tag, Tissue Sample/Release Live Fish	Rotary Screw Trap	Anesthetize Fin clip, Dye mark, Tag, PIT, Tissue Sample Scale	5,000	50
1/1/12	12/31/12	Spring Chinook	Juvenile	Natural	Capture/Mark, Tag, Tissue Sample/Release Live Fish	Rotary Screw Trap	Anesthetize Fin clip, Dye mark, Tag, PIT, Tissue Sample Scale	15,000	100
1/1/12	12/31/12	Spring Chinook	Adult	Natural	Capture/Handle/Release	Rotary Screw Trap		50	1
4/1/12	10/31/12	Spring Chinook	Juvenile	Natural	Capture/Handle/Release	Beach Seine	Anesthetize/PIT	3,000	30
4/1/12	10/31/12	Spring Chinook	Adult	Natural	Observe/Harass Live Fish	Beach Seine	Anesthetize/PIT	30	0
4/1/12	10/31/12	Summer steelhead	Juvenile	Natural	Observe/Harass Live Fish	Beach Seine		100	0
4/1/12	10/31/12	Summer steelhead	Juvenile	Natural	Capture/Handle/Release	Beach Seine		50	1
4/1/12	10/31/12	Bull trout	Juvenile	Natural	Capture/Handle/Release	Beach Seine		100	0
4/1/12	10/31/12	Bull trout	Juvenile	Natural	Capture/Handle/Release	Beach Seine		20	0
7/1/12	10/1/12	Spring Chinook	Adult Carcass	Natural	Observe/Tissue Sample Dead Fish	Spawning Ground Survey	Tissue Sample Scale, Fin clip, Opercle	1,000	0
7/1/12	10/1/12	Spring	Adult	Hatchery	Observe/Tissue Sample	Spawning	Tissue Sample	1,000	0

		Chinook	Carcass		Dead Fish	82	Ground Survey	Scale, Fin clip, Opercle		
7/1/12	10/1/12	Spring Chinook	Adult Carcass	Natural	Observe/Harass Live Fish		Spawning Ground Survey		500	0
7/1/12	10/1/12	Spring Chinook	Adult Carcass	Hatchery	Observe/Harass Live Fish		Spawning Ground Survey		500	0

12.10) Alternative methods to achieve project objectives.

Unknown

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

We expect to encounter summer steelhead juveniles and adults and bull trout during sampling. However, the number of encounters is expected to be less than 50 juvenile fish of each species and, as a result, the level of mortality is expected to be negligible.

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.

Standard methods are used to operate the rotary screw trap, with trap checks being made every 2-3 days or more frequently, if necessary, because of large numbers of fish, high flows or high debris loads. Anesthetization, handling, and PIT tagging methods follow standard procedures.

Listed steelhead, Chinook and bull trout sampled during the residual steelhead study and genetic monitoring will be conducted in compliance with NOAA Electrofishing Guidelines to minimize the risk of injury or immediate mortality.

SECTION 13. ATTACHMENTS AND CITATIONS

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SECTION 14. CERTIFICATION LANGUAGE AND SIGNATURE OF RESPONSIBLE PARTY

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

Name, Title, and Signature of Applicant:

Certified by_  ___ Date: January 23, 2012

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 the 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.

Activities associated with the operation of the Lostine program as they affect bull trout are authorized under USFWS Permit #TE001589-3.

The Upper Grande Ronde River hatchery program and associated monitoring and evaluation activities affecting bull trout are conducted under USFWS Section 10 permit #TE-844468-8 (CTUIR) and a Section 6 (4d limitation) agreement between the USFWS and ODFW (Bull Trout Permit #TE001598-1).

Threatened Species Permit TE844468-8 (which expires on May 25, 2012) authorizes CTUIR to annually take (harass by survey, capture, handle, mark, and release) listed bull trout while conducting the project. These activities are conducted in accordance with the study plans or biological assessment (as modified by the Special Terms and Conditions) accompanying the permit application. Estimated annual take is 20 individuals of all age classes, with less than 3% mortality.

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 Grande Ronde Basin including the Minam River, Wenaha River, Catherine Creek, Lookingglass Creek, Lostine River, and Upper Grande Ronde River. Bull trout utilize suitable habitat within the basin. 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.

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 traps on Catherine Creek and Lookingglass Creek. The traps are operated March through September. The number of fish trapped annually ranges from 0 to 50. Fish are held a maximum of two days, handled and passed upstream.

Bull trout are captured in the rotary screw trap operated by CTUIR at rkm 4.0. Any bull trout captured are immediately released downstream of the screw trap.

Hatchery operations - Water withdrawal for Chinook smolt acclimation occurs in the late winter and spring at a time when stream flow is high. Adequate flow is maintained for adult steelhead as well as migrant fluvial bull trout. Facility maintenance, including intake excavation, occurs in the summer months when water temperatures preclude the presence of bull trout.

Fish health - See sections 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. These releases, however, may provide substantial forage for larger fluvial bull trout overwintering in the lower reaches of the system.

Predation/competition - Fingerling releases can interact with bull trout in the rearing distribution. Some limited predation of and competition with smaller bull trout may occur in these areas.

Monitoring and evaluations - See section 12.11.

Habitat – The effects on bull trout rearing habitat of Lookingglass Creek and Catherine Creek, is unknown. Migratory behavior of fluvial bull trout is, however, disrupted briefly as they encounter the adult Chinook traps during operation.

15.4) Actions taken to mitigate for potential effects.

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